PROCEEDINGS OF THE 10TH PRAIRIE CONSERVATION AND ENDANGERED SPECIES CONFERENCE

Engaging People in Conservation

Co-hosted by:
Prairie Conservation Forum
Alberta Society of Professional Biologists

Prairie Conservation and
Endangered Species Conference

Red Deer, Alberta | February 19 – 22, 2013

Engaging People in Conservation

Proceedings of the

10th Prairie Conservation and Endangered Species Conference

February 19 to 22, 2013 – Red Deer, Alberta

Edited by

Geoffrey L Holroyd
Amy J Trefry
Brittany Crockett

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WELCOME TO THE PROCEEDINGS OF THE 10th PRAIRIE CONSERVATION AND ENDANGERED SPECIES CONFERENCE

Conference Steering Committee

The Prairie Conservation and Endangered Species Conference has provided a forum for conservation practitioners and has fostered awareness, understanding and action on issues related to native prairie conservation since 1986. The conference, occurring every three years, and alternating between the three Prairie Provinces, engages people from many backgrounds in discussion of the issues, perspectives, challenges and opportunities relating to prairie conservation. For the 10th edition, which took place in Alberta, we eagerly took on the challenge of continuing the excellent tradition that was established in previous conferences.

On behalf of Prairie Conservation Forum and the Alberta Society of Professional Biologists, the Conference Steering Committee is pleased to present to you the Proceedings of the 10th Prairie Conservation and Endangered Species Conference, which was held in Red Deer, February 19-22, 2013. The theme of the conference was Engaging People in Conservation. In choosing this theme, the Steering Committee wanted to recognize that conservation planners can (and do) talk and plan, but real change only happens when the people who live and work on the land itself are engaged and supported in their conservation efforts. This theme was picked up brilliantly by the plenary speakers, workshop and poster presenters that came together for this conference.

The conference was well attended and covered a broad array of topics. A total of 375 people from the western provinces and states participated at the conference and heard 107 live presentations and viewed 44 posters.

The logo that was developed for this conference is made of three circles representing the three Prairie Provinces, which overlap to illustrate collaboration. Inside are a plant (Rough Fescue, *Festuca hallii*), a bird (Western Meadowlark, *Sturnella neglecta*) and a mammal (Pronghorn, *Antilocarpa americana*) that are iconic of the Canadian native prairies. The colours were chosen to reflect those that tint the prairies throughout the year. Because of this logo's prairie-wide relevance, the 2013 Steering Committee is hoping that it will become a permanent symbol of this conference series.

We were thrilled to continue the tradition of the Prairie Conservation Award, honoring deserving individuals from each of the Prairie Provinces that have made a significant contribution to prairie and/or endangered species conservation. In addition, a new grant was established to mark the 10th anniversary of the Prairie Conservation and Endangered Species Conference as well as the theme of the conference. The Young Professional Stewardship Grant was created to support innovative projects being carried out by individuals aged 18-30 that advance the engagement of people in conservation in grassland and parkland ecosystems of the Prairie Provinces. Money for this grant was raised through a silent auction held during the conference banquet.

These Proceedings contain papers with detailed information from many of the plenary and concurrent presentations, and poster sessions presented at the conference. It is our hope that the papers in this volume will stimulate your interest and provide you with new information and approaches to use where you practice prairie and endangered species conservation. 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 and appreciation for the generosity of our many sponsors. This conference would have not been the success it was without their support. We would also like to thank the Prairie Conservation Forum and the Alberta Society of Professional Biologists for supporting the conference, and recognize the members of the Steering Committee, the various sub-committees and the numerous volunteers who gave so freely of their time and skill. The people involved can rest knowing that their contribution and hard work resulted in such a successful experience for conference attendees and organizers alike!

We hope you enjoy these Proceedings.

ORGANIZING COMMITTEE

François Blouin, MULTISAR-Prairie Conservation Forum, **Conference Co-chair**
Robin Gutsell, Alberta Environment and Sustainable Resource Development, **Conference Co-chair**
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Natasha Wilkie, Saskatchewan Prairie Conservation Action Plan
Neal Wilson, Antelope Creek Ranch
Shannon Yacyshyn, Alberta Environment and Sustainable Resource Development

EDITOR'S COMMENTS

Presenters at the conference were asked to choose one of three options for their contribution to these proceedings: abstract as published at the conference, an enhanced, expanded abstract with additional details, or, ideally, a full manuscript. In these proceedings you will see all three options were chosen. The full manuscripts are particularly important since they contain reviews and research details that are the backbone of the science surrounding prairie conservation. My thanks to all presenters, and particularly to those who made the extra effort to submit a full manuscript.

A few editorial notes. We have removed many acronyms, especially from abstracts, to make the text more reader friendly. However, some remain since they are repeated and enhance the readability of articles. We have capitalized all proper common names of plants and other wildlife. The submitted manuscripts had a mixture of capitalization and capitalizing all proper species names seemed most appropriate. The poster abstracts and articles have been incorporated into the relevant session sections to make these proceedings more useful to the reader. We have not compiled an index since search functions on this document are easy for you, the reader to undertake for whatever keywords interest you.

…. Enjoy!

GLH

YOUNG PROFESSIONAL STEWARDSHIP GRANTS

Supporting Young Professional and Aspiring Conservationists

The theme of the 10th Prairie Conservation and Endangered Species Conference was ‘Engaging People in Conservation’ and what better way to encourage conservation and stewardship than to offer an opportunity to financially support projects on the landscape in Alberta, Saskatchewan or Manitoba. This year for the first time, young professionals or aspiring conservationists, were given the opportunity to apply for funding support for their projects. The Young Professional Stewardship Grant was looking for innovative proposals that advance the ‘engagement’ of people in conservation in Grassland and Parkland Natural Regions of the Prairie Provinces. Applications were received from across all three Prairie Provinces and judges made their final selections.
The Stewardship Grant winners were:

Saskatchewan

Stewards of Saskatchewan: Engaging Rural Landowners in Conserving Habitat for Species-at-Risk

The Stewards of Saskatchewan (SOS) project engages landowners in voluntary stewardship to conserve habitat for plant and bird Species-at-Risk and other prairie species in southern Saskatchewan. The project comprises four voluntary conservation programs: Operation Burrowing Owl, Rare Plant Rescue, Shrubs for Shrikes, and Plovers on Shore. The main objectives are: habitat stewardship, site identification and population monitoring, and education and awareness.

Organization – Nature Saskatchewan – Stewards of Saskatchewan (SOS) project
www.naturesask.ca

Alberta

Trends in Grizzly Bear Conservation: The influences and Impact of the Social Landscape

Part of a PhD study, understanding how and why people think about and behave towards grizzly bears, as well as their relationships to landscapes ad land uses, is vitally important to the development and implementation of bear management and land use policy in Alberta. Participation by Albertans from various walks of life including land owners such as ranchers or crop producers, mining, forestry and oil and gas industry, recreationalists and tourism operators (both off-road and on-road vehicle), environmental non-governmental organizations and governmental organizations (municipal, provincial and federal). This will include eliciting socio-demographic and economic variables from existing data and participants, to better understand how and where grizzly bears and their conservation affect livelihoods and what might be done to support various land users in Alberta. The information will be used to help inform the renewal, development and implementation of Alberta’s Grizzly Bear Recovery plan and guide the BearSmart program.

Organization – The University of Alberta
www.ace-lab.org/projects.htm

Manitoba

Prairie and Parkland Habitat Education for Youth

The goal of the project is to educate young people (ages 13-15) about the importance of preserving native flora in Birds Hill Provincial Park by actively involving them in stewardship activities. Working with the park interpretive program, workshops on basic plant and habitat identification, supplemented with a field component, will be offered for free. We believe young people will leave these workshops and events with a greater appreciation of native flora, conservation science and management.

Organization – Friends of Birds Hill Park Inc.
http://friendsofbirdshillpark.ca/

Funds raised from the Silent Auction at the conference went directly to assisting these professionals or aspiring conservationists to achieve success with prairie conservation and endangered species management. Each grant recipient received $2500 towards their project.

THE PRAIRIE CONSERVATION AWARDS

The Prairie Conservation Awards are 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 these awards.

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

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 10th Prairie Conservation and Endangered Species Conference in Red Deer, Alberta on Thursday, February 21, 2013. The 2013 recipients of the awards were Ken and Nora Balog from Alberta, Gary Seib from Saskatchewan and John Morgan from Manitoba (see pages 25-27).

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
2013 – Red Deer	Ken and Nora Balog	Gary Seib	John Morgan

Ken and Nora Balog - Alberta

The MULTISAR staff nominated Ken and Nora Balog who run a cow/calf operation in the Mixed Grasslands within the County of Warner near the town of Milk River, Alberta. Ken and Nora are the fourth generation of Balogs on their ranch which consists of a mixture of private and public leased land and includes over 1400 acres of native grassland.

Ken and Nora, looking at ways that benefit both cattle and wildlife on their ranch, started to collaborate with MULTISAR in 2008. In an article that Lorne Fitch wrote for MULTISAR, he describes their passion for the environment and specifically around Northern Leopard Frog (*Lithobates pipiens*) habitat, which exists along Red Creek near the Montana border. A quote from Ken in the article states it best: “If frogs aren’t thriving around the dugout and along the creek it says something about our management. Maybe we have done some things right, because the frogs are still here. But can we do things better?” Ken and Nora Balog and their family have always valued and have been proactive in their management of wildlife and native grasslands on their ranch whether it is the days they spend traversing their ranch keeping tabs on the range condition and wildlife occurrences, the actions they took to improve wildlife habitat, Nora’s array of wildlife photos, and always being on the lookout for invasive species, the Balogs have exemplified the meaning of being true stewards of the land. Ken and Nora are also spokespeople for conservation by promoting their habitat enhancements to their neighbors and encouraging them to install hawk poles where appropriate and improve their riparian areas. For MULTISAR staff, it has been a pleasure to learn and collaborate with them on wildlife habitat improvement projects on their ranch.

Significant Contributions to Native Habitat and Endangered Species Conservation on the Balog Ranch:

- Educational tours with Milk River and Coutts schools about provincially Threatened Northern Leopard Frogs.
- Leopard Frog Egg collection site which has aided in their reintroduction near Magrath,
- Collaboration in the development and implementation of a MULTISAR Habitat Conservation Strategy for the ranch since 2008,
- Establishment of two off stream watering sites to alleviate cattle pressure and improve riparian health on Red Creek which has a breeding population of the Northern Leopard Frogs and contains Brassy Minnows (*Hybognathus bankinsoni*),
- Continued monitoring and control of Leafy Spurge and Dalmatian Toad Flax- using biological agents
- Installation of three Ferruginous Hawk poles to support the growing need for suitable nesting habitat for this provincially and nationally Endangered species. Ken and Nora approached MULTISAR for the poles in 2012 after noticing several hawk nests had collapsed or blew down due to their placement in poor nesting structures. Within two months of being installed, thanks to AltaLink, two of the three hawk poles were used resulting in 8 young being fledged, and
- Installation of a smooth bottom wire in one pasture to help facilitate pronghorn movement.

As Lorne Fitch stated: "As one example of stewardship the Balogs have figured out how to live on a piece of land and maintain species of wildlife at risk for the benefit of all. Besides technical expertise and pieces of equipment, the project's success required caring, open mindedness, ecological awareness, a strong land ethic, and a vision for the future. There is a harmony and a relationship between humans and wildlife on the Balog Ranch that is inspirational." This award demonstrates to the Balog's family that their efforts are resonating in the conservation community and should encourage other ranchers to undertake similar actions for the sustainability of the native grassland ecosystem.

Gary W. Seib - Saskatchewan

Gary Wayne Seib was born in January 1946 at Lipton, Saskatchewan. He grew up on a mixed farm, and began his education at a one-room rural school. When he was twelve, the family moved to Fort San, where he finished his elementary schooling. He started high school in Fort Qu'Appelle, and after Grade Nine, the family moved to Lipton, where he completed his high school education. After graduation from high school, Gary moved to Regina and started working for Cherry Film Productions where he was trained as a cameraman by Lawrence Cherry, one of the original employees of the National Film Board of Canada. During his time at Cherry Films, Gary worked on projects that took him from coast to coast, and as far north as Baffin Island. These films included a series of nature films for school broadcasts, a series on earth science, a film for Parks Canada on the creation of Grasslands National Park, a film on the rehabilitation of a branch rail line, a film on the construction of the Gardiner Dam, an alcohol education film in the NWT and several projects for the National Film Board. Gary then began working for the CBC, at first shooting film, then several generations of video. During his 20-year career with the Corporation he worked as a news cameraman, did some producing and ended up working as a video-journalist. Gary has served Nature Saskatchewan in many roles. He came on to the Board in 1968 as Archives Director, was elected Vice-President in 1971 and President in 1974. More recently he headed the Grasslands Park committee to continue the work of Dr. George Ledingham, and served as Member Services Director. After working as an associate editor with responsibilities for layout and design under editor Bernie Gollop, Gary spent four years as *Blue Jay* editor from 1976-80. On behalf of the Society, Gary served on the Canadian Environmental Advisory Council, and the Board of the Canadian Nature Federation, now Nature Canada. Gary also worked with Nature Canada to establish a Canada-wide Nature Network. That project involved facilitating meetings with naturalist groups across the three prairie provinces to come to a consensus on needs and outcomes. Gary has served as General Manager of Nature Saskatchewan from April 2009 to the present. His responsibilities include the publication of a series of books including *'Dragonflies & Damselflies in the Hand'*, *'Ferns & Fern Allies of Saskatchewan', 'Lilies, Irises & Orchids of Saskatchewan', 'Sedges (*Carex) *of Saskatchewan'* and '*Getting to Know Saskatchewan Lichens'.* The Dragonfly book was short-listed for a publishing award at the Saskatchewan Book Awards.

He's also served his local natural history group as newsletter editor and was the President of Nature Regina 1n 1972 and 1973. Gary has long been an advocate for our natural heritage, and served on SaskCulture's Heritage Community of Interest group that led to the formation of Heritage Saskatchewan. He then served several terms on their Board of Directors (2004-2010). As well, he was a member of the Celebrate Canada Committee for Saskatchewan and helped organize an outdoor gala concert to celebrate Saskatchewan's Centenary in 2005. Gary authored four articles in *Blue Jay* and 133 photographs published there. In addition he has published in many magazines and books, including *'Wildflowers Across the Prairies'* first published by Western Producer Prairie Books, '*The Squirrels of Canada'* published by the National Museum of Canada, and books published by *Reader's Digest.* Several of Gary's photographs are in the National Collection of Nature Photographs at the National Museum of Canada. In 1999 Gary was named a Fellow of Nature Saskatchewan in recognition of an extensive and continuing contribution of time over many years to the Society and its objectives.

John P. Morgan - Manitoba

John has a Bachelor's degree in Zoology and a Master's in Natural Resources Management from the University of Manitoba. He has had 27 years of experience as an ecologist on the Canadian prairies and in the high Arctic islands. Much of his work has focused on involving landowners in wildlife habitat management, the development of habitat stewardship programs, and, especially, the conservation of native prairie ecosystems. John initiated and managed the Tall Grass Prairie Conservation Project in Manitoba. He also set up the first protected area in Manitoba for Small White Lady's Slippers at Lake Francis, and has managed the site since 1985.

John has been actively involved in efforts to promote public awareness and preserve endangered prairie ecosystems. He was instrumental in establishing Manitoba's 1,800 ha Tall Grass Prairie Preserve, a cooperative endeavour with a variety of provincial, national and international conservation agencies. He produced and directed an award winning film narrated by Joanne Joyce, '*Manitoba's Tall Grass Prairie*,' that has been shown across North America. John also was the scriptwriter for a prairie restoration video 'Restoring Our Prairie Heritage' produced by Alberta Agriculture. John has conducted several major research projects on prairie inventory, restoration and management. He and Doug Collicutt produced a manual on prairie restoration for land managers, *Restoring Canada's Native Prairies*, the first book of its kind in Canada. John also wrote a chapter in a 1997 book entitled *The Tallgrass Restoration Handbook*, published by Island Press/Society for Ecological Restoration, Washington, DC, and co-wrote *Hands Across the Meridian A History of Brant-Argyle Manitoba* in 2000.

With his wife Carol, John is co-owner and president of Prairie Habitats Inc., Canada's first native prairie nursery and restoration company at Argyle, MB, 35 km northwest of Winnipeg. Prairie Habitats Inc. specializes in propagating over 100 species of native plants including Western Silvery Asters (*Symphotrichium sericeum*), and using them to restore public and private landscapes to native prairie. Prairie Habitats has been featured in *Equinox, Borealis, Harrowsmith, Manitoba Co-operator, Country Guide, The Green Teacher, Farmwoman* and *Canadian Gardening* magazines. In 1993 John was awarded the Friends of Equinox Magazine's Citation for Environmental Achievement and the Government of Canada's 125th Anniversary Medal for his work on restoring Manitoba's tall grass prairie. Prairie Habitats Inc. won the Manitoba Government's Sustainable Development Certificate of Recognition in 1994 and Award of Excellence for Small Business in 1997.

John in partnership with Doug Colicutt pioneered the development of techniques and equipment used in habitat restoration. Their patented portable seed harvesters are now in use in seventeen countries around the world for native and specialty crop seed harvesting. A veteran of over 40 native prairie restoration projects on school, public, private and corporate lands, John believes in conservation by doing rather than talking. He also has assisted in the set-up of numerous native plant nurseries across Canada. His main goals are to see that native prairie ecosystems are conserved and managed properly, and to integrate native species into urban and rural landscapes. John is in great demand as a consultant, writer and speaker, having made numerous presentations on native prairie landscaping, ecology and restoration.

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 conference website is: http://www.pcesc.ca/

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

2010 – Winnipeg: Patterns of Change

2013 – Red Deer: Engaging People in Conservation

PUBLISHED PROCEEDINGS

All proceedings are available at http://www.pcesc.ca/past-conferences.aspx

10th PCESC – Proceedings of the 10th Prairie Conservation and Endangered Species Conference, February 2013, Red Deer, Alberta. Engaging People in Conservation. Edited by Geoffrey L. Holroyd, Amy J. Trefry and Brittany Crockett. 2014. Alberta Prairie Conservation Forum, Lethbridge, Alberta.

9th PCESC – Proceedings of the 9th Prairie Conservation and Endangered Species Conference and Workshop, February 2010, Winnipeg, MB. Patterns of Change: Learning from our past to manage our present and conserve our future. Edited by Donna Danyluk. 2011. Critical Wildlife Habitat Program, Winnipeg, MB.

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, Alberta. 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, Alberta 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, Alberta T5N 0M6.

4th PCESC – Proceedings of the Fourth Prairie Conservation and Endangered Species Workshop, February 1995, Lethbridge, Alberta. 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, Alberta 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, Alberta 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, Alberta T5N 0M6.

1st PCESC – Proceedings of the Workshop on Endangered Species in the Prairie Provinces, January 1986, Edmonton, Alberta. 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, Alberta T5N 0M6.

PLENARY SPEAKERS' PAPERS and ABSTRACTS

FARM ENVIRONMENTAL STEWARDSHIP ISN'T FREE! AN AGRICULTURAL ECONOMIC PERSPECTIVE ON THE WEDGE BETWEEN FARMERS AND CONSERVATIONISTS

JIM UNTERSCHULTZ
Department of Resource Economics and Environmental Sociology, University of Alberta, Edmonton, Alberta T6G 2H1. Email: Jim.Unterschultz@ualberta.ca

Abstract: Implementation of farm environmental stewardship typically is a net cost to a farmer. However, improving the environment or reducing the number of endangered species is generally a benefit to society. This creates a communication wedge between conservationists and agriculture. A simple economic framework based on the work of agricultural economist Dr. David Pannell is presented to link the benefits and costs of farm stewardship with the environmental benefits and costs to society. This framework provides a basis for environmental/conservation discussions between agriculturists and conservationists. Time, opportunity cost and wealth are important economic concepts in the understanding of economic benefits and costs. Indeed, both the Canadian federal government's *Canadian Environmental Assessment Act* (2012) and the *Species at Risk Act* (2002) specifically mandate that economics and/or socio-economic considerations be considered when undertaking mitigating actions.

Once this background has been covered, specific applications of economics and this framework will be presented on such topics as: wetland preservation in cropland in Saskatchewan, farm adoption of best management practices in Alberta and Saskatchewan, and a framework for evaluating the transfer of PFRA (Prairie Farm Rehabilitation Act) lands in Saskatchewan to the private land holders. This non-technical discussion provides non-economists with an improved understanding of the farm level economic implications of conservation practices and provides a framework for reducing the communication wedge between conservationists and agriculture.

Introduction

Many factors influence farm producer decisions on land use. One key factor influencing farm decisions is economics. Farm land use and the farm practices applied to the land have an impact on farm environmental stewardship outcomes. Improving farm environmental stewardship in Western Canada typically is a net cost to a farmer to implement. However, improving the environment or reducing the numbers of endangered species is generally a benefit to society. This creates differing views on land use practice and a communication wedge between conservationists and agriculturalists. A production economics (i.e., economics of farming or ranching) perspective is presented to help reduce the communication wedge between agriculture and conservationists. This production economics discussion will then be applied to a broader societal view of how to make land use conservation decisions using the economic framework of David Pannell (Pannell 2008), an agricultural economist who studies agri-environmental issues in Australia.

Overall, economics is the allocation of scarce resources. Production economics, a subfield of economics, is about the individual farm. So in the context of this paper, I refer to farm level economics, which can be translated to including farm wealth, farm costs and farm profits.

Aside from assisting conservationists' understanding of the perspective of farmers, there are other reasons for conservationists to understand and incorporate economics into their efforts. Both the Canadian *Species at Risk Act* (SARA), and the *Canadian Environmental Assessment Act*, require that economics be considered before governments or other organizations undertake actions. Specifically SARA mentioned economics as follows:

"49. (1) An action plan must include…

(*e*) an evaluation of the **socio-economic costs** of the action plan and the **benefits** to be derived from its implementation; …" (Government of Canada 2002, p 13).

The *Canadian Environmental Assessment Act* includes the following statement.

"…FACTORS TO BE CONSIDERED

Factors 19. (1) The environmental assessment of a designated project must take into account the following factors: …

(d) mitigation measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the designated project;…" (Government of Canada 2012, p. 13)

The economic impact on farms or ranches should be included in these analyses. Some authors in the biology literature have long recognized that understanding social sciences, which includes economics, is an important component that affects positive environmental outcomes (Jacobson and McDuff, 1998).

The final reason for conservationists to understand the key motivators of agricultural producers' actions is to consider the extent to which agricultural activity and locations, where species are most at risk, overlap in the Canadian prairies. This overlap is clearly shown in Alberta land use documents (Government of Alberta 2007).

Agriculture in Alberta

If we explore a brief overview of agriculture in Alberta we can see that the livestock sector, in particular the beef sector, plays an important role to agriculture. Overall agriculture has close to $10 billion in annual sales in Alberta (Table 1) and the agri-food industry contributes a little over 4% to Alberta's gross domestic product (ARD 2012). The key point here is that the industry is large, competitive, and requires profits to survive.

Table 1: Overview of Agriculture in Alberta (Source: ARD 2013).

Description*	
Total Farms (2011)	43,234
Total Farm Sales (2011)	$9.8 Billion
Crop Sales (2011)	$5.2 Billion
Livestock Sales (2011)	$4.6 Billion

Livestock production is likely the agricultural land use that is of most interest to conservationists. About 32%, 50.5 million acres[1], of the total land area in Alberta is used in agriculture (Figure 1), and of that, close to 16 million acres is native pasture. This total land base and the agricultural land use provide the basis for livestock producers in agriculture to run their businesses successfully.

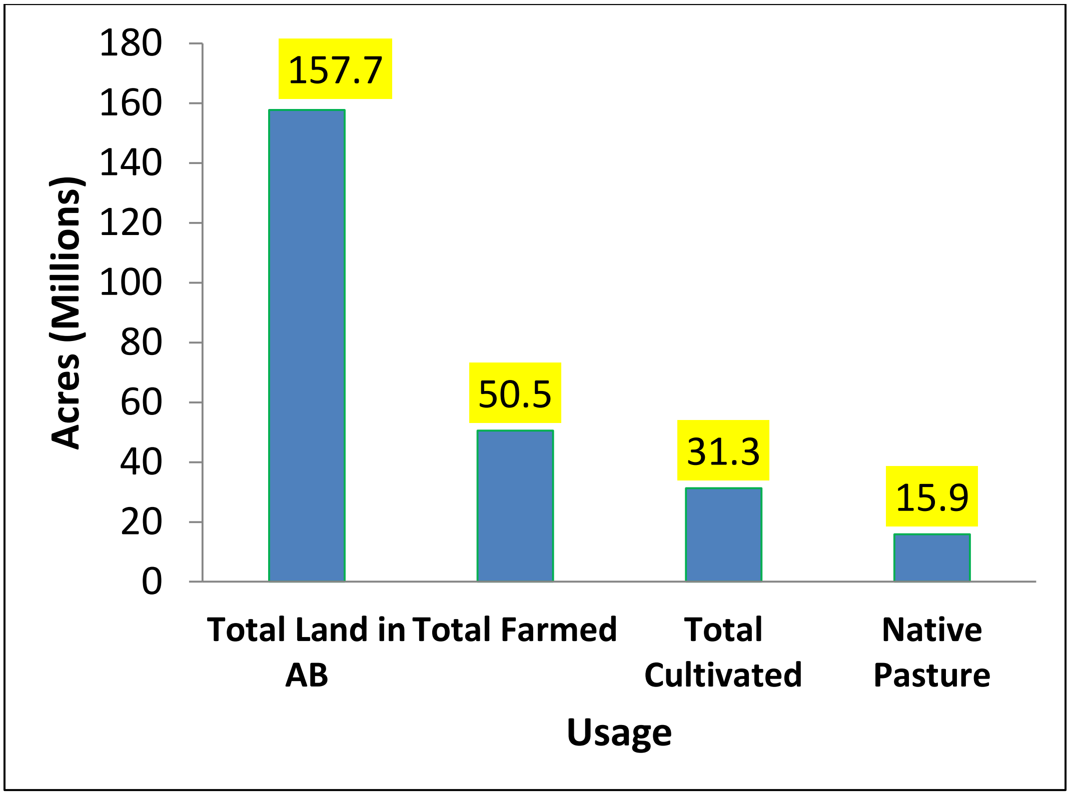

Figure 1. Land Use in Alberta (Source ARD 2013).

Economics Background

In production economics, conservation activities are most concerned with time, wealth (profits) and more generally, private benefits and costs as well as public benefits and costs. Understanding the economic implications of time and wealth on farm producer actions will improve conservationists' understanding of agricultural outcomes on land use.

Time is an important concept in economics. It helps evaluate how we trade off investment or consumption between the present versus the future. One common approach to evaluating time is the discount rate. The discount rate is a percentage that measures how to trade off the present versus the future. The higher the discount rate the less value or weight is placed upon what happens in the future (Table 2). From an agricultural business perspective, the higher the risk, the higher the discount rate. Farming has risk and farmers discount the future benefits of current investments or costs.

[1] There are 2.47 acres in one hectare. Acres are still the common agricultural area measurement in the Canadian Prairies.

Table 2. Value Placed on What Happens in the Future with Different Discount Rates (Rate of Return).

Discount Rate	**Near Future (5 years)**	**1 Generation (20 years)**	**Far Future (100 years)**	**Far Distant Future (200+ years)**
	Infinite	Infinite	Infinite	Infinite
1%	Extremely high	Very high	High	Low
3%	Very high	High	Medium	Very low
8%	High	Medium	Low	No value
15%	High	Low	No value	No value

Conservationists and environmentalists likely have low discount rates in the range of 1% to 3% and place a very high value on the future. Agricultural businesses likely have higher discount rates in the range of 8% to 15% and, from a business perspective, place a lower value on what happens in the future. This difference in discount rates often leads to a discrepancy between farmers and conservationists as to what is an immediate versus future priority.

An alternative way to look at these different views on discount rates is the impact of environmental activities on farm profits and wealth. Wealth for the farm family is created by the farm generating profits over time. The profits are used to re-invest in the business, and support family needs. Research on adding winter wheat to farm crop rotation elicited this response from a farm survey respondent.

"Wildlife is important but at the end of the day profitability is king. If society would pick up some of the tab for environmental benefits that would make decision making different"[2] Cole (2010)

This statement indicates that if conservation activities negatively impact farm wealth, some farm businesses are reluctant to implement these activities.

The benefits/costs to the farm of implementing conservation activities or land use changes are the 'private' benefits/costs incurred over time. The benefits/costs to society (excluding farmers) of implementing conservation activities and land use changes are the public benefits/costs incurred over time. The discount rate can be used to estimate and compare the present value (i.e., the total benefits/costs over time in today's dollars) of the private and public benefit-costs. For those familiar with economic terms, these present value numbers are generated using Net Present Value (NPV)[3].

Pannell (2008) developed a framework for evaluating private versus public benefits/costs, and the associated policy, which are discussed in a non-technical way on his website (http://dpannell.fnas.uwa.edu.au/). This framework can be used to understand the 'views' of society/conservationists and the 'views' of farmers (Figure 2).

Agricultural private benefits/costs (net private benefits) are measured along the horizontal line (Figure 2). Projects to the right of 0 provide a net positive private benefit (i.e., positive NPV) to the farm business. Projects to the left of 0 are a net negative private benefit. Another way of stating this is that farmers should be more inclined to voluntarily be willing to undertake projects that have a positive private benefit.

[2] These comments are not published in Cole's thesis but come from survey work done as part of the thesis. Contact Unterschultz. Including winter wheat in the crop rotation improves the nesting outcomes for migratory waterfowl versus growing spring seeded wheat.

[3] Go to Wikipedia or any general finance textbook for a discussion on NPV.

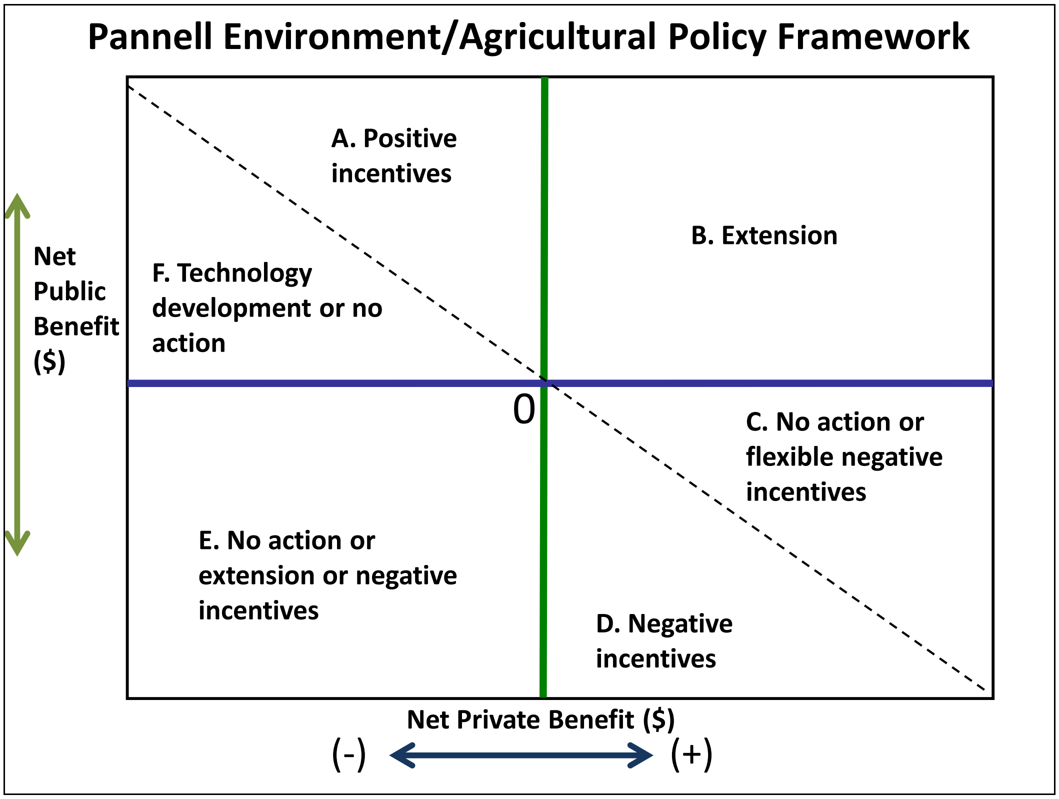

Figure 2: Public Benefits, Private Benefits and Policy (Pannell 2008).

Public benefits/costs (net public benefits that exclude net private benefits) are measured on the vertical axis (Figure 2). Projects that are above 0 have a net positive benefit to society. Projects that are below 0 have a net negative benefit to society (e.g., loss of wildlife habitat, increase in number of endangered species). Society in general supports projects that provide positive public benefits and opposes projects that lead to negative public benefits. The Pannell model (Figure 2) combines the two measures, net private benefits and net public benefits to provide a policy framework that conservationists can use to understand private actions and possible policy recommendations to government. Two examples illustrate how to use this framework.

Example 1: Minimum tillage, which is an annual cropping system with minimal cultivation of the soil, has positive social benefits such as decreased soil erosion (i.e., above 0 in Figure 2). For many farms, adopting reduced tillage increases farm profits by reducing fuel and other expenses (i.e., to the right of 0 in Figure 2). This places this farm practice in section B. This suggests that the only policy required to get adoption may be education (e.g., extension).

Example 2: Draining wetlands in annual cropland is a net negative benefit to society. Wetlands provide water quality improvements and wildlife habitat. However draining wetlands is usually a net positive benefit to the farmer by reducing nuisance costs (i.e., driving machinery around small wetlands) and increasing crop production (Cortus et al. 2011). This places the drainage practice in segments C or D in Figure 2. Depending upon the extent of the public and private net benefits, it may be optimal for society to do nothing (C) or implement regulation, monitoring and fines for farm drainage.

A key issue from an economics perspective is in estimating the net private benefits and net public benefits. Generating these estimates can be difficult and time consuming. However, at the very least, the Pannell framework provides an approach for conservationists to evaluate or understand farmer's actions.

Applications

Governments and organizations are promoting farm practices called Beneficial Management Practices (BMP). These BMPs, if adopted by farms, may result in improved environmental outcomes. A few of these BMPs recommended in the Canadian Prairie region are:

- Not draining wetlands in annual cropland,
- Fencing sensitive riparian areas to control cattle grazing,
- Adding grassed buffer strips next to waterways,
- Converting land use from annual crops to pasture or hay land, and
- Changing annual crop rotations to include legume crops or other pulse crops.

Studies using production economics, in relation to private benefits and costs of farms adopting selected BMPs have been done across Canada. Farmland drainage research in Saskatchewan (Cortus et al. 2011) reported the drainage of wetland was a \$28 to \$120/hectare/year net benefit to farmers. However other research reported by Cortus et al. (2011) indicated the net benefit to society was negative in the range of -\$48 to -\$80/hectare/year. This is area C or D in Figure 2.

Others such as Dollevoet (2010) for Saskatchewan and Unterschultz et al. (2004), Koeckhoven (2008) and Trautman (2012) for Alberta reported that implementing most BMPs, such as buffer strips, riparian fencing, or cover crops at the farm level were a negative net benefit (i.e., a cost) to the farm (i.e., to the left of 0 in Figure 2). Similarly, a recent study for AAFC on three watersheds in MB (Jeffrey et al. 2013) strongly suggested that land use changes such as converting cropland to grass hay land to reduce phosphorous runoff into Lake Winnipeg could have huge negative impacts on farm wealth (i.e., negative net benefits to farms). The net benefits to society have not been estimated in these studies, which leave some uncertainty as to appropriate policy approaches.

The general conclusion is that widespread adoption of most BMPs by farms and ranches may not occur voluntarily due to the perceived negative net benefits. Additional regulations, enforcement or incentives may be required. Thinking about Figure 2 may assist conservationists in developing better approaches to affect agricultural land use change. Using the framework proposed by Pannell (2008) can be used to evaluate proposed government policies and some likely land use outcomes.

We can use the Pannell framework to consider the issue of conversion of pasture or native range to annual crop land in the context of recent federal government announcements on ownership of PFRA pastures (AAFC 2013). Farm land market value or price is determined by its use and future income as: *Land Market Value = Present Value of Future Income + Value Alternative Use*

Current land use and current market values provide information on the future private land use of agricultural land that provides the highest net private benefits.

In 2012, the Government of Canada indicated it was transferring their PFRA community pastures to the provincial governments (AAFC 2013). These lands are mostly in pasture and native range. The majority of these pastures are located in Saskatchewan. The government of Saskatchewan initially indicated that it wanted to sell or transfer these PFRA pastures to private landholders or groups. One PFRA pasture that was initially slated for transfer was the Newcombe PFRA pasture in RM 260. The Pannell framework provides some guidance as to the future land use pressures on this pasture land.

One question would be what is the land use pressure on these Newcombe lands if transferred to private owners? Aerial photos of this PFRA pasture and the surrounding lands clearly show that much of the surrounding private land is being used for annual cropping activities (Government of Saskatchewan 2013). Farm Credit Corporation information on recent land sales shows that market land values in this region average $1,275/acre for cropland and $251/acre for native range. Very likely, there is a very high net positive private benefit to convert some of the land in the Newcombe PFRA pasture to annual cropland. The net public benefits of retaining these lands in pasture are not known. At the time of writing, there was continuing debate and uncertainty as to the final actions of the Saskatchewan government with respect to the PFRA pastures.

Conclusions

Profits and farm costs are key motivators to farmers and ranchers that lead to specific land use outcomes. In Alberta and the rest of the Canadian Prairies much of the agricultural land use overlaps important wildlife habitat locations. Conservationists who understand some of these key economic issues, such as wealth, discounting and time, may be better prepared to understand agricultural perspectives and possibly affect positive changes that improve land use for wildlife. Hopefully this can improve communications between agriculture and conservationists.

The Pannell land use economic framework is a method to assist balancing conservation related private benefits/costs to public benefits/costs. Most Beneficial Management Practice land use changes at the farm level are a net cost (net negative benefit) to farms. Conservationists can help contribute to the discussion by clearly articulating and/or assisting in identifying the net benefits to society of changing various land uses. Some land use changes likely do not warrant public action while other land use changes do warrant public action. The Pannell framework can help identify those land use changes that are most important to consider undertaking and communicate the importance to the people involved.

Acknowledgements

I would like to acknowledge the collaborative work of my colleagues at the University of Alberta, Drs. Scott Jeffrey, Peter Boxall and Vic Adamowicz. As well there are the numerous graduate students (Jamie Miller, Steve Koeckhoven, Brett Cortus, Brad Dollevoet, Dawn Trautman, Kara Barnes, Jesse Cole, Danyi Yang, Catalina Solano Rivera, Shuoyi Xie and Mani Kanjilal) and others who have worked on these projects over the past decade.

References

AAFC. 2013. Community Pasture Program. http://www.agr.gc.ca/eng/?id=1298388156452 . Last accessed July 25, 2013.

ARD, Alberta Agriculture and Rural Development. 2012. Alberta Agri-Food Industries Data and Trends.

ARD, Alberta Agriculture and Rural Development. 2013. Agriculture Statistics Factsheet. Agdex 853.

Cole, J. 2010. Producer Stated Preference for Hypothetical New Winter Wheat Varieties on the Canadian Prairies. M.Sc. thesis. University of Alberta, Edmonton, Alberta.

Cortus, B.C., S.R. Jeffrey, J.R. Unterschultz, and P.C. Boxall. 2011. The economics of wetland drainage and retention in Saskatchewan. *Canadian Journal of Agricultural Economics* 59: 109-126.

Dollevoet, Bradley Edward. 2010. Farm wealth implications of ecological goods and services practices and policies. M.Sc. thesis. University of Alberta, Edmonton, Alberta.
Government of Alberta. 2007. Understanding Land Use in Alberta. https://landuse.alberta.ca/Documents/LUF_Understanding_Land_Use_in_Alberta_Report-2007-04.pdf,(pages 18 and 34). Last accessed July 25, 2013.
Government of Canada. 2012. Canadian Environmental Assessment Act.
Government of Canada. 2002. *Species at Risk Act*. S.C. 2002, c. 29. Assented to 2002-12-12. HTML version. . http://laws-lois.justice.gc.ca/eng/acts/S-15.3/page-1.html. Last accessed December 21, 2012
Government of Saskatchewan. 2013. Agricultural Crown Land Map Viewer. http://www.agriculture.gov.sk.ca/CrownLand-map. Last accessed July 23, 2013.
Jacobson, S. K. and M. D. McDuff. 1998. Training Idiot Savants: The lack of human dimensions in conservation biology. *Conservation Biology* 12:263-267.
Jeffrey, S., V Adamowicz, M. Kanjilal, C. Solano Rivera, Q. Chen, J. Unterschultz and A. Moe. 2013. Red-Assiniboine Project (RAP): Determining Economic Costs for Land Management Scenarios: Boyne, Little Saskatchewan, and La Salle Watersheds. Final Report for Agriculture and AgriFood Canada.
Koeckhoven, S. 2008. Economics of agricultural best management practices in the lower Little Bow Watershed. M.Sc. thesis. University of Alberta, Edmonton, Alberta.
Pannell, David J. 2008. Public Benefits, Private Benefits, and Policy. Mechanism Choice for Land-Use Change for Environmental Benefits. *Land Economics* 84:225-240.
Pannell Discussion. Various Dates a. Various Topics. http://dpannell.fnas.uwa.edu.au/. Last accessed July 23, 2013.
Pannell Discussions. Various Dates b. Public: Private Benefits Framework. http://dpannell.fnas.uwa.edu.au/ppf.html . Last accessed July 23, 2013.
Trautman, D. 2012. The economics of beneficial management practices adoption on representative Alberta crop farms. M.Sc. thesis. University of Alberta, Edmonton, Alberta.
Unterschultz, J., J. Miller and P. Boxall. 2004. The On-Ranch Economics of Riparian Zone Cattle Grazing Management. *Environmental Management* 33: 664-676.

Endnotes

[i] There are 2.47 acres in one hectare. Acres are still the common agricultural area measurement in the Canadian Prairies.

[ii] These comments are not published in Cole's thesis but come from survey work done as part of the thesis. Contact Unterschultz. Including winter wheat in the crop rotation improves the nesting outcomes for migratory waterfowl versus growing spring seeded wheat.

[iii] Go to Wikipedia or any general finance textbook for a discussion on NPV. [1] There are 2.47 acres in one hectare. Acres are still the common agricultural area measurement in the Canadian Prairies.

REGULATORY HAMMER OR VOLUNTARY CONSERVATION? WIN-WIN SOLUTIONS FOR THE 21ST CENTURY

DAVE NAUGLE
NRCS Sage Grouse Initiative, College of Forestry and Conservation, 32 Campus Drive, University of Montana, Missoula, Montana 59812, USA

Abstract: Remaining prairie and sagebrush steppe habitats are imploding under the weight of a burgeoning human population. Native range is sod busted to grow bio fuels, catastrophic wildfires inhale sagebrush steppe, and massive oil fields are mistaken for cities on nighttime satellite photos. Our track record for conserving at-risk species through government regulation is dismal; still, agencies raise their regulatory hammers knowing full well they lack the resources necessary to implement a remedy. Human nature dictates our collective desire to be on a winning team, but fear of regulation alienates the very partners who hold the key to success. Aarrgg…h. There has to be a better way! The new recipe for solving at-risk species is voluntary, collaborative and incentivizes stakeholders to engage in lasting conservation. Today we discuss the ingredients of this recipe including shared vision, strategy, trust and credibility, accountability, leverage, and certainty. We draw on successful case studies from around the West where partnerships solve the toughest at-risk issues for Greater Sage-Grouse (*Centrocercus urophasianus*) and Grizzly Bear (*Ursus arctos*). You'll be amazed at what can be accomplished when nobody takes credit.

CONNECTING STORY AND SCIENCE

CHRIS FISHER
Calgary, Alberta. Website: http://www.chrisfisher.ca, Email: chris@chrisfisher.ca

Abstract: Inspiring people to care about something unknown is not easy. From engaging local audiences on grassland conservation issues to connecting visitors to obscure destinations around the world, Chris Fisher understands that the challenge of winning audiences over requires a highly sophisticated approach. Through stories of world-wide adventures, this presentation will demonstrate the techniques that make subjects connect with novel audiences so that they may resonate and become ingrained. Using stories and first-hand accounts with purpose, Chris will show how big thoughts are best shared through small, intimate and familiar stories. His presentation will build on effective but underutilized communication devices in the sciences. He will discuss the advantages of intellectual or intuitive approaches and the circumstances that favour these choices. Throughout the narrative of his presentation he will show how a celebration of landscapes, wildlife and people can be used to bridge an audience to unfamiliar ground. As someone born on the prairies and enthralled with the landscape of the Great Plains, Chris has a passionate appreciation of grassland conservation challenges and is pained by a corresponding lack of public engagement. He believes that it is possible to influence this discussion with a more refined approach. Chris is eager to have an opportunity to share his engagement experiences and to remind conference goers to resist speaking so much like a scientist - and to start speaking a bit more like a storyteller.

GRASSLAND SONGBIRD RESEARCH AND CONSERVATION IN THE WORKING CANADIAN PRAIRIE LANDSCAPE

STEPHEN K. DAVIS
Canadian Wildlife Service, 2365 Albert Street, Regina, Saskatchewan S4P 4K1

Abstract: Large-scale loss and degradation of North American native prairie coupled with sharp declines in grassland bird populations call for a clear understanding of the effects of land-use practices on bird habitat selection and demography. Not surprisingly, in Prairie Canada most research has focused on the effects of various agricultural activities and programs on grassland birds. How different agricultural practices impact grassland birds is important to know given the amount of grassland these land-use practices affect. More recently, attention has focused on oil and gas development, again, due largely to the amount of land that has been impacted within a relatively short time period.

Ample research demonstrates that grassland birds select suitable breeding habitat based on a suite of local-, patch-, and landscape-level factors. However, most research has focused on local-scale factors that, while being useful for informing site-specific management, have limited utility across broader spatial and temporal scales. Furthermore, much of this research involves counts that are assumed to reflect other demographic processes such as reproduction and survival. In addition, local habitat measurements taken by researchers are somewhat taxon-centric and have little meaning or relevance to those that manage the land, making information exchange between researchers and land managers challenging.

This talk will review the conservation status of grassland songbirds along with research conducted in Prairie Canada that has, or, might inform conservation of grassland songbirds in the region. I use the South of the Divide multi Species-at-Risk action plan in southwestern Saskatchewan to illustrate the importance of asking appropriate research questions to inform the conservation of working prairie landscapes.

WINTERING GRASSLAND BIRDS AS BIO-INDICATORS IN THE CHIHUAHUAN DESERT OF MEXICO AND SOUTHWEST USA

ARVIND PANJABI
Rocky Mountain Bird Observatory, 230 Cherry Street, Suite 150, Fort Collins, Colorado 80521 USA.
Email: info@rmbo.org

Abstract: Grassland bird populations have experienced significant declines over the last four decades in North America, possibly caused by a decrease in winter survival due to changes in habitat quality. Several species of grassland birds migrate every year from northern United States and Canada to spend the winter in the grasslands of the Chihuahuan Desert found within the Rio Grande Basin in Texas and Chihuahua, Mexico. Winter grassland bird communities that were sampled were highly variable in species abundance and composition between winters. Bird densities may change by orders of magnitude at the Desert Grassland Priority Conservation Areas (GPCA) level and bird species may reach their maximum density at different GPCAs between winters. Therefore, we emphasize the need to investigate the ultimate processes driving this high variability in winter bird abundance throughout the Chihuahuan Desert, highlighting the role of rainfall on food limitation. The winter avifaunas of Chihuahuan Desert grasslands are characterized by the dominance of a few species including Chestnut-collared Longspur (*Calcarius ornatus*), Lark Bunting (*Calamospiza melanocorys*), Vesper Sparrow (*Pooecetes gramineus*), Horned Lark (*Eremophila alpestris*), Brewer's Sparrow (*Spizella breweri*), and Savannah Sparrow (*Passerculus sandwichensis*). A cluster analysis based on bird species composition shows a delineation of 6 conservation regions for grassland birds in the Chihuahuan Desert. Biodiversity metrics suggest that Cuchillas de la Zarca in northern Durango, Janos in northwestern Chihuahua, and Malpais in southeastern Durango harbor diverse winter bird communities and require effective protection and management. Landowners may use grassland birds to ascertain the condition of their land as habitat for other wildlife species and rangeland management strategies. The presence of species of birds such as Baird's Sparrow (*Ammodramus bairdii*), Sprague's Pipit (*Anthus spragueii*), and Chestnut-collared Longspur represent land with potential for conservation for other species that prefer conserved grasslands as main habitat. Our results of telemetry studies of survival of Vesper Sparrows suggested that poor grassland conditions could be an important cause of grassland bird population declines. These results underscore the need, and indicate the potential, of restoring grassland health to reverse persistent declining trends in grassland bird populations. We present the first available wintering habitat capacity estimates for Chihuahuan Desert GPCAs for five study species. Habitat relationships and spatially-explicit capacity estimates provide a starting point for strategic habitat conservation and management for these five grassland bird species in their core wintering grounds. It is estimated that 70% of the temperate grasslands have been converted to agricultural use. In northeastern Mexico, tendency has been similar with a loss of 74% of the desert grasslands, mainly due to land conversion to potato fields. Grassland bird specialists are using the agricultural matrix of northeastern Mexico during the wintering season;

however, other factors that may be affecting their survival such as pesticide and novel parasites exposure, anthropogenic stress and immune system status should be studied. Conservation efforts are underway to engage private ranchers, communities, range managers, and educators, especially in Mexico, and assist them in implementing best management practices for birds, livestock and agricultural crops. (Recent website posting at:
http://rmbo.org/v3/Home/tabid/41/EntryId/48/Fieldwork-in-Chihuahua-Mexico-Identifying-Threats-to-Overwintering-Grassland-Birds.aspx

CURRENT AND FUTURE NATURAL CAPITAL VALUATION IN THE UPPER BOW BASIN

HARVEY BUCKLEY
Action For Agriculture, Box 382, Cochrane, Alberta T4C 1A6. Website: www.actionforagriculture.com

Abstract: Action for Agriculture will present the outcomes of a study by ALCES which was contracted in June 2010 with completion in the fall of 2012. Alberta's sustainable future is dependent on conserving our natural capital. The board of directors of Action for Agriculture saw a need to provide land use decision-makers (land planners and municipal councilors) with a better understanding of the value of our natural capital before these assets are in short supply or lost to development decisions. There is an illusion that capital is only of financial and human sources, and that our environment/natural capital comes free of charge. However, the reality is that Albertans are over-spending our natural capital. The study identifies financial benefits of using land use tools that the province provided in the Land Use Framework and followed with the *Alberta Land Stewardship Act* (ALSA) legislation. This project demonstrates the clear value of providing natural capital protection in the Upper Bow Basin. This study can be applied to any watershed in Alberta. Action for Agriculture recommends the next step is to establish regulations through which revenue streams can be utilized to incent landowners to rebuild and maintain our natural capital.

ENVIRONMENTAL CONSUMERISM: ARE PEOPLE REALLY WILLING TO PAY?

KEITH EVERTS
Stillridge Ranch, Box 1581, Pincher Creek, Alberta T0K 1W0.

Abstract: A group of ranchers for 16 years stuck together to help protect eco-systems by branding their product under the certified organic banner. What were the obstacles, and what still are? Why is it so important to partner with the people that have the same values? Does it really work to get a percentage above conventional price, or do we need to start paying for real costs? We are in the food business not real estate. Keith will reflect on over 30 years of efforts by himself, his family and his fellow ranchers to maintain sustainable ranching that preserved their ranches' ecosystems, water quality, and soils. Their efforts included the award winning 'Producers of the Diamond Willow Range'.

Rapporteur's Closing Notes: 2013 Prairie Conservation and Endangered Species Conference

KEVIN VAN TIGHEM
Author, Canmore, Alberta

I want to start out with a brief rant that I've been saving up since the opening welcomes for this conference.

But before I do that, I'd also like to congratulate the organizing committee who put together this program. What a great agenda. What a great blend of expertise and perspective. We have economists here! I almost even understood them! We have professional communicators, youth educators, restoration ecologists, ranchers, agency professionals, conservation biologists, pipeline reclaimers, First Nations land managers, old, young… what a rich stew you brewed for us. Congratulations, and thanks.

Now to the rant: I would like to propose that we institute an immediate and permanent embargo on the use of the word 'balance' by politicians when speaking to conservationists. I'm never sure what is meant by 'balance' but I can't help assuming the worst. I suspect it's something along the lines of compromise. And we all know that compromise is when everyone abandons hope of getting the outcome they had wanted and goes home equally disappointed. That is aiming too low for any discussion I'm prepared to have about prairie conservation and I suspect the same applies to everyone here.

Bob Peart talked to us about the state of the world's temperate grasslands yesterday and the work the international conservation community is doing to protect a tithe – a mere 10% – of them by the end of next year. He pointed out that Canada – in spite of being one of the wealthiest countries on the list of those with grasslands – has protected barely 3.4% of ours. So if 10% is an international definition of this idea of balance, it's pretty clear that we need to add a lot more weight on the protection side of the scale before we approach balance. The world is watching. We got their attention with our bitumen sands so the good thing is they'll definitely notice when we surprise them by stepping to the front of the pack and giving meaningful protection to what we learned this week is, among other things, the global centre of distribution for many endangered and declining bird species.

Protection, as we all know by now, does not mean protection from livestock. It means protection from permanent vegetation damage – while managing the range with ruminants. Range and ruminants have been fellow travelers down the long halls of evolution. Some of the most interesting and creative work in stewardship is already well advanced, as we heard in some of the presentations, in terms of finding ways to match our ruminant of choice – the domestic cow – to the ecology of our native grasslands. We didn't always use to get that right, but the proof of intelligent and sensitive prairie stewardship is increasingly apparent out on the range.

If those references to balance referred to a healthy blending of environment and economy and social well-being in prairie Canada then I suspect we haven't really seen that since sometime around the year I was born. That would be 1952. I am told (my personal recollections of that year being a bit hazy) that there were sloughs all through the aspen parklands and prairie pothole country, and that those sloughs were teeming with waterfowl in the 1950s. Calgary still sat inside its river valleys and hadn't yet begun to metastasize across the fescue grasslands of the Alberta foothills. There were no well roads or pipelines across the Suffield block or the shortgrass plains south of Medicine Hat. Irrigation was only downslope from the canals. Farm families sustained the fertility of their soils with mixed cropping and livestock manure, not with chemical fertilizers, and they were prosperous enough that they could raise their kids to maturity on the farm without having to take two second jobs in town. There were Burrowing Owls nesting on the outskirts of Calgary (I know this because they were still there when I was a 12 year old birdwatcher) and hunters pursued Sage Grouse along the Frenchman and Milk Rivers without any doubt that they'd be there to be hunted again next fall.

So if we can't ban the use of the word 'balance', let's at least make sure that those who use it understand that we'll need to secure all our surviving native prairie against further conversion and fragmentation and get a whole lot of grassland, prairie wetlands, native species and farm families back into the landscape before we even begin to approach anything resembling balance again.

It's not conservation that needs to put anything more on the table for prairie Canada to get to balance. *There is no more room for compromise in prairie conservation*.

But that doesn't mean we need to get snarky about things either. Mostly, we just need to fix the conversations and transactions that take place out there on those rolling plains. We need a more robust prairie economy, more respectful relationships, and a language we all understand in talking about the nature of this place and our relationship to it. We can be aggressive about conservation while yet taking joy in it and in one another.

W.O. Mitchell wrote a prairie classic around the time I was born, called ***Who Has Seen the Wind***. I don't need to tell you about it; you've all read it. Or if not, you're going to, right? I don't think anyone can forget the image of the young protagonist, Brian, walking out to where the sidewalk ends, past the singing of the telephone lines, grasshoppers clacking away underfoot, and finding his first hint of the presence of God out on the vast open prairie that, in his time, seemed to go on forever. That sense of place – of young Brian becoming who he is through immersion in sky and drought and gophers and grass and a living community in a rural place – resonates again and again with each prairie Canadian who reads it – even as that prairie Canada fades into the past. Even while some folks keep telling us we need 'balance…'

W.O. Mitchell was onto something fundamentally important to any sort of landscape conservation work. In many ways, he was onto the most important thing. His writing helped western Canadians see prairie not just as a natural place but as a cultural place: a place that gives us our meaning. His work was one of the first great contributions to the consciousness that we *are* a prairie people and for that reason alone, prairie matters. How can you know yourself as a prairie person if there is no prairie? What if there were no meadowlark song, no shooting stars or prairie crocuses, no smell of sage or sudden flicker of a snake vanishing behind a lichen-crusted rock….where would we be citizens of then? What God would whisper to tomorrow's Brians from so emptied a place?

The other evening Chris Fisher explored the nature of deep and effective communication – its emotive and deeply personal nature and how our ability to really connect with others is critical in enabling communication and influencing change. I think Trevor Herriot and many others who are fighting to save Saskatchewan's community pastures from poorly-conceived policies that could lead to their fragmentation or loss is an example of getting that kind of communication right. They aren't using intellectual arguments, or at least they aren't leading with them – they are going right to the heart of what it means to be *of* Saskatchewan, of being rooted and rural and committed to place and responsible for stewardship of things that are rare and valuable. Science can support these discussions (science *must* support them) but respect for one another and love of place must form the heart of them. When we get those discussions right, we get more than just conservation; we get community. That's why Cows and Fish, and Operation Grasslands Community, and

MULTISAR have been successful; they build conservation through community… and community through conservation.

Still, we can't go back to W.O. Mitchell's time, much less to Crowfoot or Red Cloud's time when these prairies truly sang. We're not going to get to 'balance' by driving with our eyes glued to the rear view mirror, as our friend Lorne Fitch often says.

But nor can we settle for that other kind of 'balance' – the weak compromises, what one of our opening speakers described as 'conservation triage'. What? Why would we do that? Doesn't our unique piece of this planet – of the Universe – matter? Are we so conditioned to loss and compromise that we think it's good enough to settle for the last bits of the last bits of the last bits of what was once a vital, living, rich and self-sustaining ecosystem and – at least in the middle years of the twentieth century – a productive and vital rural social economy? Is it good enough to keep captive-raising and releasing endangered species in hopes that they'll hang on long enough for a miracle, or mining our soils as if petroleum-based fertilizers and equipment will someday become less expensive and less destructive? Is it acceptable to see more windows grow dark behind dying windbreaks as yet another hard-working farm family gives up and moves to the city because their only income streams have gotten too shallow? Are we okay with seeing long-billed curlews only in books, next to the Eskimo curlew?

No way. That is a picture of prairie failure. And I don't see losers here.

Well, in the last three days I think we've seen and heard enough to tell us that we can indeed get to the right kind of balance – and that it will involve restoration, innovation, new conversations built on new kinds of relationships and, frankly, a new kind of economy. It's happening – in bits and pieces, slowly and sometimes painfully – all around us. The people in this room are making it happen. And the people outside of this room with whom you have formed relationships, created new kinds of conversations and set in motion new kinds of stewardship and restoration are making it happen too.

I'm going home from this conference with new hope and new determination because of what I saw and heard here. What are some of those things?

1. Remarkable advances in landscape classification, evaluation, mapping and analysis that enable us to identify high conservation value landscapes and the distribution of ecosystem goods and services across the land. Those tools mean that we no longer need talk in broad generalities or guess about the impacts of policies or the scope of needed conservation measures. Our conversations are far more scientifically literate, and our aim can be far more accurate.

2. A remarkable degree of mutual respect arising from collaborative effort between biologists, land owners, industry, regulators and academia. It wasn't that long ago that we talked about each other, each in our own separate and comfortable enclaves; now it's become the norm to talk with each other. Instead of each having our own language that excludes one another, we have moved to a point where we each bring our own knowledge to conversations in which we speak a common language to inform, inspire and learn from one another.

3. Rather than letting the complexity and unknowns and risks of economic innovation discourage us, there is some amazing work being done to quantify ecological goods and services like native prairie restoration, carbon capture, wetland recharge and so forth, and then to develop economic instruments

that can enable those whose stewardship of private lands ensures a continuing or renewed supply of those benefits to profit economically from them. This is probably, to me, some of the most exciting and important work underway today because it goes both to reversing the loss of prairie Canada's ecological wealth ***and*** revitalizing and renewing rural economy. Farming is not just about producing food; it is about sustaining land. Society values both. The market should reward both and, frankly, ecological goods and services are worthy of public investment. We've certainly never had difficulty investing public funds in ways that degrade ecosystems, even though I can't think of any credible argument that the degradation of ecosystems is in the long-term public interest. So it's way past time for government to redirect public investment into incentives and rewards for things that are truly in the public interest – living landscapes, clean air and water, vitality, wholeness – restored and vibrant ecosystems. In other words: a future worth living in and a future where we can still know ourselves as prairie people because the prairie, the whole prairie, is still there.

4. Meaningful and effective efforts to replace us baby boomer bunny-huggers and cattle wranglers with a next generation of passionate, educated, engaged and effective conservationists not just through volunteerism and mentorship and internships but starting even earlier – helping more young Brian's find their way out into the prairie where they can listen for the whispering voice of God and hear it – in the tinkling sky song of Sprague's Pipits or the far whistle of an Upland Sandpiper or the muffled booming of dancing Sage Grouse. There are people here who are doing exceptional work at putting prairie into the hearts of young Canadians and filling them with knowledge and experience that will motivate and empower them to take renewal and restoration to levels the 'balancers' probably can't even imagine.

We are going to get this right. Since the first Prairie Conservation Forum, we've lost a lot more of prairie Canada so no, you'd have to be naïve to suggest we're going to get it right easily or entirely. We've followed some false starts, spent perhaps too much time hanging around with people we're comfortable with rather than getting to know those with whom we aren't, dithered a bit too long on some policy fronts (like market instruments and public investment in ecological goods and services), ridden a few economic and political roller-coasters that were not friendly to science or policy development or conservation…. But we are going to get this right. Each of you will make sure of that.

This truly is a time of 'dangerous opportunity'. The motivators today – the levers that can deliver successes we could only have dreamed of before – are, ironically, the very threats that frighten us most.

Climate change for example: yes, it adds new vulnerabilities in our stressed and fragmented prairie ecosystems but it has also created huge social license issues for the energy industry and governments who rely on their profits. Meaningful, tangible and lasting protection of prairie ecosystems – whether through new Heritage Rangelands in Alberta or innovative First Nations Joint Ventures on Saskatchewan's community pastures – can go a long way towards repairing the damage others' blunders have caused to Canada's social license and reputation.

Health and sustainability concerns are increasingly motivating consumers to seek out products they can feel good about, whether that be Forest Stewardship Council certified wood, bird-friendly coffee or sustainably-produced beef. The markets are finally ready to help us conserve prairie and reward enlightened stewardship.

We've passed peak water – how scary is *that*? – and there are no longer any water licenses to give out in the South Saskatchewan basin. But that means that wetland and headwaters restoration that promises groundwater recharge and more water in our streams can suddenly look like a good idea to a lot more people than just those of us who care about ducks, willets, frogs and dragonflies.

Do these issues mean we're in deep trouble? Of course they do. Do these things mean we can mobilize political, economic, industry and community support for restoring prairie ecosystems and reinventing rural economy now as never before? *Darn right they do*. And we're ready. We saw that this week. What we can't afford is to be 'balanced' or 'reasonable' when we're faced with so much loss and presented with so much opportunity at this moment in history – make no mistake about it: prairie conservation requires determined advocacy from everyone in this room. Because if not us, then whom?

Forget this stuff about 'balance' if balance means settling for anything less than vibrant prairie ecosystems, fully restored populations of species currently at risk, and prosperous ranches and farms that profit not only from the production of food but also from ecological goods and services.

Conservation cannot be about riding the brake pedal to delay the inevitable plunge off the cliff. It must be about sitting up straight, looking around, grabbing that steering wheel, lining up on where we should have been all along, and hitting the gas pedal.

We've got important work to do, and we have good people to do it with, and spring is coming. It's time now to get out there and show the world that prairie Canada will *always* be a place where small boys can find the sacred in the real; where rural families can thrive while producing things that really matter in places that are really alive; where there will always be strange little owls on fence posts and frog choruses in the evening and the whistle of duck wings in the dark and renewed expanses of grassland, sageland, wetland, human land reaching back out to the horizons where they were always meant to reach… our Canadian prairie land – the place that makes us who we are.

That is our work and *this* is our time. It's been an informative and inspiring week. So let's get out there and get it done.

SESSION SPEAKERS ABSTRACTS AND PAPERS

SESSION 1: SOCIO-ECONOMICS OF PRAIRIE CONSERVATION

THE ECONOMICS OF BMP ADOPTION IN THE CANADIAN PRAIRIE REGION

D. TRAUTMAN[1], K. BARNES[1], S. KOECKHOVEN[1], S. XIE[1], J. UNTERSCHULTZ[1], S. JEFFREY[1], and **C. ROSS[2]**

[1] Department of Resource Economics and Environmental Sociology, University of Alberta, Edmonton, Alberta T6G 2H1.

[2] Policy Development Division, Agriculture and AgriFood Canada, Edmonton, Alberta

Abstract: Society places importance on environmental quality, as evidenced by current public policy. Within agriculture, this translates into incentives for production of Ecosystem Services, which are enhanced through on-farm adoption of Beneficial Management Practices (BMPs). Implementation of many BMPs is costly, and therefore policy intervention (i.e., positive or negative incentives) is likely required to ensure significant adoption of these practices. Additionally, government-funded farm risk support programs may contribute to opportunity costs of Ecosystem Services production. Estimates of the economic impacts of government programs and BMP adoption are necessary to determine appropriate policy. The economic impacts of BMP adoption, including buffer strips, nutrient management, and off-stream watering for cattle, are estimated for the Canadian Prairie region using representative farm analysis, Monte Carlo simulation and capital budgeting techniques. The impacts of government support programs on BMP adoption are also evaluated. This paper provides an overview of results from multiple research projects. The magnitude of economic benefits/costs varies by location, the nature of environmental risks, and potential profitability of agricultural production. However, conclusions may be drawn from patterns that emerge from the studies. Adoption of some BMPs (e.g., buffer strips) have an associated net farm-level cost. Other BMPs, however, appear to have potential for positive net farm benefits (e.g., nutrient management and some pasture-related BMPs). Public risk management programs appear to reinforce disincentives for on-farm BMP adoption. The paper concludes with a discussion of the lessons learned and ideas for future work in this area.

ASSESSING THE EFFECTIVENESS OF AN ALBERTA-BASED AGRI-ENVIRONMENTAL EXTENSION SERVICE

STEPHANIE SIMPSON, CURTIS ROLLINS and **PETER BOXALL**
Department of Resource Economics and Environmental Sociology, University of Alberta, Edmonton, Alberta T6G 2H1.

Abstract: The Natural Advantage Program (NAP) was an agricultural extension service offered by the Alberta branch of Ducks Unlimited Canada to Alberta-based producers between 2007 and 2008. This voluntary program provided producers with farm-specific recommendations on actions they could adopt to improve their on-farm wildlife habitat and biodiversity, and sources of assistance they could access to help them implement those actions. To date, external evaluations of such stewardship programs in the Canadian context have been limited. The goal of this research, then, was to evaluate the efficacy of the NAP and to provide recommendations on how to improve program design and conduct a program evaluation. Personalized surveys were developed to assess action completion, assistance access and related individual- and farm-level characteristics. These surveys were mailed to all consenting NAP participants (131), as well as to a group of individuals who signed up for the NAP but did not receive the service (60). Findings indicate that respondents were similar in age to the average Albertan producer, but had more years of education and were more likely to have completed an environmental farm planning exercise. Program participants completed an approximate average of 3.3 actions per individuals, while non-participants completed an approximate of average of 1.3, suggesting some degree of program efficacy. Participant completion rates for recommended actions ranged from 20% to 81%, while access rates for recommended forms of assistance ranged from 0% to 39%. Findings indicate that NAP participants who operated large farms, owned their land or participated in a watershed group were most likely to have adopted recommended actions. The actions most likely to be adopted were those requiring a relatively low investment of time or money, and those with obvious private benefits. Key reasons for non-adoption and non-access were similar, and included concerns over the required investment of time and money, and the relevance of the recommendation to their farm. Using these findings, recommendations for improving program design and program evaluation will be provided.

HABITAT CONSERVATION FOR GRASSLAND SPECIES-AT-RISK: A MULTI-SPECIES BENEFIT-COST ANALYSIS

A. ENTEM, W.L. ADAMOWICZ, and **P. C. BOXALL**
Department of Resource Economics and Environmental Sociology, University of Alberta, Edmonton, Alberta T6G 2H1. Email: aentem@ualberta.ca

Introduction

Species-at-Risk recovery strategies and action plans, and their associated socio-economic analyses, have largely been completed on a species-by-species basis under the *Species at Risk Act* (SARA). The multiple-Species-at-Risk (Multi-SAR) action plan underway in southwest Saskatchewan – the South of the Divide Action Plan – provides a unique opportunity to conduct a Multi-SAR benefit-cost analysis (BCA) in a grassland setting (Kirk and Pearce 2009). The BCA compares three conservation scenarios – light conservation, moderate conservation, and heavy conservation – that consider unique combinations of conservation actions intended to provide for the protection and recovery of five Species-at-Risk within the region. For each scenario, the net present values (NPV) of conservation costs and benefits were compared and BCA decision rules were used to select the most efficient conservation scenario for the region (Campbell and Brown 2003).

Methods

Three scenarios were designed for the conservation of five grassland Species-at-Risk – Burrowing Owl (*Athene cunicularia*), Greater Sage-Grouse (*Centrocercus urophasianus urophasianus*), Loggerhead Shrike (*Lanius ludovicianus excubitorides*), Sprague's Pipit (*Anthus spragueii*), and Swift Fox (*Vulpes velox*) – that have large tracts of critical habitat either legally designated or proposed within the southwest corner of Saskatchewan. The scenarios – which varied in several key features – were labeled as 'light', 'moderate' and 'heavy' conservation and are compared to the current (or status quo) conservation in the area. Firstly, the scenarios were distinguished by geographical location. Figure 1 shows the study region and two geographical conservation areas (A and B) that are considered within the scenarios. Conservation area A is made up of the legally designated or proposed critical habitat within the southwest corner of Saskatchewan. Conservation area B, by comparison, is largely cultivated land and, therefore, not suitable for critical habitat designation. However, this area – following re-vegetation with native grassland species – could offer a habitat corridor capable of connecting the eastern and western blocks of native grassland critical habitat.

Each conservation scenario had two additional components – a conservation activities component and a Species-at-Risk biological response component – considered in conjunction with its geographical extent. Each scenario had a prescribed combination of conservation actions (focused on agriculture and oil and gas beneficial management practices), and in response to the combination of conservation actions employed, each scenario also had a unique 30-year projected survival and recovery reaction for each of the five Species-at-Risk considered in the analysis. Species responses were defined as the probability that a Species-at-Risk would become extirpated from the southwest corner of Saskatchewan at the end of a 30-year period. The probabilities of extirpation were estimated by Canadian Wildlife Service and Parks Canada Species-at-Risk biologists. Table 1 presents the conservation actions and species responses for each of the conservation scenarios.

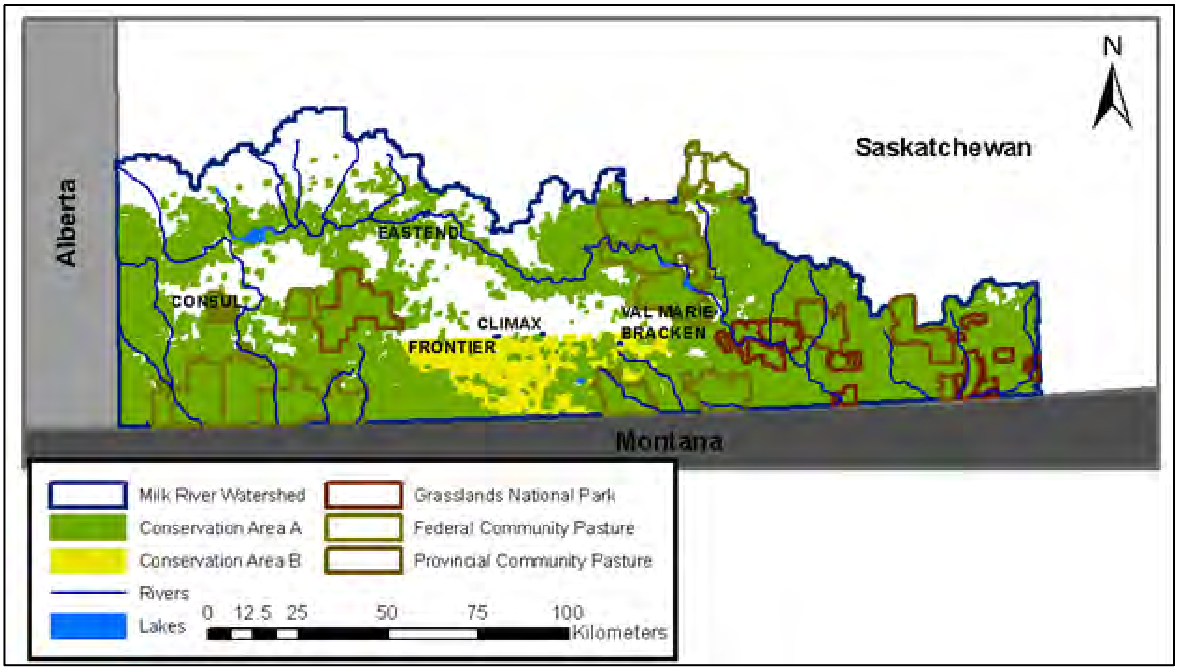

Figure 1. A map showing the possible geographic locations for the application of Species-at-Risk conservation activities within southwest Saskatchewan. Conservation Area A is composed of all quarter sections intersected by proposed critical habitat. Conservation Area B is cultivated land that could be converted back to native grassland in an attempt to connect the eastern and western critical habitat areas.

Table 1. The location and conservation activities that comprise three potential conservation scenarios within southwest Saskatchewan as well as each species' estimated risk of becoming extirpated from the region within the next 30 years under the scenarios. Additional beneficial activities that were suggested, but not included, were translocation of individuals to restore or improve local populations, restricting pesticide usage, restricting predator control, strategically removing and/or maintaining perching areas, restricting irrigation, implementing land stewardship agreements, etc.

	Conservation Scenario		
	Light	**Moderate**	**Heavy**
Conservation Areas			
Area A	Yes	Yes	Yes
Area B	No	Yes	Yes
Conservation Activities			
Agriculture Beneficial Management Practices[a]	Grazing BMP (stock livestock at recommended rates on native grasslands)	Conservation easements on privately-owned land	Acquisition of agricultural land
	Conversion of hay and crop fields to native grasslands	Conversion of hay and crop fields to native grasslands	Conversion of hay and crop fields to native grasslands

	Light	Conservation Scenario Moderate	Heavy
Oil and Gas Beneficial Management Practices	Increased regulation for new development (max. 4 wells per section)	No new oil and gas development, except on existing sites (max. 4 wells per section)	Cessation of oil & gas activities
	Reclamation on sites no longer in use	Reclamation on sites no longer in use	Reclamation on sites no longer in use
	Re-vegetation with native species and installation of exclusion fencing on sites following drilling	Re-vegetation with native species and installation of exclusion fencing on sites following drilling	
Species' Extirpation Risk in 30 Years			
Loggerhead Shrike	Moderate Risk	Moderate Risk	Moderate Risk
Sprague´s Pipit	Low Risk	Low Risk	No Risk
Greater Sage-Grouse	High Risk	Moderate Risk	Low Risk
Burrowing Owl	Low Risk	Low Risk	Low Risk
Swift Fox	No Risk	No Risk	No Risk

Once the conservation scenarios were clearly defined – in terms of conservation actions and biological responses – the additional economic costs and benefits of the scenarios (in comparison to the status quo or baseline conditions) were calculated. The economic costs of the scenarios were calculated as the costs (both direct and opportunity) of implementing the conservation activities on the landscape (Entem 2012). Spatially heterogeneous conservation costs were estimated using several methods including net present value models and hedonic land models (Hauer et al. 2010; Palmquist and Danielson 1989). The benefits (both use and non-use) of the conservation scenarios were calculated as the value Saskatchewan residents placed on reducing the probability that the Species-at-Risk will be extirpated from the region.[4] Benefits – measured as Saskatchewan residents' willingness to pay (WTP) to aid Species-at-Risk recovery – were quantified using a referendum-style contingent valuation survey that was administered to a representative sample (n=327) of Saskatchewan residents (Adamowicz et al. 1998). Respondents were asked to make trade-offs between changes in species' probability of extirpation and increases in their household income taxes. All scenarios' costs and benefits were brought into net present values (2012 CAD). The present value of net benefits for each conservation scenario was calculated and BCA decision rules were used to choose amongst conservation scenarios (Campbell and Brown 2003).

[4] While additional values (carbon sequestration, hunting, etc.) may arise from the implementation of the conservation scenario, these values were considered negligible and not included in the analysis.

Results

The net present value of the aggregate conservation scenario costs varied from a low of $225 million for the ‘light’ scenario to a high of $891 million for the ‘heavy’ scenario (Table 3). On a per household basis, WTP measures ranged from a low of $77/household/year for the ‘light’ scenario to a high of $188/household/year for the ‘heavy’ scenario (Adamowicz et al. 2012).[5] The net present value of benefits was found by aggregating WTP values across the Saskatchewan population (387,140 households) and discounting, at r = 4%, over 30 years. The resulting net present value of aggregate benefits ranged from a low of $515 million for the ‘light’ scenario to a high of $1,259 million for the ‘heavy’ scenario (Table 3). The net present value of aggregate net benefits ranged between $290 million and $444 million for the ‘light’ conservation scenario, between $341 million and $790 million for the ‘moderate’ conservation scenario, and between $113 million and $692 million for the ‘heavy’ conservation scenario. While all three conservation scenarios have positive net benefits, and are, therefore, socially desirable, the conservation scenario with the greatest net benefits (i.e., greatest social net gain) is the moderate conservation scenario.

Table 2. The estimated additional costs, benefits and net benefits of each conservation scenario (as compared to the ‘status quo’ or current conservation). All monetary values are net present values reported in millions of dollars (2012 CAD).

	Conservation Scenario		
	Light	**Moderate**	**Heavy**
Estimated Additional Cost			
Aggregate Cost ($ million)	225	315 – 436	567 - 891
Estimated Additional Benefit			
Aggregate Benefit ($ million)[a]	515 – 669[b]	777 - 1,105	1,004 - 1,259
Estimated Additional Net Benefit			
Aggregate Net Benefit ($ million)	290 - 444	341 – 790	113 - 692

a. The aggregate benefit values were calculated using ‘per household’ willingness to pay values ($/household/year) that resulted from surveying Saskatchewan residents (n = 327) regarding their households’ preferences for Species-at-Risk conservation. The ‘per household value’ was aggregated across Saskatchewan’s 387,140 households and discounted over a 30-year period at a rate of 4%.
b. Upper and lower bound aggregate estimates of benefits result from the upper and lower bound estimates of per household benefits.

Discussion

A comparison of aggregate costs and benefits indicates that all three conservation scenarios are economically feasible with the net present value of net benefits ranging between $113 million and $790 million. The ‘moderate’ scenario, with net benefits ranging from $341 million to $790 million provides the greatest net benefits. These findings suggest that a ‘middle of the road’ conservation strategy would provide the greatest net social benefits. The strategy would not impose the high level of costs on the economy that a ‘high’ scenario would generate, but results in large economic benefits of conservation, relative to the ‘low’ case.

[5] Upper and lower bound ‘per household’ willingness to pay estimates were calculated. The lower bound estimates used all respondents surveyed (n = 327). The upper bound values were estimated using only the respondent that indicated within the survey that they believed their responses would be used to influence policy (n = 161).

These findings, based on estimates of direct and opportunity costs, suggest a 'middle of the road' strategy would provide the greatest benefit to society. However, there remains the question of how to implement the desired conservation actions on the landscape, and the selection of implementation mechanism (e.g., extension and education, regulations, voluntary programs, reverse auctions for grassland establishment, etc.) will ultimately influence the true costs of achieving the conservation targets. The next step in the conservation planning for southwest Saskatchewan, therefore, will be to determine which mechanisms will be used to achieve Species-at-Risk conservation.

Literature Cited

Adamowicz, W.L., P.C. Boxall, M. Williams and J. Louviere. 1998. Stated preference approaches for measuring passive use values: Choice experiments and contingent valuation. *American Journal of Agricultural Economics* 80: 64-75.

Adamowicz, W.L., P.C. Boxall, A. Entem, and S. Simpson. 2012. South of the Divide Action Plan: Economic Cost and Benefit Assessment. Report to the Canadian Wildlife Service, Prairie and Northern Region, Edmonton, Alberta.

Campbell, H., and R. Brown.2003. Benefit-cost analysis: Financial and economic appraisal using spreadsheets. Cambridge University Press, New York.

Entem, A.R. 2012. Cost-effective Conservation Planning for Species at Risk in Saskatchewan's Milk River Watershed: The Efficiency Gains of a Multi-species Approach. M.Sc. thesis, University of Alberta, Edmonton, Alberta.

Hauer, G. W. Adamowicz, and R. Jagodinski. 2010. A net present value model of natural gas exploitation in northern Alberta: An analysis of land values in woodland caribou ranges. Project report #10-01. Department of Rural Economy, University of Alberta, Edmonton, Alberta.

Kirk, D.A., and J.L. Pearce. 2009. A literature assessment and analysis on multiple-species recovery implementation in southwestern Saskatchewan. Final report to the Saskatchewan Ministry of Environment, Regina, Saskatchewan.

Palmquist, R. B., and L. E. Danielson. 1989. A hedonic study of the effects of erosion control and drainage on farmland values. *American Journal of Agricultural Economics* 71: 55-62.

Endnotes

[1] Critical habitat spatial data was provided in October, 2011 by the Canadian Wildlife Service. Critical habitat data used in this analysis was the best data available at the time, but changes have since been made to the proposed critical habitat areas for several of the Species-at-Risk.

[2] While additional values (carbon sequestration, hunting, etc.) may arise from the implementation of the conservation scenario, these values were considered negligible and not included in the analysis.

[3] Upper and lower bound 'per household' willingness to pay estimates were calculated. The lower bound estimates used all respondents surveyed (n = 327). The upper bound values were estimated using only the respondent that indicated within the survey that they believed their responses would be used to influence policy (n = 161).

Environmental and Socio-economic Implications of Growing Bioenergy Production Crops on Marginal Land in Saskatchewan

BRANIMIR GJETVAJ[1] and MURRAY J. BENTHAM[2]

[1] School of Environment and Sustainability, University of Saskatchewan, Room 323, Kirk Hall, 117 Science Place, Saskatoon, Saskatchewan S7N 5C8. Email: branimir@shaw.ca

[2] Agriculture and Agri-Food Canada, Saskatoon Research Centre, 107 Science Place, Saskatoon, Saskatchewan S7N 0X2.

Abstract: A dramatic transformation of the once vast Northern Great Plains grasslands to one of the most threatened ecosystems on Earth has been accelerated by a rising global demand for food and energy, advances in modern farm technology, new cropping systems, and government subsidy policies affecting food, fibre, and fuel production. New bioenergy production crops are being developed that can be grown on degraded and agriculturally marginal lands not well suited for conventional crop production. Tame pasture and native grasslands are agricultural land classes that are considered marginal under the current level of production, agriculture policies and macro-economic conditions, but are susceptible for cultivation with bioenergy production crops. Although planting biofuel crops on marginal lands might offer higher potential local economic benefits, it is questionable whether conversion of grasslands into industrial agricultural production would provide broad societal benefits since grasslands provide important ecosystem services such as carbon sequestration, water filtration, and protection of biodiversity. The suitability of marginal lands for sustainable biofuel production on the Canadian Prairies is poorly documented. A risk assessment of threats to grassland habitat and biodiversity and impact from land-use change is especially urgent after the announced devolution of the Federal Community Pasture Program and transfer of AESB (Agri-Environment Services Branch), PFRA (Prairie Farm Rehabilitation Administration) lands to private users. We will determine the environmental and socio-economic implications of converting grasslands to dedicated biofuel crop production in southern Saskatchewan, and examine the environmental cost of critical habitat loss for species-at-risk. We will identify marginal agricultural regions suitable for growing second-generation biofuel crops, and assess the threat risk to biodiversity and Species-at-Risk from land-use conversion in these regions.

SESSION 2: EDUCATORS TACKLE NATURE DEFICIT DISORDER

CONNECTIONS BETWEEN PEOPLE AND NATURE: TRENDS AND CHALLENGES

GLEN HVENEGAARD
Augustana Campus, Science Department, University of Alberta, 4901-46 Ave., Camrose, Alberta T4V 2R3.

Abstract: People are losing contact with nature in the prairies. For example, the average child spends less than an hour per week in unstructured play outdoors and over ten hours per day focused on various media, a drastic reversal from decades past. Many adults spend their entire day indoors, either working at a desk, driving a car, or sitting indoors. Even our interactions with nature are mediated by various forms of media, rather than direct contact. We are losing direct contact with nature for many reasons, including competition for our time, lack of experience, societal pressure, loss of natural places, and fear of the outdoors. What are the consequences? We are losing opportunities to maintain mental and physical health, learn in innovative ways, develop valuable skills, increase self-awareness, and nurture an ethic of environmental responsibility. How can this trend be reversed? We need to develop opportunities for people to be in nature, have physical contact with nature, be with others in nature, and have satisfying interactions with nature. By doing so, people can strengthen their sense of place, enhance their personal awareness, develop skills for thriving in this world, change their management paradigm, and respond to their innate tendencies.

Introduction

People are losing contact with nature in the prairies. This involves many groups, including children, adults, parents, farmers, ranchers, food consumers, teachers, and urban residents. These people are losing contact with a wide variety of settings in the prairies, from fescue grasslands to aspen woodlots, from wilderness protected areas to urban parks, and from badlands to backyards. This paper will explore some of the reasons why people are losing contact with nature, as well as the consequences of that changing relationship, and highlight some of the opportunities in rebuilding that relationship.

While many other groups of people are implicated, we often speak about children losing contact with nature. In decades past, urban and rural children spent several hours a day outdoors engaged with nature, and little time playing with electronics. Today, the average child spends 30 minutes per week in unstructured play outdoors (Hofferth and Sandberg 1999) and approximately 10.5 hours per day with various media (Rideout et al. 2010). For children, Louv (2005) referred to this trend as 'nature deficit disorder', but acknowledges that the same troubling trend applies to adults (Louv 2011). Many adults spend their entire day indoors, either working at a desk, driving a car, or relaxing at home, leaving less time outside in nature for them or their children. Many of those interactions that we do have with nature are often mediated by various forms of media rather than through direct contact. For example, when people spend leisure and exercise time in nature (e.g., camping), they are more likely to do so with the potential distractions provided by cell phones, Wi-Fi service, or satellite television reception.

Within the context of our food systems in the prairies we are also losing direct contact with nature. In terms of the food cycle, consumers have little knowledge of the producer, quality of the food, or geographic origin of the food. While there are many opportunities to interact with the land, even food producers can be isolated from nature. With modern technology, farmers can plant, tend, and harvest crops within the air-conditioned confines of a comfortable tractor or combine and many ranchers choose to herd cattle with trucks or quads, rather than horses. These new techniques of food production create a distance between the producer, consumer and product as well as the environmental systems within which it is grown.

Others are losing contact with nature as well. Elementary, high school, and university students rarely take field trips to interact with nature because of travel costs, reduced funding, larger class sizes, reduced interest of teachers, a lack of field skills, safety concerns, and paperwork (Jenkins 1994; Simmons 1998). Even researchers, whose job it is to better understand prairie species and processes, spend more time behind a computer screen than in the field.

This loss of direct contact with nature is occurring for many reasons. For children, there is competition for time through planned activities and electronics, fear of the outdoors, and safety conscious parents. For adults, it might be a lack of experience or societal pressure to avoid wild or rural areas. For parents, the reasons might have to do with the demands of work or shuttling kids, and the perceived amount of time to prepare for the unknown qualities of going to the natural world. For the growing number of urban residents, there are fewer opportunities to interact with nature as those urban areas become increasingly developed (Miller 2005). Consumers can purchase food easily and cheaply in urban centers, without needing to know who produced it, or how or where it was grown. Farmers and ranchers might choose machinery that is more efficient, economical, or comfortable than alternatives. Students have little power or background to request alternative sites for learning. For many of us, we are losing the expertise (e.g., skills in outdoor travel, safety, and identification) to be competent and knowledgeable in the outdoors.

Why do We Need Connections with Nature?

There are six key reasons supporting the promotion of a connection between nature and people in the prairies. First, a large proportion of prairie has been dramatically altered from its original state (WWFC 1988). One result of this has been high rates of species endangerment across the Great Plains (Savage 2011). Whatever the causes and whatever the results, it is becoming increasingly difficult to find native prairie for the average person to experience. We need these experiences to connect us with our history, to help us understand our current uses of the prairie, and to help us think about the kind of future we want for our prairie landscapes.

Second, a personal connection with nature can raise personal awareness. As Wendell Berry said, “you can’t know who you are until you know where you are” (Harwell and Reynolds 2006, p. 6). Knowing the natural world, and knowing our place in the natural world is especially important as most environments are undergoing significant change, and as we lose direct connections with how the natural world shapes us (e.g., water, weather, and food). A thorough understanding of, and connection with, the natural world, can help us feel grounded in local places.

Third, interactions with nature are important for physical, mental, and social health (Maller et al. 2008). Many others have reviewed the wide variety of benefits, but Jaffe (2010) describes how time spent in nature “has a profound restorative effect on the brain’s ability to focus”. Increasing our sense of connection with prairie landscapes is one way of generating the positive effects of well-being to which Jaffe (2010) refers.

Fourth, a sense of place in nature can help us better manage those natural environments. Research has shown that people who are emotionally, psychologically, or functionally attached to a place will act to protect that place (Kaltenborn and Williams 2002; Walker and Chapman 2003) and will have greater intentions to engage in pro-environment behaviors. If we are attached to a place, we experience that place as a set of relationships, rather than as a set of things or resources (Tuan 1977; Hay 1992). Those relationships help us understand, for example, where we obtain our food or how wetlands clean our water. Thus, with a focus on relationships, resource management in those places occurs more in the context of communities, rather than commodities (Rolston and Coufal 1991). This perception is critical to solving many problems associated with environmental change.

Fifth, developing a sense of place can increase our prospects for survival. To consider this point, ask yourself how you invest your time in learning about the world around you. We can typically identify far more features of urban popular culture than of the natural environment. This suggests we are living in an age of missing information (McKibben 1992), in which we invest very little time or energy in the places and information upon which our survival depends (e.g., soil, wildlife, weather, and gardening). Human learning through interaction with natural spaces can add to the re-balance of this knowledge paradigm.

Last, nurturing meaning in natural places is a response to our instinctive tendencies. Biophilia, literally a 'love of life', is an innate need for human beings to affiliate with other living beings (Kellert and Wilson 1993). As humans, we should capitalize on this natural love of life and respond favorably to opportunities to interact with wildlife, soil, plants, the air, and other aspects of nature. This can only restore our inward sense of balance as we develop, nurture, and intensify our relationships with wild species and ecosystems.

How Can This Trend be Reversed?

Research shows that our connections to natural places take effect in some key, overlapping ways (Brooks et al. 2007). A sense of place develops from *physical interactions <u>in</u> a place*. Watching a forest through a window, short urban walks, day trips to the park, and extended wilderness expeditions can all involve important experiences in natural environments. More than just travel through natural places, interactions in that place (e.g., on the landforms, in a defined natural setting) provide the groundwork for developing meaning with and among the components of that place.

Physical interactions <u>with</u> a place increase our learning and meaning gained from that place. These interactions include lessons learned from good and bad experiences, exploration, adventure, and physical contact. For example, we can develop connections by identifying native plants, recording changes in ecosystems, and getting involved in ecological restoration efforts.

Through *social interactions in a place* we can also develop connections with nature. Any type of shared experience increases personal connections with the surrounding landscape. These shared experiences provide opportunities for reflection about that place and a collective set of memories that can be re-visited on a regular basis.

Finally, *satisfaction about a place* suggests feeling good about one's time there; positive memories of that place and time enhances one's attachment to place. Such memories are especially important for children (Louv 2005), as those memories are a strong indicator of positive environmental involvement later in life (Wells and Lekies 2006).

Ideally, all of us can develop this sense of place in multiple locations as we maintain an awareness of and connection with our physical environment. However, this does not always occur and often people feel more at home or in touch with nature at distant travel destinations than with their own back yard or home ecosystem. This increased awareness of 'exotic' or foreign environments can come at the expense of our acknowledgement of the spaces within our everyday lives. It is important that we should develop attachment to nature close to our residences, or what Rowe (1990) calls our own 'home places'. After that, we will have gained the skills and confidence to develop a sense of place wherever we study, travel, or live.

Conclusion

Orr (1992, p. 130) asked rhetorically if we are inhabitants or residents of this place. "A resident is a temporary occupant", looking to gratify immediate needs to survive and is not interested in permanent roots or making any real investments in a place. In contrast, an inhabitant has a deep, complex, and reciprocal relationship with a place. I argue that by developing deep connections with nature in the prairie through activities that are appropriate for each person and place, we can encourage more inhabitants than residents.

Orr (2004, p. 147) also says: "I do not know whether it is possible to love the planet or not, but I do know that it is possible to love the places we can see, touch, smell and experience." These meaningful first-hand connections between people and nature, which develop meaning with natural places, have a few connotations. First, a *sense of place* suggests a symbolic and emotional attachment to a place (Williams & Stewart, 1998). Second, according to Tuan (1974), *topophilia* indicates a strong affective tie between humans and places. Third, *geopiety* implies a human relationship with place that embodies reverence, pity, compassion, affection, gratitude, respect, and reciprocity (Tuan 1976). Since we and our fellow prairie inhabitants benefit greatly from our interactions with these natural places, we should feel compelled to ensure that those natural places benefit as well.

Literature Cited

Brooks, J. J., G. N. Wallace, and D. R. Williams. 2007. Is this a one-night stand or the start of something meaningful? Developing relationships to place in national park backcountry. In A. Watson, J. Sproull, and L. Dean (comps.), Science and Stewardship to Protect and Sustain Wilderness Values. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado. Pages 451-459.

Harwell, K. and J. Reynolds. 2006. Exploring a sense of place: how to create your own local program for reconnecting with nature. Conexions: Partnerships for a sustainable future, Palo Alto, CA.

Hay, H. 1992. An appraisal of our meaningful relationships in place. *Trumpeter* 9: 98-105.

Hofferth, S. and J. Sandberg. 1999. Changes in American Children's Time, 1981-1997. University of Michigan, Institute for Social Research, Ann Arbor, Michigan.

Jaffe, E. 2010. This side of paradise: discovering why the human mind needs nature. *Association for Psychological Science Observer* 23: 10-15. http://www.psychologicalscience.org/index.php/publications/observer. Accessed February 14, 2013.

Jenkins, A. 1994. Thirteen ways of doing fieldwork with large classes/more students. *Journal of Geography in Higher Education* 18: 143-154.

Kaltenborn, B. P. and D. R. Williams. 2002. The meaning of place: attachments to Femundsmarka National Park, Norway, among tourists and locals. *Norsk Geografisk Tidsskrift – Norwegian Journal of Geography* 56: 189-198.

Kellert, S. R. and E. O. Wilson. 1993. The Biophilia Hypothesis. Island Press, Washington, DC.

Louv, R. 2005. Last Child in the Woods: Saving our Children from Nature Deficit Disorder. Chapel Hill, NC, Algonquin Books.

Louv, R. 2011. The Nature Principle: Human Restoration and the End of Nature Deficit Disorder. Chapel Hill, NC, Algonquin Books.

Maller, C., M. Townsend, L. St. Leger, C. Henderson-Wilson, A. Pryor, L. Prosser, and M. Moore. 2008. The Health Benefits of contact with Nature in a Park Contest: A Review of Relevant Literature. Deakin University and Parks Victoria, Melbourne, Australia.

McKibben, B. 1992. The Age of Missing Information. Random House, New York, New York.

Miller, J. R. 2005. Biodiversity conservation and the extinction of experience. *TRENDS in Ecology and Evolution* 20: 430-434.

Orr, D. 1992. Ecological Literacy. State University of New York Press, Albany, New York.

Orr, D. 2004. Earth in Mind: On Education, Environment, and the Human Prospect. Island Press, Washington, DC.

Rideout, V. J., U. G. Foehr, and D. F. Roberts. 2010. Generation M^2: Media in the Lives of 8- to18-year-olds. Henry J. Kaiser Family Foundation, Menlo Park, CA.

Rolston, H. and J. Coufal. 1991. A forest ethic and multivalue forest management. *Journal of Forestry* 89: 35-40.

Rowe, J. S. (1990). Home Place: Essays on Ecology. NeWest Publishers Limited, Edmonton, Alberta.

Savage, C. 2011. Prairie: A Natural History. Greystone Books, Vancouver, BC.

Simmons, D. 1998. Using natural settings for environmental education: perceived benefits and barriers. *Journal of Environmental Education* 29: 23-31.

Tuan, Y.-F. 1974. Topophilia: A Study of Environmental Perception, Attitudes, and Values. Prentice-Hall, Inc., Englewood Cliffs, NJ.

Tuan, Y.-F. 1976. Geopiety: a theme in man's attachment to nature and to place. Pages 11-39 in D. Lowenthal and M. J. Bowden (eds.), Geographies of the Mind: Essays in Historical Geography. Oxford University Press, New York, New York.

Tuan, Y.-F. 1977. Space and Place: The Perspective of Experience. University of Minnesota Press, Minneapolis, MN.

Walker, G. J. and R. Chapman, 2003. Thinking like a park: the effects of sense of place, perspective-taking, and emphathy on pro-environment intentions. *Journal of Park and Recreation Administration* 21: 71-86.

Williams, D. R. and S. I. Stewart. 1998. Sense of place: an elusive concept that is finding a home in ecosystem management. *Journal of Forestry* 96: 18-23.

Wells, N. M., and K. S. Lekies. 2006. Nature and the life course: Pathways from childhood nature experiences to adult environmentalism. *Children, Youth and Environments* 16: 1-24.

World Wildlife Fund Canada (WWFC). 1998. Prairie Conservation Action Plan. WWFC, Toronto, Ontario.

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Photos by Glen Hvenegaard who teaches Environmental Studies at the University of Alberta's Augustana Campus in Camrose. He conducts research on the conservation aspects of ecotourism, bird biogeography, and environmental education in the prairies. He is a father of two young boys, helps lead community conservation projects, and is developing a sense of place in the local aspen parkland natural region.

Engaging the Next Generation of Conservationists in Alberta

MYRNA PEARMAN
Ellis Bird Farm Ltd., Box 5090 Lacombe, Alberta T4L 1W7. Website: www.ellisbirdfarm.ca

Introduction

Children are spending an increasing amount of time indoors in front of screens and therefore less time being out in nature. While this trend is of concern, it is important to recognize that there are many Alberta organizations and agencies successfully implementing strategies and programs to engage children in nature. This presentation summarizes the programs that are currently being offered throughout Alberta, with an emphasis on initiatives not covered by other presenters. Specifically it will look at the services provided by wildlife rehabilitation centres, the Robert Bateman Get To Know Program, the Grounds for Change program of the Calgary Zoo, initiatives of the Alberta Council for Environmental Education, and the Deep Roots program.

The intent of the presentation is not to offer an exhaustive list of all programs, but rather to give examples to illustrate some of the diverse and creative programs currently being offered which support environmental literacy in Alberta.

Most environmental education initiatives aimed at school-aged children in Alberta are designed to complement the Learning Objectives of Alberta Education. A summary of these topics for each grade is summarized below:

ECS:	Environmental and Community Awareness
Grade 1:	Needs of Animals and Plants; Senses; Seasonal Changes
Grade 2:	Small Crawling and Flying Animals
Grade 3:	Animal Life Cycles
Grade 4:	Plant Growth and Changes
Grade 5:	Wetlands
Grade 6:	Trees and Forests
Grade 7:	Interactions and Ecosystems
Grade 9:	Biological Diversity
Grade 11:	Ecosystems and Impacts

National Parks

Alberta is fortunate to have several National Parks within its boundaries. Each park offers its own unique environmental education programs. The program outlines listed below are targeted at children and are in addition to the learning opportunities provided by park interpreters to adult visitors.

Waterton National Park offers several school programs: ‘Three of the Little Wonders walk’, ‘Discover the Magic of the Many Creatures Living in the Maskinonge Wetland’, ‘Bertha Trail Hike’ and ‘A Bear's View Hike’.

Banff National Park provides Edu-Kits for hands-on environmental learning opportunities, has a program which immerses Banff school students in a science-based curriculum program that ’opens their eyes to the natural environment beyond their doorstep’, and provides Discovery Packs which can be rented by visitors to complement their walk around the park.

The Palisades Stewardship Education Centre (PSEC) in Jasper National Park delivers innovative, experiential education programs that empower youth through connection to their natural and cultural heritage. The goal of their programs is to assist students to connect with nature and the cultural stories of place and to embrace the values of protected areas. PSEC offers outreach programs to other National Parks and Historic Sites and has also established a number of partnership programs.

Learning experiences offered by Elk Island National Park include ‘Living Classroom’ field trips, including ‘National Treasures and Wetland Wonders’ for Grade 5 and FIT (Forest Investigator Team) for Grade 6.

Provincial Government Agencies

Alberta Parks offers hands-on school programs that enrich the experience of place and highlight the importance of protected areas. Provincial parks are ‘outdoor classrooms’ with the power to inspire students. Enthusiastic environmental educators deliver curriculum-based programs in 19 parks across the province to over 55,000 students. Examples of programs offered include Parks in the Classroom programs, educational video conferencing, geo-caching, snowshoeing adventures, family workshops, ‘Family Discovery Packs,’ and ‘Moms and Tots’ programs. One unique facility in northern Alberta is The Boreal Centre for Bird Conservation, located in Lesser Slave Lake Provincial Park. It is a bird banding facility which offers educational programs related to bird banding as well as regionally specific school programs related to bears and the boreal forest. In Calgary, the Fish Creek Environmental Learning Centre provides outdoor education programs in one of Canada’s largest urban Provincial Parks.

Alberta Environment and Sustainable Resource Development (AESRD) also has several initiatives such as Environment Week, Waste Reduction Week, and The One Simple Act School Toolkit. The department has an extensive Resource List and offers a wealth of free teaching resources.

National and International Organizations/Programs

There are a number of national and international organizations, agencies and programs that can effectively engage Alberta children in nature-based activities. Scouts Canada and Girl Guides Canada both have excellent nature-based programs for youth, as does Junior Forest Wardens. Citizen Science programs such as Project FeederWatch, NestWatch and the Great Backyard Bird Count (sponsored by Cornell Lab of Ornithology, Bird Studies Canada and other partners) can be used at home or in the classroom, as can the programs offered by the National Wildlife Federation (which has a goal to get ten million kids outdoors). The Canadian Wildlife Federation also has a number of youth-based programs: Wild Education, Project Wild, Below Zero, WILD Classes, Dance for Wildlife, Habitat 2020, Backyard Habitat. Nature Canada also has a number of programs, including Nature Explorers (goal to get over a million children and their families in the outdoors), My Parks Pass (free parks passes for 400,000 Grade 8 students), and NatureWatch (a suite of citizen science projects). Nature Canada also encourages families to join local naturalist clubs, of which there are about 40 in Alberta. Other national and international programs include the Child and Nature Network, The Child-Nature Alliance of Canada, the Nature Clubs for Families, and Forest School Canada. More details of these programs can be found on their individual websites using Google Search.

Academic Support

Recognizing the need for academic support for environmental educators, the Canadian Centre for Environmental Education (CCEE), which is a partnership between Royal Roads University and Environmental Careers Organization, offers training and educational needs of the expanding labour market in the environmental sector. There are also courses/programs offered at Alberta universities and colleges which focus on environmental education.

'Made in Alberta'

Complementing the above-mentioned agencies/programs are several Alberta-specific programs and initiatives. The Alberta Recreation and Parks Association supports child-nature initiatives and facilitates Cliff Lacey's Alberta Child-in-Nature blog – a blog that keeps subscribers updated on child-nature happenings in the province and beyond. Nature Alberta has recently launched the Young Naturalist Club in Alberta, a family-based outdoor/nature program which is delivered by local naturalist clubs throughout the province. The Take Me Outside program, inspired by Colin Harris's nine-month run across Canada, seeks to raise awareness about the importance of children getting outdoors. Evergreen Theatre is an Alberta-based theatre company that performs environmental-themed productions in schools across the province. There are also provincial citizen science programs such as, AESRD's Amphibian Monitoring Program and Nature Alberta's Alberta Plant Watch which are suitable for children.

On the local front, there are several organizations in central Alberta that are at the forefront of environmental education programs. I have worked at Ellis Bird Farm, a private bird sanctuary located north of Red Deer, for close to thirty years. We have over 11,000 visitors during the 15 weeks that we are open during the summer, including 1,200 school children. Our programs are curriculum-based and involve hands-on nature experiences, (e.g., examining owl pellets, dip netting, bird box/bumble box building). We host events such as a Bluebird Festival and Bug Jamboree, day camps, nature day camps, grandparent's days and birthday parties, all themed around nature exploration. Our use of webcams on owl, tree swallow and purple martin nests as well as in our beaver lodges provide unique educational opportunities for students around the world.

The Waskasoo Environmental Education Society, which operates the Kerry Wood Nature Centre, is also a key education centre in Central Alberta. They deliver ECS to Grade 6 programs that meet specific learner expectations for each grade level. They also offer a Nature School for Grade 4 and host other programs such as astronomy, an owl program, self-guided walks and tours. They also provide resources such as discovery kits and binoculars, for visitors, offer youth badge programs for Scouts, Guides etc., host a World Conservation Badge day, and hold sleepovers for school groups or badge-based for youth groups.

North of Red Deer is the JJ Collett Natural Area, a sanctuary administered by the JJ Collett Natural Area Foundation. It is open to the public year-round and delivers programs to local schools, especially Grade 6 classes, each spring.

Medicine River Wildlife Centre, a wildlife rehabilitation centre located west of Innisfail, uses non-releasable animals as part of their education programs, which they deliver both on-site and in classrooms around the province.

Other Nature Centres in Alberta include the Helen Schuler Nature Centre in Lethbridge, which offers programs to schools throughout the school year. Programs include dipping for aquatic invertebrates, photographing nature discoveries, learning to track local animals, creative writing and developing nature-based art. The Medicine Hat Interpretive Program, operated by the Grassland Naturalists, is delivered from the nature centre at Police Point. They offer a wide variety of curriculum-based programs and also work with different groups to tailor programming for specific needs. Their programs are conducted either at the Nature Centre or in school classes.

The Ann and Sandy Cross Conservation Area (ASCCA) south of Calgary delivers curriculum based, hands-on experiential programs to thousands of Calgary-area students each year. They offer ‘Conservation Discovery’ on-site day school programs as well as out-reach programs to schools, self-guided hikes and interpretive programs covering many badge components. They also offer Nature Safari Day Camps, a Campus Calgary/Open Minds program, and a special Grade 7-8 Citizen Science project involving the re-introduction of beavers to the ASCCA.

The City of Calgary seeks to engage its citizens in the environment. Their Family Nature Adventure Programs are designed to get the whole family outside and exploring nature through such programs as, ‘Family Birding in a Nutshell’ and ‘Going Batty at the Sanctuary.’ The city’s school programs are available to school children from preschool to Grade 12, with programs ranging from short nature explorations to full day educational programs. Programs are offered at the Inglewood Bird Sanctuary, at any City of Calgary park, in specific natural areas or in classrooms. The Ralph Klein Park, Calgary’s newest park, delivers innovative environmental education programs with an emphasis on promoting sustainability and stewardship. Drop-in programs include ‘What Bird is That?,’ ‘The Art of Nature,’ and ‘Wetland Bug Safari.’

In Edmonton, the John Janzen Nature Centre offers a wide variety of programs to schools. Examples include ‘Peter Rabbit Comes for a Visit’ (Preschool – K), ‘Snowshoe Bunnies’ (Grades 1 – 3), ‘Busy Bees and Bugs’ (Preschool - Grade 2), ‘Peek Life Cycles’ (Grades 1 – 3); ‘Pond Exploration’ (Grades 2 – 3), ‘Children's Theatre with Kaybridge Puppets: Are You My Mother?’ (Preschool - Grade 1).

The Edmonton Valley Zoo offers educational programs. The scope and reach of their educational programming will be expanded once their state-of-the art education centre opens in 2013.

The Clifford E. Lee Nature Sanctuary, located west of Edmonton, is a natural area where teachers are able to bring their students to explore the diversity of life in a marsh or learn about local plant communities. Programs available include fieldtrips, summer camps, birthday parties, special group bookings and family events.

The Devonian Botanic Garden, located southwest of the city of Edmonton and operated by the University of Alberta, has offered educational programs for the past 25 years. Their forests and gardens bring children closer to nature through interactive and exciting outdoor learning. Some of their programs include Wetland Wonders, Going Buggy, Kids and Critters, Plants and People, Trees and Forests, Wildlife of Alberta, Conserving Biodiversity, Aquatic and Terrestrial Study and Garden Tours.

Located east of Edmonton, the Strathcona Wilderness Centre offers programs that focus on outdoor recreation and environmental education. Programs include wildlife viewing, hiking, cross-country skiing, snowshoeing, canoeing, outdoor skills, nature awareness, social studies and science programs. Programs for K-12 include, ‘Lost in the Woods’ (Grades: K-3), the Grades K- 2 ‘Nature Detective’ series: Spring Fever; Fabulous Fall and Winter Wonderland, Waste in Our World (Grade 4), Discover Wetlands (Grade 5), and Orienteering: GPS (Grades 7 - 12).

Also east of Edmonton, on Beaverhill Lake, the Beaverhill Bird Observatory (BBO) promotes community interest in birds and the natural world by delivering programs which focus on children and families. Their programs include on-site demonstrations such as, mist netting, nest boxes and bird census as well as public events like their Big Birding Breakfast and Steaks and Saw-whets. The BBO also provides classroom visits and banding demonstrations at family events throughout the province (ie., Bluebird Festival at Ellis Bird Farm, John Janzen Nature Center, Miquelon Provincial Park, Migratory Bird Day Calgary).

In conclusion, Alberta youth are fortunate to have a wealth of nature-based resources and opportunities at their disposal. However, there are still challenges. Time is an issue for most young families, and access to facilities and programs can be a challenge for rural youth who live beyond bussing distance from parks or facilities that offer programs. Hutterite and native youth are two other groups that greatly benefit from nature-literacy programs but are underserved. Finally, one of the biggest obstacles to getting children outside is that 'screens' are becoming increasingly formidable in their hold over children and adults alike. The challenge for us as environmental educators is to ensure that as many Alberta children as possible are given the opportunity to experience the wonders of nature.

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ENGAGING THE NEXT GENERATION OF CONSERVATIONISTS IN SASKATCHEWAN

LACEY WEEKES and **REBECCA MAGNUS**
Nature Saskatchewan, Room 206, 1380 Lorne St., Regina, Saskatchewan S4P 2L7.
Email: info@naturesask.ca

Abstract: Regardless of the technological era we live in with screens dominating our lives and 'nature deficit disorder' becoming a common malady, many organizations are actively engaging youth in outdoor nature programs and activities throughout Saskatchewan. This presentation will provide an overview of current environmental education efforts in Saskatchewan, focusing on the unique and successful strategies implemented to engage youth in nature. Some organizations such as Meewasin Valley Authority, Nature Saskatchewan, Prairie Conservation Action Plan, Saskatchewan Burrowing Owl Interpretive Centre, Saskatchewan Outdoor Environmental Education Association, Saskatchewan Wildlife Federation, Wascana Centre Authority, and other valuable conservation/education organizations, have implemented successful programs and initiatives that will be highlighted, with the intention of sharing tools and strategies for participants.

(Editor's note: the following is a summary of the PowerPoint presentation in note form)

Nature Saskatchewan

- Non-government charitable organization
- Member-based: over 800 members & 14 nature societies
- Saskatchewan's largest volunteer-driven, non-profit naturalist organization
- 'A voice for nature in Saskatchewan'
- Stewards of Saskatchewan Program Goals
    - Habitat Stewardship
    - Site ID and Population Monitoring
    - Education and Awareness
    - Stewardship Support and Extension
- Nature Quest
    - Traditional Storytelling
    - Students building traditional sweat lodge & portaging gear through the forest
- PlantWatch
    - Over 200 citizen scientists involved, including 30 school and youth groups

Saskatchewan Burrowing Owl Interpretive Center

- Opened its doors in 1997
- Raises awareness about Canada's Species-at-Risk
    - Focuses on the Burrowing Owl (Athene cunicularia)
- Non-profit organization
- <u>Mandate</u>: to promote conservation through education, eco-tourism and stewardship

- Accomplished through:
  - In-house tours
  - Owls on Tour program
  - Day camps
  - Park presentations
- Highlight of programming is use of imprinted owls
- Over the past 5 years, the Center has welcomed ~16,000 in-house visitors, and has traveled to 250 schools reaching ~18,000 students
- Future plans include:
  - Upgrades and building expansions to extend season and accommodate more visitors
  - Provide Burrowing Owls for a breeding and release program

Saskatchewan Prairie Conservation Action Plan

- The SK PCAP partnership represents 34 organizations working towards prairie and Species-at-Risk conservation
- At Home on the Prairie objective:
  - More people are aware of and appreciate native prairie SK Prairie Conservation
- Action Plan
- The SK PCAP has been involved with many educational initiatives
  - Eco-Extravaganza (2000-2009)
  - Owls and Cows (2001-2009)
  - Prairie to Pavement (2007-2009)
- Partner involvement has been essential
  - e.g., Nature Saskatchewan, SBOIC, GNP, SWA, DUC, AAFC-AESB
- It's estimated that more than 60,000 elementary students in SK have been reached by the educational program
- Current and future programs include:
  - Pitch for Pipits and Plovers; Interactive game show
  - Taking Action for Prairie; Interactive 2 hour program for grades 6-8 students
  - Adopt a Rancher; Connects grade 10 students with a local rancher

Wascana Junior Naturalists

- Program was established in 2009
  - Gives urban youth the opportunity to learn and explore the natural world around them
- Delivered by Wascana Centre Authority
- Focuses on nature within Wascana Centre
  - 2,300 acre urban park in Regina, SK
- Junior naturalists have participated in banding, pond dipping, bird house building, and native grass seeding
- Learn about migration, diversity, species ID, etc.
- Program runs Feb.-May and Sept.-Dec., meeting twice/month for 2 hours each session

- One of the kids' favourite sessions has been the CSI: Animal Crimes session
- 'Crime scenes' are set up and the kids use their observation and ID skills to figure out what happened
- To date, 207 spots have been made available for youth aged 9-13
- Feedback has been very positive; return rate is between 50-80% of kids

Saskatchewan Wildlife Federation

- SWF delivers a variety of educational programs:
    - National Archery in the Schools Program (NASP)
    - Women's Outdoor Weekend
    - BigFOOT snowshoe loan
    - Conservation Camp
    - Mentored Hunt
    - Yellow Fish Road
- The busiest program has been NASP
    - Over 200 schools in SK participate in the program
    - 500 participants in provincial tournament
- Conservation Camp is another popular program
    - Highlights include seine netting, a deer necropsy, trapping and hide stretching demonstrations, native plant ID, and demonstration from the SK Conservation K9 unit
- The Women's Outdoor Weekend is yet another successful program
- Weekend includes fly fishing, canoeing, hunting and wildlife cooking classes
- The Yellow Fish Road Program is a nationwide effort to educate youth about local water supplies
    - Participants learn what happens when harmful chemicals, detergents, pollutants, etc. enter water systems
    - Last year, over 100 youth painted yellow fish on community storm drains to remind locals where runoff is going
    - Community residents also receive door hangers

ADVANCING ENVIRONMENTAL EDUCATION IN ALBERTA: AN OVERVIEW OF THE PROGRAM OF ALBERTA COUNCIL FOR ENVIRONMENTAL EDUCATION.

CHRISTINA PICKLES
Alberta Council for Environmental Education, 911 Larch Place, Canmore, Alberta T1W 1S5.
Email: christina@abcee.org

Introduction

The Alberta Council for Environmental Education (ACEE) works collaboratively to advance environmental education in Alberta. We are a small non-profit founded in 2005 and currently host four full time staff and a board of 11 members. In the founding documents, ACEE identified six roles for the organization:

- **Champion environmental education.** ACEE will be a voice for the advancement of environmental education, speaking in support of the need for environmental education and its role in a changing society.
- **Convene stakeholders.** ACEE will convene the environmental education community, encouraging a variety of strategic conversations, liaisons, networking, actions, and synergistic collaborations between environmental education groups.
- **Facilitate leadership.** ACEE will help create, clarify, and coordinate leadership within the environmental education community.
- **Build networks.** ACEE will develop, encourage and support networks that facilitate the exchange of information and provide opportunities for collaboration within the Albertan environmental education community.
- **Increase capacity.** ACEE will develop partnerships and mechanisms to build capacity for, and help ensure, the continual improvement of environmental education groups.
- **Connect the community.** ACEE will work with all interested environmental education providers to promote resources, services, and events to the widest possible audience of Albertan educators; and connect Albertan environmental education efforts to relevant national and international networks, resources, and activities.

Goals of the ACEE

Our vision is that Alberta is a leader in environmental education, with citizens that are informed and motivated to live more sustainably, be responsible stewards of the environment, and help ensure future generations' quality of life.

ACEE works with two definitions of environmental education:

1. Environmental Education helps children and adults develop knowledge, values, skills and behaviors that help them meet present-day needs without compromising the well-being of future generations.
2. Environmental education is a learning process that:
   - Increases peoples' knowledge and awareness about the environment and associated challenges;
   - Develops the necessary skills and expertise to address these challenges, including critical thinking skills; and

- Fosters attitudes, motivation, and commitment to make informed decisions and take responsible action.

Environmental education is not just for children but all Albertans at any stage of their life.

ACEE supports individuals and organizations delivering environmental education programs in the province. We have divided our audience into two main groups: teachers in the formal K-12 education systems and agency professionals who deliver environmental education programs to all Albertans. Our programs and services address the needs of these two audiences.

ACEE Resources

To facilitate the search for quality environmental education resources in Alberta, ACEE created an on-line, searchable resource database (http://www.abcee.org/resources). Currently, there are 550 resources from over 110 organizations listed in the database. Users can search by topic, audience, curriculum, type of resource, and area of the province. Although many of the resources are directed to teachers in the K-12 education system, there are also resources posted for all audiences.

Teachers can integrate environmental education into their classrooms in many different ways, and to help teachers find the connections between the curriculum and environmental education, ACEE created the teacher toolkit (www.abcee.org/toolkit). This on-line tool is broken down by grade and shows the teachers the curriculum links, resources and teaching examples they can use to integrate excellent environmental education into their classrooms.

One of the most effective ways to help encourage teachers to deliver more environmental education in their classrooms is to provide them with professional development that will increase their skills in this area. ACEE promotes professional development provided by other organizations as well as delivering sessions at teachers' conventions and conferences on various environmental education topics.

ACEE Projects and Programs

The final major program that focuses on the K-12 education system is our work with Alberta Education. Over the past 3 years, Alberta Education has been looking at the education system as a whole and considering how to improve it. ACEE saw this as an important opportunity to ensure quality environmental education is included in this new direction. As part of this, we have recently completed a draft of the Environmental Education Framework (www.abcee.org/our-work/eef). It lays out what an environmentally literate person looks like and how this would translate into the K-12 education system. In the spring of 2013, ACEE will be seeking feedback on this document from Albertans before it is submitted to Alberta Education.

Since 2008, ACEE has been hosting an environmental education leadership clinic (www.abcee.org/leadershipclinic) sponsored by Cenovus Energy. This is a three and a half day event attended by teams of three to four individuals who are working together towards a specific goal. At the clinic, each team creates a plan to accomplish their goal. ACEE provides the structure, facilitation, professional development, and follow up support the teams need to help them create and implement their plan. Eight teams are selected to attend this fully funded leadership clinic, applications opens in the spring and the clinic takes place in November of each year.

In the fall of 2012, ACEE initiated a program of Communities of Practice for Environmental Educators in Alberta (www.abcee.org/cop) around five topics: Water Education, Waste Education, Land Use/Conservation

Education, Outdoor Education and Climate Change/Energy Education. By supporting the convening and on-going interaction of environmental education groups in Alberta, ACEE would like to increase collaboration and connections between the many different groups delivering programs in the province with the goal of increasing efficiencies and advancing work on these important topics.

Conferences are important events that celebrate accomplishments and energize communities. ACEE has received funding from Tervita to host environmental education conferences for the next three years starting in 2013 (www.abcee.org/conference). The Earth Matters Conference will be held April 25-27 at the Radisson in Canmore. This year, the keynote address will be from Richard Louv, author of *Last Child in the Woods*.

ACEE keeps in contact with environmental educators across the province using several different avenues. Our website details all our programs and initiatives as well as lists resources that support environmental educators in the province. ACEE releases an on-line newsletter every month, one for teachers and a second for agency professionals. These newsletters list resources, programs, conferences, funding opportunities and much more. ACEE also has an active Facebook page where programs and resources are shared.

Conclusion

The Alberta Council for Environmental Education is a young and growing organization. We are inspired and encouraged by the amazing work being done by environmental educators, outreach specialists, engagement leaders and teachers across the province. Our goal is that our programs and services will help them do their job more effectively and efficiently and that we can all work towards advancing environmental education in Alberta.

From Asphalt to Agroecology: Redesigning Schoolyards for Ecological Encounters

MICHELLE DRISSLER
Calgary Zoo, 1300 Zoo Road NE, Calgary, Alberta T2E 7V6. Email: michelled@calgaryzoo.com

Abstract: During their elementary school years, students spend about 6200 hours at school. With some creativity and a few changes to schoolyards, a fair number of these hours can be opportunities for nature encounters. Unfortunately, typical turf/asphalt-based schoolyards do little to provide material for hands-on, cross-curricular learning or spaces for creative play and reflection. Since 1998, the *Grounds for Change Program* at the Calgary Zoo has been working with Calgary schools to re-imagine their schoolyards. Using native and food plants these areas can be transformed into mini ecological reserves that provide stimulating informal and formal learning opportunities. This presentation will provide examples of schoolyard projects and how they are being used to create ecological literacy.

Introduction

Since 1998, the Grounds for Change program has been helping schools redevelop schoolyards. Schoolyards offer one answer to the challenge of getting children reconnected with nature, simply due to the land base and total time children spend at school. However, a simple concrete or turf schoolyard does not allow many chances for nature encounters.

Redesigning a schoolyard with native and/or food plants is one way to make them more engaging and encourage nature interactions while at school. This paper will discuss examples of Calgary-based schoolyard naturalization projects, food gardens and combinations of the two. It will also highlight some programming based around the projects and the potential for programming in mixed native and food plant projects.

Schoolyard Potential

In Calgary, children spend approximately 6200 hours in classes over their elementary years (k-6) (CBE 2012). Combined with their recess and lunch breaks of approximately 1 hour/day, this offers significant potential for children to interact with natural spaces. Schoolyards often have a significant land area. In a GIS analysis of three USA states, schoolyards were estimated to cover more than 68% of schoolyard property, averaging about 1-2.5 ha in size (Shulman and Peters, 2007). Thus, schoolyards have a fair amount of available space for potential conservation of local ecology.

Schoolyard Naturalization

The definition of naturalization used by the Grounds for Change Program is the process of using local plant material to create an area of structural and botanical diversity within the grounds of a school for educational, social and environmental benefits (http:/www.calgaryzoo.com/schoolyard_ naturalization). Before naturalization the schoolyard is simple turf (Figure 1), potentially requiring water and chemical inputs for its upkeep and not inspiring many outdoor activities. Figure 2 shows the yard with a naturalized area, in which the school has planted a variety of native plant species, included rocks representing the geology of Alberta and provided pathways to encourage children to interact with these elements while still preserving plant life.

Figure 1. Simple turf schoolyard before naturalization.

Figure 2. Naturalized portion of a school yard.

Many other projects have been undertaken in Calgary with the total number of schoolyards planted being over 90. Some have simple projects, approximately the size of a traditional man-made playground while others are the size of almost the entire schoolyard. As well as plants, projects have included elements like murals, mosaics, teepees, inuksuks and informative signs. Some projects have included man-made play structures within the planted area, challenging the compartmentalization of play areas.

Schoolyard Gardens

Several schools in the Calgary Area have also undertaken schoolyard gardens. Many have chosen to go with standard raised beds, while others have planted into mounds of earth, modified raised beds or simple planters (Figure 3). Simple planters may be a good option for schools where support is lacking from the general school body or school boards are concerned about the future maintenance of projects.

Figure 3. Raised bed.

Combined Projects

Some schools have added food plants into their existing naturalized areas, while others have designed projects to incorporate both elements from the start. Altadore Elementary School, for example, added potatoes into their school planting. Haysboro School designed a project based on a dreamcatcher, which features planter boxes as the centre and native plants as the feathers (Figure 4).

Figure 4. Dreamcatcher concept design.

Teaching and Learning in Schoolyard Projects

All of these different schoolyard projects provide the opportunity for curriculum-based education. During the planning phase teachers can link many topic areas to development, which helps keeps students involved in what is often a two - three year process. Grounds for Change has developed a program called the *Seedlings Program,* which models activities for classes at their schools that relate to the naturalization of their schoolyard. Language arts topics include spelling and brainstorming garden words or developing and completing surveys, art projects may be based on garden models or elements, math projects can be based on data compilations and science projects on baselines of soil quality and animal, plant and insect life.

Once developed, projects can be used for all types of study as well. The *Groundworks* program models curriculum-based learning for schools with completed projects. Kindergardeners explore concepts such as shape and texture in the outdoors. Grade 2s may do integrated studies such as oral story telling with a basis of cultural and ethno-botanical facts. Most grades can do science projects based on insects and insect homes, such as the discovery of an insect gall (see Figure 5).

Figure 5. Student discovering an insect gall.

Food gardening projects may specifically involve children in the discovery of nutritious food. As well, there is the opportunity to talk about food systems – where food comes from, energy inputs and social factors involved in distribution. Students may discover the joy of planting and there is the possibility of manipulating system elements (agroecology) without heavy consequences for plant loss. Finally food gardening projects in Calgary often require ongoing cooperation between communities and schools to allow for plant care during the months of July and August.

The benefits of combining both types of schoolyard projects include a strong opportunity for year-round involvement such as winter use of the native trees and shrubs and spring time ability to manipulate the garden via food plants. The combination also allows for the creation of microclimates, possible soil enrichment and companion plantings between a greater diversity of species. Finally, combinations of both expose children to a wide variety of gardening skills that they may be able to bring to their family garden and to future property ownership.

Conclusion

As involvement with nature decreases, schoolyards may present a very viable opportunity for children to reconnect with nature. Through native plant and food gardens children can explore a variety of current curricular topics in the outdoors and in a way that is hands-on. The Grounds for Change program hopes to continue to inspire schoolyard change in order to conserve and teach the next generation about local ecology.

Literature Cited

Calgary Board of Education (CBE). 2012. 2012-2013 Traditional Calendar. CBE website: http://www.cbe.ab.ca/calendars/PDF-Docs/2012-2013-Traditional.pdf. Last accessed February 14, 2013.

Schulman, A and Peters C. 2007. GIS analysis of urban schoolyard landcover in three U.S. cities. Urban Ecosystems. http://www.princeton.edu/~cap/papers/Schulman%20Peters%20urban%20ecosysems.pdf. Last accessed February 14, 2013.

BEST PRACTICES FOR CONNECTING YOUTH WITH NATURE THROUGH THE ARTS

M. KRUPA-CLARK[1] an**d GORDON COURT**[2]
[1] Get to Know Program, BC. Email: mclark@gettoknow.ca; Phone: 250-980-3969
[2]Alberta Sustainable Resource Development, 9920-108 St., Edmonton, Alberta T5K 2M4.
Email: gord.court@gov.ab.ca; Phone: 780-422-9536

Abstract: The creative arts provide a powerful conduit for helping youth develop meaningful personal connections to nature and to their neighbours of other species. By encouraging youth to develop these connections from an early age, we can instill in them a desire to spend more time outdoors and to take an active role in conserving the environment in their communities. The Get to Know Contest, Best Practices Page, OISEAU mobile app, Hikes for Health, BioBlitzes, Art in the Park Day, Flash Art Mobs, and other resources can be used by organizations looking to complement their existing education/outreach programming and boost awareness and participation in these programs. Get to Know is a collaborative model that seeks to provide youth with an engaging gateway 1) to nature and 2) to the programs offered by our partners. This session will present a ready-to-use, place-based toolkit, applicable to diverse audiences and settings; the toolkit includes strategies for using the creative arts to incentivize young people and their families for getting outdoors and (re)connecting with nature and their neighbours of other species, right in their own communities. The session will also present cutting-edge research about using the arts and technology to connect youth with nature, including findings from a ground-breaking formal evaluation of the Get to Know Program (by Dr. Patricia Winter of the U.S. Forest Service Pacific Southwest Research Station).

For more information about these resources please visit www.gettoknow.ca

Other Key Links:

Get to Know Contest Homepage: www.get-to-know.org/contest/canada/
Get to Know Educational Resources: www.get-to-know.org/education/
Get to Know Research Page:www.get-to-know.org/research/
Get to Know OISEAU: Agents of Nature Mobile App: www.get-to-know.org/oiseau/
Get to Know Facebook Page: www.facebook.com/GetToKnow
Get to Know YouTube Channel: www.youtube.com/user/gettoknowprogram/videos

COMMUNITY ENGAGEMENT IN BIODIVERSITY MONITORING AND HABITAT ENHANCEMENT PROJECTS IN CENTRAL ALBERTA - PARTNERING BUSINESS AND CONSERVATION.

C.E. PRIESTLEY and **D.L.TAKATS PRIESTLEY**
STRIX Ecological Consulting, Box 1013, Tofield, T0B 4J0 Alberta. Email: chuck@strixecological.ca.

Abstract: Lafarge Canada Inc. is a member of the Wildlife Habitat Council (WHC), a nonprofit, non-lobbying group of corporations, conservation organizations, and individuals dedicated to restoring and enhancing wildlife habitat. WHC helps large landowners, particularly corporations, manage their unused lands in an ecologically sensitive manner for the benefit of wildlife. Habitat projects vary in scope, but are corporate-driven cooperative efforts between management, employees, community members, local conservation groups and local, state/provincial and federal agencies. During 2010, 2011 and 2012 we participated in a variety of community engagement initiatives including delivering presentations at schools and community events and hosting on-site events to showcase first-hand biodiversity monitoring and habitat enhancement projects at active gravel mine sites. In 2011, we partnered with the Parkland School Division and during program planning we worked alongside Parkland's curriculum facilitator and teachers to ensure that outreach content met learning objectives. The goal of the partnership was finding new and meaningful ways to engage and involve local students with Lafarge's Biodiversity Program and use local examples to help students learn biodiversity and ecosystem concepts. Content delivered during school visits described local research, monitoring and conservation projects. Common messages we tried to convey were, 'science-based projects are happening locally', 'Alberta is fortunate to support a variety of interesting wildlife and ecosystems', and 'conservation initiatives and management projects can ensure that people and wildlife can thrive alongside each other.' During community engagement activities we had the opportunity to interact directly with more than 3,000 people who live in the communities around two of Lafarge's active mine sites.

Background

Lafarge Canada Inc. is a member of the Wildlife Habitat Council (WHC), a nonprofit, non-lobbying group of corporations, conservation organizations, and individuals dedicated to restoring and enhancing wildlife habitat. Created in 1988, WHC helps large landowners, particularly corporations, manage their unused lands in an ecologically sensitive manner for the benefit of wildlife. Habitat projects vary in scope, but are corporate-driven cooperative efforts between management, employees, community members, local conservation groups and local, state/provincial and federal agencies. WHC also works to broaden understanding of wildlife values through the incorporation of environmental education, volunteer participation and community outreach programs (Wildlife Habitat Council 2013).

In order to meet its commitments made as a member of WHC, Lafarge established a Global Biodiversity program (Lafarge 2012) with the following specific objectives:

1. Monitor and ensure the persistence of biodiversity at the Berrymoor Pit and Onoway Wash Plant.
2. Enhance and create habitat for wildlife on and around the Berrymoor Pit and Onoway Wash Plant.

3. Create opportunities for Lafarge employees, employee families and community members to participate in wildlife projects and help build awareness of wildlife that use the Berrymoor Pit and Onoway Wash Plant.

Lafarge has identified the goals of ‘continually improving environmental performance’ and ‘seeking ways to preserve heritage, landscape and biological diversity’ in its operations. Outreach efforts have enabled Lafarge to demonstrate ways that it has been working toward achieving these goals in tangible ways. Here we report results from the community engagement portion of Lafarge's Biodiversity Program.

Program Overview

During 2010, community engagement involved a combination of school presentations and participation in local community events. A presentation was made during Environment Week to all the students and staff at Elmwood School in Edmonton. After the presentation a live Barred Owl (*Strix varia*) was shown to the group. A presentation was made to the grade seven students at High Park School in Stony Plain and to a grade four class at Graminia Elementary School near Devon. After the presentations, students met a live Barred Owl. Lafarge employees, their families and community members were invited to attend a Biodiversity Day event at Berrymoor Pit. During this event we presented information about Lafarge’s Biodiversity Program and showed attendees live Barred and Burrowing Owls (*Athene cunicularia*). With the help of a spotting scope, the group also had an opportunity to view the Bald Eagle (*Haliaeetus leucocephalus*). An open house was also organized for the Onoway Wash Plant, during which the team was on-site to discuss the Biodiversity Program, to share pictures, and show a live Burrowing Owl.

After the delivery of a school presentation in 2010, Parkland School Division staff expressed interest in making the Biodiversity Program accessible to additional schools across the Division. The Division serves more than 58,000 residents in an area of over 3,995 km^2 and manages 22 schools.

Our team entered into formal discussions and a planning process with members of the Parkland School Division administration during 2011. The goal was finding new and meaningful ways to engage and involve students with Lafarge's Biodiversity programs and use local examples to help students learn biodiversity and ecosystem concepts.

A document "Summary of Potential School Presentations" was developed and distributed to staff at schools in the communities surrounding Berrymoor Pit and Onoway Wash Plant. The document conveyed that presentations were designed to help teachers meet curriculum objectives. Content delivered during school visits described local research, monitoring, and conservation projects. Local examples illustrated that science was not a distant or abstract concept. Common messages conveyed were, ‘science-based projects are happening locally, Alberta is fortunate to support a variety of interesting wildlife and ecosystems, and conservation initiatives and management projects can ensure that people and wildlife can thrive alongside each other.’

Three presentations tied directly to our biodiversity monitoring programs were developed. Most presentations were delivered using a combination of a PowerPoint presentation, an interactive game designed to revisit content covered, and a visit with a live animal such as a Barred Owl – a popular bird with audiences and one which is currently considered a priority species for guiding effective forest management in Alberta. Biologists also brought wildlife field equipment to show students various technologies used during fieldwork.

From the document "Summary of Potential School Presentations", presentation topic summaries for schools and community events are listed below.

Raptors of Alberta

Raptors including eagles, hawks, falcons and owls are fascinating. Alberta is fortunate to support a variety of raptors at all times of year. Each has its own unique and interesting story. For example, the ghost-white Snowy Owl (Bubo scandiacus) *leaves its arctic breeding ground to travel down to places like central Alberta to spend the winter. Bald Eagles have a varied diet and can be found across the province especially near large water bodies and along rivers. Owls have unique adaptations for hunting at night. In order to maintain their position at the top of the food chain, raptors have specialized adaptations such as sharp locking talons, misshapen eyes (from a human point of view) and razor-edged feathers. These topics are among those discussed during our 'Raptors of Alberta' presentation.*

Bats and other Creatures of the Night

Despite being very common and critically important, bats are not commonly encountered in Alberta. Most bats are nocturnal aerial insectivores that locate and hunt prey using echolocation. Most aerial insectivore birds, such as swallows, do not hunt at night. For this reason, the nocturnal habits and specialized adaptations of bats allow them to access food resources without a lot of competition from other species. Throughout most of the world, with the exception of the North and South Pole, bats play important roles in ecosystems. They help regulate abundances of invertebrate populations, pollinate flowers, and disperse seeds. Learn about the variety of bats found in Alberta including the common and widespread Little Brown Bat (Myotis lucifugus) *and the large orange-coloured Hoary Bat* (Lasiurus cinereus)*. Bats also use hibernation to survive through winter. Hear about local research, monitoring and habitat enhancement projects designed to meet the needs of Alberta's bats.*

Amphibians and other Wetland Wildlife

Wetlands are places that are biologically rich. They act as ecosystem filters and are critically important for human health and wellbeing. The majority of wildlife in Alberta uses or depends on wetlands during some part of their lifecycle. Amphibians have a particular connection with wetlands. These fascinating creatures start life in wetlands and as they grow they go through a full-body transformation, which enables them to become more land-based as adults. Shedding gills, which allows them to breath underwater, they develop lungs, which makes it possible for them to breathe air. Because they eat invertebrates, they have a large and important role to play in Alberta's ecosystems. Meet these and other creatures when we visit to discuss 'Amphibians and other Wetland Wildlife'.

In addition to delivering prepared presentations, we also welcomed opportunities to work with teachers and students to offer presentations on additional topics. A number of school presentations were delivered in 2011 and public outreach and engagement also occurred at community events. The team participated in Polynesian Days at Alberta Beach. Hundreds of people attended and learned about biodiversity, made a bird feeder and met a live Peregrine Falcon (*Falco peregrinus*). The team made a presentation about urban wildlife and led a nature walk near Lafarge's Edmonton office at the Virginia Park Senior's Residence for residents and Lafarge employees.

Public engagement work continued to grow during 2012. We continued formal discussions and program planning with administrative staff and teachers from the Parkland School Division. One of the outcomes was a site visit to Onoway Wash Plant by two grade five classes from Forest Green School. Students had the opportunity to see how a wash plant works, view different stages of reclamation after operations have been completed at gravel mines, and see first-hand work done for Lafarge's Biodiversity Program including amphibian and bat monitoring and habitat enhancement. The group was lead on a tour of the wetlands at Onoway Wash Plant and observed wildlife using it. They were shown how Lafarge continues to monitor water quality at the site, and the group did pond dipping for invertebrates along Kilini Creek.

Presentations, which tied directly to our biodiversity monitoring programs, were delivered in schools during 2012 and at community events. The team was invited back to participate in Polynesian Days at Alberta Beach which featured bird and frog crafts and a live Barred Owl. We organized a public event in conjunction with Northern Saw-whet Owl autumn monitoring and members of the community, students and staff from NAIT, and employees and their families were invited to participate. Courtney Whalen, a reporter from the Drayton Valley Western Review, attended the event and wrote a story about Lafarge's Biodiversity Program that appeared in the 9 October 2012 edition of the paper.

Figure 1. Searching for amphibians at Berrymoor Pit, a site located along the North Saskatchewan River east of Drayton Valley, Alberta.

During 2010, 2011 and 2012, more than 3000 people were reached through direct interactions. The audience included people who live in the communities surrounding the Berrymoor Pit and Onoway Wash Plant, Lafarge employees and their families, students and teaching professionals.

Next steps

It has been exciting to watch this program develop and grow during the past three years. Building on previous work, the following is a list of activities planned for the future:

1. Continue to deliver presentations in schools and at public events on the topics ‘Raptors of Alberta’, ‘Bats and other Creatures of the Night’ and ‘Amphibians and Other Wetland Wildlife’.
2. Continue to grow the partnership with Parkland School Division by hosting additional on-site visits at Onoway with classes from schools in the Division. In addition, host an event at Berrymoor Pit to showcase the wildlife and on-going work at that site.
3. Continue to participate in events at Berrymoor Pit and Onoway Wash Plant and at venues in the surrounding communities.
4. Create videos which showcase Lafarge's Biodiversity Program and make them available online and for use during presentations.

Acknowledgments

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Literature Cited

Larfage. 2012. Sustainability our ambitions for 2020. Lafarge Inc. website: http://www.lafarge.com/wps/portal/2_10-Ambitions-2020. Accessed on February 1, 2013

Wildlife Habitat Council. 2013. About WHC. Wildlife Habitat Council website: http://www.wildlifehc.org. Accessed February 1, 2013.

The Importance of Connecting Children to Nature

JIM ROBERTSON
Waskasoo Environmental Education Society, 6300-45 Ave., Red Deer, Alberta T4N 3M4.
Email: jim.robertson@waskasoopark.ca

Abstract: The Waskasoo Environmental Education Society is a non-profit charity that operates the interpretive program on contract for The City of Red Deer, including the Gaetz Lakes Sanctuary, Kerry Wood Nature Centre and Fort Normandeau historic site. The society also conducts city- and district-wide interpretive and environmental education programs in central Alberta. This presentation will show how a nature-based preschool program has had a long-term effect on children's attitudes towards the environment, and extrapolating from that the importance of connecting children to nature for the sake of protecting the natural environment.

WILDLIFE REHABILITATION AND ENVIRONMENTAL EDUCATION

COLIN WEIR
Alberta Birds of Prey Foundation, 2124-16 Ave., Coaldale, Alberta T1M 1N7. Email: info@burrowingowl.com

Located in Coaldale, ten minutes east of Lethbridge Colin Weir has been caring for injured raptors since 1983. Since that time, the Alberta Birds of Prey Centre has created a number of environmental education opportunities utilizing injured/non-releasable birds.

OUTREACH ACTIVITIES OCCURRING IN SOUTHERN ALBERTA

T. KUPCHENKO
Rangeland Agrologist, Alberta Environment and Sustainable Resource Development, Provincial Building, 346-3 St., SE, Medicine Hat, Alberta T1A 0G7.

Abstract: This poster is a discussion of extension/education/outreach activities occurring across southern Alberta. These events generally occur during the summer months of the year; the tours, camps and schools each have a targeted audience and are the result of extensive partnerships and collaboration. Various groups are encouraged to attend including youth, women, industry representatives, workers, consultants, ranchers, urbanites, acreage owners, academia and researchers. Specifically mentioned on the poster will be the annual Southern Alberta Youth Range Days, Women's Grazing Schools, Foothills Restoration Forums, Industry Range Health Schools, and Society for Range Management, International Mountain Section summer tours. The various groups that collaborate to make such activities successful include, but are not limited to, government agencies (such as ESRD-Rangeland Management Branch), watershed groups, municipal districts and counties, industry and NGOs. Regardless of their affiliation, all parties involved share a common goal which is to encourage an understanding and appreciation of native grasslands to the audience. By doing so we hope to foster a desire to sustain and maintain all native grasslands on which they may work/live/play. So bring your calendars for 2013! Its' going to be another busy summer of fun learning activities!!

SESSION 3: MITIGATING INDUSTRY EFFECTS ON PRAIRIE RAPTORS

TOOLS TO REDUCE AVIAN ELECTROCUTION AND COLLISION MORTALITY ON DISTRIBUTION POWER LINES IN SENSITIVE PRAIRIE ECOSYSTEMS

CINDY M. KEMPER
Avian-Power Line Interaction Specialist (Independent), Edmonton, Alberta.
Email: cindy.kemper@shaw.ca

Abstract: The influence of distribution power line (<69kV) development and operation on prairie ecosystems, and to avian Species-at-Risk in particular, can be profound. Potential impacts to the ecosystem as a whole include construction disturbance, habitat fragmentation, increased predation opportunities on Species-at-Risk, and direct mortality of raptors and other birds from electrocution and collision. The latter has been well-documented on a variety of species; however, implications of direct mortality can be exacerbated for Endangered or Threatened species, such as the Ferruginous Hawk (*Buteo regalis*). Effectiveness of mitigation strategies such as perch deterrents, alternative nest platforms, electrocution mitigation, aerial markers, and power line burial, will be discussed. The concept of implementing a voluntary Avian Protection Plan (APP) as a management tool will also be introduced. APP guidelines were formally developed through the Avian Power Line Interaction Committee (APLIC) and the U.S. Fish and Wildlife Service in 2005, and they are quickly becoming the standard for industry leaders in Canada. A detailed analysis of raptor electrocution mortality can be found in: Kemper, C.M., G.S. Court, and J.A. Beck. 2013. Estimating Raptor Electrocution Mortality on Distribution Power Lines in Alberta, Canada. The Journal of Wildlife Management 77(7):1342–1352.

Use of Avian Protection Plans during Transmission Power Line Construction and Operation in Alberta

NIKKI S. HECK

Environmental Advisor, AltaLink Management Ltd., 2611-3 Ave., SE, Calgary, Alberta T2A 7W7.
Phone: (403) 267-2134, Email: Nikki.Heck@AltaLink.ca

Abstract: Construction and operation of power transmission lines (>69kV) has the potential to impact Species-at-Risk in sensitive prairie ecosystems. Potential impacts range from habitat loss and fragmentation, and sensory disturbance, to the creation and alteration of nesting and perching sites for birds of prey and, subsequently, increased predation opportunities on Species-at-Risk. Direct avian mortality from transmission power lines is primarily due to collision with the overhead shield wire, a narrow diameter wire that protects the system from lightning damage and, to a lesser extent, electrocution. The construction of power transmission lines (>69kV) in Alberta is in the midst of major growth. This growth is due to several factors including an aging transmission system, population boom, economic growth, and the need to connect new wind generation sources in southern Alberta to the power grid. Avian Species-at-Risk, particularly those in these sensitive prairie ecosystems, are at increased risk of direct impacts due to this transmission line development if appropriate mitigation is not implemented. To address these impacts, AltaLink Management Ltd., Alberta's primary transmission service provider, was the first Canadian electric utility to voluntarily implement an Avian Protection Plan (APP). An APP is a management system specific to reducing avian power line impacts; the APP framework was developed jointly in 2005 through the Avian Power Line Interaction Committee (APLIC) and the U.S. Fish and Wildlife Service. While numerous American electric utilities have adopted APPs, the concept in Canada is still in its infancy. Elements of AltaLink's APP will be presented, including unique challenges and successes of implementing best practices within sensitive native prairie.

THE INFLUENCE OF LAND COVER AND INDUSTRIAL DEVELOPMENT ON FERRUGINOUS HAWK REPRODUCTIVE SUCCESS

JANET W. NG[1], ERIN M. BAYNE[1], and **TROY I. WELLICOME[1,2]**
[1] Department of Biological Sciences, CW 405, Biological Sciences Building, University of Alberta, Edmonton, Alberta T6G 2E9.
[2] Environment Canada, Canadian Wildlife Service, 9250 – 49 St, Edmonton, Alberta T6B 1K5.

Abstract: Ferruginous Hawks (*Buteo regalis*) are considered highly dependent on grasslands and negatively affected by human disturbance, yet they are found nesting in areas with high proportions of cropland and near roads, oil and gas wells, and other industrial infrastructure. Comparative reproductive success between natural and developed areas is unknown and understanding the effects of land cover and energy sector development is important because they are dominant land uses in southern Alberta and Saskatchewan. Development may result in habitat loss and degradation, which may threaten this Species-at-Risk by potentially reducing reproductive output. While grassland conversion to cropland has stabilized in Canada, energy sector development continues to increase and the related industrial infrastructure, such as wells, roads, and power lines, can alter habitat quality for Ferruginous Hawks. Our objective is to determine the influence of land cover and energy sector development on Ferruginous Hawk nesting success. In 2010-2012, we monitored ~400 nests with 0% to 100% native prairie in the surrounding landscape. Within this gradient, we also monitored nests that were in high versus low oil and gas density. We monitored the fate of each nest, sources of nest mortality, reproductive output (number of young fledged), and daily nest survival. We will compare these reproductive parameters across the gradients of land cover and industrial development and determine how they may influence reproduction. Comparing reproductive performance between natural and developed areas is essential to understanding how agricultural conversion and industrial development may affect species conservation and recovery.

INDUSTRIAL AND AGRICULTURAL INFLUENCES ON SURVIVAL OF POST-FLEDGING FERRUGINOUS HAWK

M.A. JOHNSON[1,2], ERIN M. BAYNE[1], and TROY I. WELLICOME[1,3]
[1] Department of Biological Sciences, CW 405, Biological Sciences Building, University of Alberta, Edmonton, Alberta T6G 2E9.
[2] AltaLink Management, Edmonton, Alberta.
[3] Environment Canada, Canadian Wildlife Service, 9250 – 49 St, Edmonton, Alberta T6B 1K5.

Abstract: Increasing pressure from development and conversion of native rangeland into cropland contribute to habitat loss and degradation for many species. Ferruginous Hawks (*Buteo regalis*) have experienced significant population declines and have recently been uplisted to Threatened nationally, Endangered in Alberta, and apparently secure (S4) in Saskatchewan. Although various factors including habitat alteration have been linked to population trends, the post-fledging period is often not understood nor considered when developing recovery and management plans for avian species, even though this period exhibits high mortality rates, and understanding factors that influence juvenile survival could be a key component in reversing declines. Therefore, in 2011 and 2012, we tracked a total of 98 hawks to determine if the composition of landscape features (including agricultural-use type, road density and electrical powerline density) can predict areas of high mortality risk for juvenile Ferruginous Hawks. Landscape composition around nest sites and morphometric features of fledgling hawks were analyzed as indices of parental care, to determine if these variables predict mortality. Preliminary analyses indicate mortality rate for juveniles was 38% and most of the mortalities occurred within 3km of the nest. Mortality rates were highest in native rangeland and cropland with main causes including predation (Great-horned Owls (*Bubo virginianus*) and Coyote (*Canis latrans*)), vehicle strikes, starvation and probable powerline collisions. Our study suggests that juvenile mortality is correlated with human activities and the placement of industrial features and artificial platforms on the landscape may mitigate juvenile Ferruginous Hawk mortality rates.

SESSION 4: PRAIRIE BIODIVERSITY MONITORING

STATUS OF BIODIVERSITY IN ALBERTA'S GRASSLAND NATURAL REGION

JIM HERBERS
Alberta Biodiversity Monitoring Institute, CW 405 Biological Sciences Building, University of Alberta, Edmonton, Alberta T6G 2E9.

Abstract: The Alberta Biodiversity Monitoring Institute (ABMI) is an arm's-length, value-neutral, scientific organization that measures and reports on the health of Alberta's wildlife and biodiversity. The core business of the ABMI is to provide scientifically credible information to management systems in order to establish baselines and outcomes for wildlife and biodiversity. The four major monitoring initiatives that the ABMI currently has operating in the Grassland Natural Region are a terrestrial program, wetland program, winter mammal program and human footprint monitoring program. Data collected from these initiatives are being used to report on the status of biodiversity in the south and to support scientific activities related to cumulative effects management, land use planning, and climate change adaptation. We will report on the status of biodiversity in the Grassland Natural Region using data from hundreds of species of native vascular plants, non-native vascular plants, landbirds, and soil invertebrates. We will also report the status and trends in human footprint across the prairies in the past decade. The role of the ABMI in the new provincial monitoring system will be discussed. Land Use/Regional planning - The ABMI is a long-term regional monitoring program that measures and reports on the status of species, habitat and footprint across the province including the prairies. Data from the institute are free and can be used to help formulate practical and applied research programs related to conservation and Species-at-Risk. A strong relationship between the ABMI and the research community will greatly enhance the knowledge base that supports major land use planning and conservation decisions.

ASSESSING THE VULNERABILITY OF ALBERTA'S NATIVE SPECIES TO CLIMATE CHANGE

A. NIXON, C. SHANK, D. FARR,
Alberta Biodiversity Monitoring Institute, CW 405 Biological Sciences Building, University of Alberta, Edmonton, Alberta T6G 2E9.

Abstract: Increasingly, climate change is being recognized as a clear threat to biodiversity, both globally and in Alberta, prompting natural resource managers to consider incorporating this risk in their management plans. The Alberta Biodiversity Monitoring Institute is leading a collaborative project to develop essential knowledge to support the management of Alberta's biodiversity under future climate scenarios and promote successful adaptation in a changing climate. A critical first step is to determine which of Alberta's native species are most vulnerable to climate change and identify patterns of vulnerability that may be used to inform policy and management. We are currently evaluating the vulnerability of more than 150 of Alberta's species to climate change using an assessment tool developed by NatureServe. We will present 1) an overview of this tool and its application to Alberta species, and 2) initial results from these assessments that describe the vulnerability of each species to climate change and provide insight into broader patterns of species vulnerability associated with geography, taxonomy, and 'at risk' status. The results from this assessment, and the project as a whole, are ultimately intended to support the adaptation of Alberta's biodiversity management system to climate change.

Ecosystem Services Assessment for Environmental Innovation and Competitiveness

T. HABIB and **D. FARR,**
Alberta Biodiversity Monitoring Institute, CW 405 Biological Sciences Building, University of Alberta, Edmonton, Alberta T6G 2E9. Email: thabib@ualberta.ca

Abstract: Resource managers and stakeholders need access to relevant and credible systems for assessing ecosystem services and biodiversity. The Alberta Biodiversity Monitoring Institute (ABMI) is leading a collaborative project to map ecosystem services using detailed spatial models incorporating both biophysical and socioeconomic data. These models build on ABMI's existing capacity to map biodiversity using field data from a long term, province-wide monitoring program. Focal ecosystem services in the first stage of the project include water purification, forest production, rangeland production, pollination, and carbon storage. We will demonstrate three applications of this new information to emerging markets and land-use management: 1) ecosystem service stewardship reporting to support domestic and international marketing of Alberta’s natural resource and agricultural products using credible and unbiased information, 2) conservation offsets in which units of ecosystem services lost or gained from human activities can be quantified, and 3) land-use planning in which desired future levels of ecosystem services can be estimated under a range of alternative policy scenarios. The presentation relates to the conference focus on socioeconomic research by directly linking biophysical elements and processes to people living and working in Alberta’s prairies. The information developed in this project will allow for better informed decision making for land use management.

SESSION 5: ADVANCES IN WETLAND CONSERVATION

ALBERTA'S *WATER ACT* – AVOID, MINIMIZE.... WHAT ABOUT THE LANDSCAPE?

DAVE L. SCOBIE
Avocet Environmental Inc., P.O. Box 820, Station Main, Brooks, Alberta T1R 1B7.

Abstract: Alberta's *Water Act* has three tenets when addressing impacts to water bodies; Avoid, Minimize or Compensate for loss of water body function. One of the unforeseen impacts of petroleum development is the impact avoidance is having on the landscape especially when it comes to Class I and II water bodies. This presentation will give a synopsis of accepted classifications for the prairie region of Alberta, present some case studies of avoidance and offer some alternatives that may address the overall impact the current regulatory system is having on the landscape.

WETLAND SOILS OF ALBERTA; USING SITE AND SOIL INFORMATION TO IMPROVE MANAGEMENT

RON MCNEIL
LandWise Inc., #407, 210A 12A Street N, Lethbridge, Alberta T1H 2J1.

Abstract: Wetland soil information over most of Alberta generally lacks sufficient detail in both scale and information presented. Two recent initiatives provide improvements in inventories and related knowledge, particularly in southern Alberta and in the White Zone of Alberta: the Grassland Vegetation Inventory (GVI) and Wetland Soils of Riparian Plant Communities. The GVI developed by Alberta Environment and Sustainable Resource Development (AESRD) includes ten wetland site types, representing five Lentic and five Lotic wetland types. Lentic wetlands are classified by the degree of permanency, ranging from temporary to permanent water bodies. Lotic wetlands are classified according to natural vegetation structure as herbaceous, shrub, deciduous or coniferous trees. Wetlands in GVI are mapped to a minimum polygon size of 1 hectare, and cover southern Alberta. AESRD Lands Division and Cows and Fish contracted the Wetland Soils of Riparian Plant Communities project, to obtain detailed site and soil descriptions for about 100 unique plant community types in the White zone of Alberta. All soils were classified using the Canadian System of Soil Classification, and interpretations include potential for degradation, physical impairment, invasive plants, the difficulty of restoration following disturbance, and land management recommendations. Examples will be provided with a focus on Lentic wetlands in southern Alberta. Improved characterization of wetlands will allow plant ecologists and soil scientists to integrate descriptions of soils and plant communities for a more complete landscape perspective.

Alberta's Wetland Mitigation System – A Wetland Conservation Organization's Perspective

TRACY SCOTT
Ducks Unlimited Canada (DUC), Alberta. Email: t_scott@ducks.ca

Abstract: Natural wetlands provide a host of valuable Ecosystem Services to society, yet these valuable ecosystems continue to be lost despite existing provincial legislation to protect them. In this presentation Tracy will provide an overview of these Ecosystem Services including recent Canadian and Alberta research, review the status of historical and ongoing wetland loss, and discuss some of the reasons for those losses. He will share some observations gleaned from DUC's 75-year history of wetland conservation and restoration including DUC's most recent role as a Wetland Restoration Agency operating within Alberta's wetland mitigation process. Based on that experience, he will speak to some of the challenges of the current mitigation process and offer potential solutions to those challenges as Alberta moves towards the adoption of a new provincial wetland policy.

DEVELOPING SPATIALLY-EXPLICIT MODELS TO IMPROVE HABITAT CONSERVATION AND MANAGEMENT FOR WETLAND-ASSOCIATED BIRDS WITHIN THE PRAIRIE HABITAT JOINT VENTURE DELIVERY AREA

K.L. DRAKE[1], **S.D. WILSON**[2] and **J.A. CONKIN**[2]

[1] Bird Studies Canada, c/o 11 Innovation Boulevard, Saskatoon, Saskatchewan S7N 3H5.

[2] Canadian Wildlife Service, Environment Canada, 11 Innovation Boulevard, Saskatoon, Saskatchewan S7N 3H5.

Abstract: During 2008 to 2012, we conducted a study aimed at linking the occurrence of wetland-associated migratory birds to habitat characteristics at varying levels of spatial scale (e.g., marsh-specific to landscape-level habitat attributes) with the overall goal to develop spatially-explicit decision support system models that will serve efforts to conserve and manage habitats for wetland-associated birds. In the field we conducted ~7,700 point counts for wetland-associated birds at 1,430 survey stations within 67 study sites in Alberta, Saskatchewan, and Manitoba. This work occurred at 1,115 wetlands to garner information on species-habitat associations for wetland-associated birds throughout the Prairie Habitat Joint Venture (PHJV) area. We used existing spatial databases and the data from field-based point counts to generate models whereby location-specific occurrence or abundance by a species is predicted by habitat variables. For each species, we applied ordinary kriging to predict species occupancy or abundance throughout the PHJV area and we have developed first-generation decision support system occurrence/abundance maps for select wetland-associated birds within the region. This habitat-based work has provided region-wide information that (1) is used to develop tools to predict the occurrence and distribution of wetland-associated birds, (2) provides a means to investigate the value of current North American Waterfowl Management Plan conservation programs to other wetland-associated birds, and (3) benefits efforts to set PHJV bird population and habitat objectives.

SESSION 6: OFFSETS AS A TOOL FOR PRAIRIE CONSERVATION

CARBON OFFSET WORK AND INITIATIVES

P. F. JUNGNITSCH
Greenhouse Gas Offset Agrologist, Environmental Stewardship Division, Alberta Agriculture and Rural Development, 206 J.G. O'Donoghue Building, 7000-113 Street, Edmonton, Alberta T6H 5T6. Phone: 780-427-3801, Email: paul.jungnitsch@gov.ab.ca

Abstract: Carbon offsets may be one way in the future to provide income from the creation of new prairie environments. A short explanation of the origins of the carbon markets and the factors that affect them is combined with detailed descriptions of two protocols under development that may be of interest for prairie conservation. These protocols include the conversion of annually cropped land to perennial forages (Conversion to Perennials) and the restoration of drained wetlands (Wetlands). This talk showed how income from the environmental market could create an incentive for producers to create more prairie habitat.

Conservation Cropping

Overview: Conservation Cropping replaced the old Tillage protocol in the 2012-13 season. It is similar to that protocol in that it is based on direct or two pass seeding building up organic matter, and thereby storing atmospheric carbon in the soil. The carbon yield is fixed at 0.11 tonnes/acre in the Parkland area and 0.06 in the Dry Prairie. Due to increased province-wide levels of direct seeding and the present stalling of the carbon price, it has a somewhat lower payout than Tillage protocol. In addition, a system wide increase in the standard of proof has led to higher record requirements and no more allowance for historical claims. Used on a wide scale in Alberta, together with the Tillage protocol these have had over $140 million in sales so far. It should be operational at least until the next review in 2017.

Update: Generally, this protocol is working well but some clarifications are being proposed to measurements and records. While the income is low for now, getting into the system will leave a farmer set up if the carbon price increases.

Nitrogen Fertilizer (Nitrous Oxide Emissions Reduction Protocol, or NERP)

Overview: This protocol is based on improving nitrogen fertilizer efficiency by putting more in the crop and less in the air as nitrous oxide, a potent greenhouse gas. It uses the 4R system: right source, right rate, right time, and right place. The carbon harvest is variable, depending on crop yield versus nitrogen applied, the degree of nitrogen management, and the improvement over a three year record of previous yields. Substantial fertilizer savings may result as well as the carbon payment, plus the bonus of accurate agronomic records. Crops do not need to be direct seeded, but if they are, Conservation Cropping carbon payments may be collected off the same field. This protocol has been approved for some years but has not been used yet, mostly due to its complexity and the measurements and proofs required.

Update: This protocol is a work in progress. A test project was started in 2012 to get the protocol operational. The main issue is getting accurate and provable, yet practical and affordable, yield and fertilizer use measurements. Changes are being proposed to make the protocol easier to use, partly based on a revised version prepared for the upcoming Saskatchewan carbon market. The carbon yield was testing at 0.25 to 0.3 tonnes/acre. Look for the Canadian Fertilizer Institute to start a major information campaign on the 4R Fertilizer program and NERP as part of their green initiative.

Beef: Reduced Age at Harvest

Overview: Aimed at beef cattle, mostly at the feedlot end, this protocol rewards shortening the birth-to-slaughter time, which reduces methane and nitrous oxide production. Similar to the NERP protocol, the carbon yield is variable, depending on the improvement over a 3 year baseline. Feed savings should result from the earlier harvest dates, in addition to the income from the carbon payment. This protocol has also been around for a few years, and the amount of records and the need for practical methods of getting and proving them have been the main difficulties.

Update: This protocol is a work in progress. A test project was started in 2013 to see what the issues are, looking at streamlining the process and making it operational. It has been getting a carbon harvest of around 2.3 tonnes/animal. Some incentives may come out of this for the cow-calf producer.

Beef: Reduced Days on Feed

Overview: Also a protocol which looks at a shorter feeding time for cattle, but this deals only with the period in the feedlot. Similar issues to Reduced Age at Harvest are present here, but with a much smaller window of opportunity.

Update: This protocol is a work in progress. A test project was started in 2012, getting a carbon harvest of around 0.06 tonnes/head. It has been proposed that the protocol be changed to animal head/days, and greenhouse gases per kg of carcass weight.

Beef: Residual Feed Intake (RFI)

Overview: Cattle are bred for more efficient feed use, reducing methane and nitrous oxide. Carbon yield is variable. Feed savings appear to be the main benefit so far.

Update: This protocol is new this year, and has not been trialed yet. Work is needed on how to make RFI operational as a carbon system, especially with regards to the measurements and proofs.

Dairy

Overview: More efficient production of milk from dairy cattle, which reduces methane and nitrous oxide emissions. A market advantage from reducing the carbon footprint of milk is expected to be a benefit, plus feed savings and the carbon income. Another complex protocol, it would seem to be well matched to the highly managed dairy industry, but getting it operational has been difficult.

Update: This protocol is a work in progress. One trial was just completed on 50 farms in Alberta with Alberta Milk and the Atlantic Dairy and Forage institute, with a new case study underway on record keeping technologies.

Wind

Overview: Wind electricity replaces coal or natural gas fired power. Used on a wide scale, this is the second largest generator of offset carbon tonnes after the Tillage/Conservation Cropping protocols. The carbon yield is fixed, at present 0.65 tonnes carbon for every megawatt/hr generated, under a tenth of the income of the power generated. It is an easy protocol to measure and prove. Renewable Energy Certificates (RECs) sold in California have been an alternate source of green income for some operators.

Update: In 2014 it is expected that the carbon yield will be reduced by 12% as the main Alberta electrical grid gets greener.

Biogas

Overview: Biologically produced gas is used to create heat or electricity that substitutes for coal or gas-fired power. One large feedlot project has been operational and posted credits.

Update: Similar carbon yield reduction to the wind protocol in 2014 due to the greener grid.

Energy Efficiency

Overview: Carbon offsets are given for improvements in energy use. An early protocol, it was originally intended for farm operations but adopted instead by a number of industries. Research has been done to see if upgrades to barns and other farm buildings (furnaces, lights, etc.) would qualify. Problems have been with measurements and proofs, especially as improvement has to be shown from a baseline of records.

Update: There are no updates. A newer protocol that deals with improvements to energy efficiency in commercial and institutional buildings may be a better fit for farmers.

Distributed Renewable Energy Generation

Overview: Carbon credits for small scale solar and wind power. This protocol was new this past spring and has not been used yet. The generation has to be small scale (under one megawatt) and connected to the grid.

Update: No projects have been done with this protocol yet.

Afforestation Conservation (developing)

Overview: Carbon dioxide from the air is stored in trees. The current draft is for planted trees only, with the land not being in forest for at least 20 years previously, and it has to be locked into trees for at least 60 years. The trees could have been planted in 2002 or later, but the carbon would be only claimable from the start of the project, i.e., 2014.

Update: This protocol is under revision and should be up for public review in fall 2013. The ability to measure carbon from trees already planted would increase the amount of carbon harvested considerably.

Afforestation Harvest (developing)

Overview: Carbon dioxide is also stored in trees, however the trees could be harvested and the carbon would be considered to be locked into the harvested product. Here pulp has been a stumbling block because of methane produced from paper in landfills. The debate now is whether to take pulp out to move the protocol ahead more easily, or take a chance and try to get the protocol passed with pulp included.

Update: Development is ongoing.

Conversion to Perennial Forages (developing)

Overview: Land is planted to perennial forages, increasing the carbon dioxide stored in the soil as organic matter. Some form of locking the land into forages for a time will be necessary.

Update: An initial draft is nearly completed.

Transportation (developing)

Overview: Transportation efficiency improvements reduce fuel usage, which reduces carbon dioxide emissions. This protocol focuses on truck, load, route and driving modifications. It may be best suited to larger fleets. Benefits could include fuel savings as well as carbon offset payments.

Update: There is a 2014 timeframe for approval for this protocol.

Wetlands (developing)

Overview: This protocol involves the restoration of previously drained wetlands.

Update: Completed but under review.

Conclusion

Income from the carbon environmental market for farmers is still mainly limited to direct seeding, but many other carbon protocols are being worked on, including several that may help to encourage wildlife habitat.

BUREAUCRATIC SLIPPAGE AND ENVIRONMENTAL OFFSET POLICIES: THE CASE OF WETLAND MANAGEMENT IN ALBERTA

S. CLARE[1] and **N. KROGMAN**[2]

[1] Department of Renewable Resources, University of Alberta, and Fiera Biological Consulting Ltd., #200, 10318-82 Ave, Edmonton, Alberta T6E 1Z8.

[2] Department of Resource Economics and Environmental Sociology, University of Alberta, Edmonton, Alberta T6G 2H1.

Abstract: Environmental trading programs, of which wetland mitigation is a well-known example, are premised on the idea that the units being traded are in some way fungible. Well-designed trading programs consider the timing, location, duration, currency, and equivalency of the trade and despite the complexity associated with addressing these issues, these programs are seen as promising policy tools that 'balance' economic considerations with conservation objectives. However, giving agency decision-makers the discretion to make decisions or 'barter' on a case-by-case basis opens the door to inconsistent interpretation and implementation of environmental guidelines, in a process known as bureaucratic slippage. In this presentation we present clear examples of bureaucratic slippage in the Alberta wetland permitting process and maintain that the problems that lead to bureaucratic slippage, and ultimately policy failure, are fundamentally political and administrative in nature. This agency context is rarely, if ever, considered in the design of environmental trading programs. The presentation was based on the following publication: Clare, S. and N. Krogman. 2013. Bureaucratic slippage and environmental offset policies: The case of wetland management in Alberta. Society and Natural Resources 26(6): 672-687.

Southeast Alberta Conservation Offset Pilot – Voluntary Offset of Industrial Impacts to Native Prairie through Reseeding of Cultivated Lands to Native Species

K. RAVEN, **R. DUNN**, and **T. GODDARD**
Environmental Stewardship Division, Alberta Agriculture and Rural Development, c/o 7000-113 St., Edmonton, Alberta T6H 5T6.

Abstract: The Government of Alberta is championing a voluntary conservation offset pilot in south-east Alberta in collaboration with industry and landowners. The pilot is led by Alberta Agriculture and Rural Development in partnership with ACA, Alberta Innovates Technology Futures, University of Calgary, LandWise Inc., and Alberta Environment and Sustainable Resource Development. This pilot is based on a voluntary offset of new industry development impacts on private and publicly owned native prairie within the Dry Mixed Grass prairie region (Brown soil zone). This area is home to a significant number of Species-at-Risk. Participating companies will offset their impact by purchasing contracts with private landowners who are willing to convert annually cultivated land into mixed native grasses. The contracts with farmers, and establishment of the native perennial species, will be managed through a third party (NGO) as will verification and inspections to ensure success and quantify offset results. Representatives from several industries have engaged in initial pilot development workshops, with landowners to be engaged in winter 2012/13. Since this pilot is in the early stages, the presentation will focus on early experiences and needs of creating a pilot project and the key components that have been developed to date. The presentation will also highlight some of the issues and milestones ahead.

OVERVIEW OF ALBERTA'S AGRICULTURAL CARBON OFFSET TRADING SYSTEM: 2007 TO 2011

SHEILAH NOLAN, TOM GODDARD, ANGELA BENTLEY, and PAUL JUNGNITSCH,
Alberta Agriculture and Rural Development, 206, 7000 – 113 St., Edmonton, Alberta T6H 4Z9.
Email: Sheilah.Nolan@gov.ab.ca

Abstract: Alberta was the first jurisdiction in North America to regulate greenhouse gas (GHG) emissions. Alberta's *Specified Gas Emitters Regulation (SGER, 2007)* created a market between regulated companies and others who can voluntarily lower emissions by methods such as improving agricultural management practices. Government of Alberta approved offset quantification protocols which provide the basis for this carbon trade. Protocols link science based emission reductions to innovative management improvements that can be verified by independent third parties. Close to one third of all Alberta offset protocols are agricultural, representing emission reductions from improvements in cropping, livestock and energy management. Agricultural offsets represent 40% of all offsets used to meet 20% of emission reductions required by regulators to meet compliance obligations (since 2007). This has generated close to $100 million in income for farmers and aggregators in Alberta. Carbon offsets represent important opportunities to gain incentives for management improvements that lower GHG emissions, while increasing production efficiencies and improving record keeping capacity that can support access to other emerging environmental market opportunities.

USING LANDSCAPE GENETICS TO IDENTIFY BARRIERS TO ENDANGERED SPECIES

K.L. BIRD[1], **K.P. REESE**[1], and **N.W. KACZOR**[2]
[1] Department of Fish and Wildlife Resources, College of Natural Resources, University of Idaho, 709 S Deakin St., Moscw, Idaho 83844, U.S.A.
[2] U.S. Fish and Wildlife Service, Division of Refuge Planning, 134 Union Boulevard, Lakewood, Colorado 80228, U.S.A.

Abstract: Anthropogenic disturbance and habitat loss are major threats to endangered species because they impact gene flow, genetic diversity, and population size. Landscape genetics, which combines population genetic data with GIS habitat data and spatial statistics, is an important tool for understanding how disturbance impacts the genetics of species and provides important direction towards conservation and management. Greater Sage-Grouse (*Centrocercus urophasianus*) are a lekking species that have declined by 66–98% during the past 44 years in Alberta. Our goals were to determine if gene flow is positively correlated with Silver Sagebrush (*Artemesia cana*) across the landscape, if anthropogenic disturbance poses a barrier to gene flow, and if both habitat and disturbance influence how Sage-Grouse utilize the landscape and disperse between leks. We sampled 792 individuals from Alberta between 1998 to 2009 and genotyped each at 13 microsatellite loci. We found that, historically, gene flow was positively correlated with contiguous habitat corridors. Currently, males exhibit a positive relationship between gene flow and both straight-line distance and least cost distance using both habitat and anthropogenic disturbance variables. Females do not have this relationship suggesting that they have lost sensitivity to disturbance and/or utilize alternative dispersal methods, such as flying between habitat patches. Even though Sage-Grouse are Endangered in Alberta and occur in highly fragmented habitat, they have maintained genetic diversity. However, population declines in Alberta are extreme, birds on most leks have low probabilities of surviving dispersal, and habitat is becoming increasingly fragmented suggesting that if extensive habitat conservation measures are not adopted now, Sage-Grouse in Alberta are destined for extinction.

SPRAGUE'S PIPIT - PHANTOM SINGER OF THE PRAIRIES

M. DRUT, and **C. GARDNER**
Medicine Hat Interpretive Program, Police Point Park Nature Centre, Society of Grasslands Naturalists, Box 2491, Medicine Hat, Alberta T1A 8G8. Email: mhip@natureline.info

Abstract: Sprague's Pipit (*Anthus spragueii*) is a distinctive species of the Canadian prairies but few people know of its existence or realize how important remaining native prairie landscapes are to its continued survival. Reasons for their obscurity include lack of visibility in the field and the general public's perception of prairie as lacking biodiversity, especially songbirds. As a prairie nature centre, our goal is to increase awareness and understanding of this vital ecosystem and its importance to both human and non-human inhabitants. We believe this increased knowledge will lead the public, including ranchers and land managers, toward better care and concern for the prairie and its species. To accomplish this goal, the Interpretive Program obtained a grant through Environment Canada's Environmental Damages Fund. The primary source of money for this fund comes from fines paid by industry for violations of federal environmental regulations and the money can be used for research and educational purposes. We will develop and use a variety of methods to impart our message of prairie conservation using the Sprague's Pipit as an ambassador. This includes developing a travelling display to be used for public programs at different venues/events across southern Alberta, developing and conducting related school programming, producing relevant and topical digital stories, and sponsoring and/or conducting appropriate field trips. We also plan to work cooperatively with the other nature centres in Alberta on this project. Many of the outcomes from this project will be ongoing or will be reusable long past the grant period. We began preliminary work on the project in early 2012 and will present results from those experiences. We will also detail our future plans for the project through to the grant end in 2014 and beyond.

USING DIGITAL RECORDINGS TO ESTIMATE OCCUPANCY AND DETECTION OF MARSH BIRDS

K.L. DRAKE[1], R. HEDLEY[1], S.D. WILSON[2], C.M. FRANCIS[3] and J.A. CONKIN[2]
[1] Bird Studies Canada, c/o 11 Innovation Boulevard, Saskatoon, Saskatchewan S7N 3H5.
[2] Canadian Wildlife Service, Environment Canada, 11 Innovation Boulevard, Saskatoon, Saskatchewan S7N 3H5.
[3] Canadian Wildlife Service, Carleton University Campus, Ottawa, Ontario K1Z 0H3.

Abstract: Autonomous recording units (ARUs) have the potential to supplement field-based observers in ways that can test some of the assumptions of monitoring programs, and help to design more cost-effective monitoring of secretive marsh birds. We estimated detectability and occupancy for 11 species of secretive wetland-associated birds in Alberta and Saskatchewan, Canada. We set up ARUs to record continuously in the morning and evening for several consecutive days, and had field technicians conduct three to seven 15-minute field surveys at the same locations following the guidelines of the standard North American Marsh Bird Monitoring Protocols. From the recordings, we used skilled birders to analyse multiple segments at different times of day using a combination of listening and viewing spectrograms. We used occupancy analysis to (1) compare species-specific estimates of occupancy and detection probabilities derived from field surveys with those derived from analyses of subsets of the ARU acoustic surveys, and (2) to evaluate temporal and seasonal variation in detection probabilities a suite of species. For some species, occupancy estimates generated from ARUs were greater than those estimated from field surveys, while for others they were comparable. For most species, precision of the estimates (occupancy and detection probability) derived from ARU data was similar to, or higher than, estimates from the field surveys. Detection probability varied by time of day and time of season in different ways for each species suggesting that the optimal sampling period may vary among species. Sampling over multiple periods (as required to estimate detectability and occupancy) and at different times of day can be done more cost-effectively using ARUs than field observers, because the field crews only need to make two visits per season to each site, once to set up and once to retrieve the recorder, and this can be done at any time of day.

HABITAT ASSOCIATIONS OF BURROWING OWLS IN PRAIRIE CANADA: WHAT HABITAT IS CRITICAL?

T.I. WELLICOME[1,2], E. BAYNE[2], A.J.F. STEVENS[1,2], C. SCOBIE[2], A.J. MARSH[2], R.J. FISHER[2]
[1] Environment Canada, Canadian Wildlife Service, 9250 – 49 St, Edmonton, Alberta T6B 1K5.
[2] Department of Biological Sciences, CW 405, Biological Sciences Building, University of Alberta, Edmonton, Alberta T6G 2E9.

Abstract: Burrowing Owls (*Athene cunicularia*) have declined by 90% over 30 years, and they now occupy <40% of their historical range in Canada. Habitat loss may have had an important influence on the historical owl decline, yet recent rates of decline for this Endangered species have far outpaced the rate of grassland loss in Canada. From 2003-2010, in Alberta and Saskatchewan, Canada, we examined habitat associations of Burrowing Owls at multiple scales. Soil and climate indices produce the most predictive models of selection of home-ranges by Burrowing Owls, creating unique environmental conditions for owls independent of land use. When foraging within home-ranges, Burrowing Owls sometimes select for, and sometimes avoid, native versus non-native habitat types. At a fine scale, areas of successful prey capture contain high proportions of exposed ground and low overhead vegetation compared to areas available to them for foraging. Burrowing Owls do select for grassland cover (tame or native) in the immediate vicinity of their nest burrows, perhaps because more burrows are available in permanent grass than in cultivated land. Owls in Canada apparently occur, survive, and reproduce equally well in landscapes dominated by native rangeland and those dominated by cropland and introduced grasses. Factors other than grassland loss appear to be required to explain the decline of this species in Canada, though habitat change in the United States and Mexico, where Canada's Burrowing Owls migrate each year, cannot be ruled out.

EXTREME WEATHER EVENTS AND AVIAN BREEDING SUCCESS IN PRAIRIE CANADA: A CASE-STUDY USING BURROWING OWLS

R. J. FISHER[1], **T. I. WELLICOME**[1,2], AND **E. BAYNE**[1]
1. Department of Biological Sciences, CW 405, Biological Sciences Building, University of Alberta, Edmonton, Alberta T6G 2E9.
2. Environment Canada, Canadian Wildlife Service, 9250 – 49 St, Edmonton, Alberta T6B 1K5.

Abstract: Climate change scenarios predict an increase in the number of extreme weather events in North America, potentially having adverse consequences on reproductive success of many birds. Due to human-alteration of the grassland landscape, birds are also confronted with a landscape that is presumably composed of patches of varying quality. Since 2003 we have monitored over 900 nesting attempts of the Endangered Burrowing Owl (*Athene cunicularia hypugaea*) in the Mixed-Grass Ecoregion of Canada. Using a subset of monitored nests, we examined variation in daily nest survival of Burrowing Owls in native (n=621) and tame pastures (n=82) and roadside ditches (n=51), in response to precipitation, temperature, and soil texture. We also used a supplemental feeding experiment in 1992, 1993, and 1996 to examine how individual nestling survival changed in response to inclement weather. The largest source of nest failure was due to burrow flooding (32% of failures) and maximum one-day precipitation between nest visits had the largest negative effect on daily nest survival. Daily nest survival did not differ amongst habitat types. Nestlings receiving supplemental feeding survived at higher rates when exposed to heavy precipitation events compared to unfed nestlings. The youngest members of the brood succumbed to food limitation more readily compared to their older siblings. Our results suggest that exposure is not the main cause of mortality of Burrowing Owl nestlings when inclement weather occurs, but rather food limitation. Increases in the frequency of extreme weather events under various climate change scenarios could be just as influential on Burrowing Owl reproductive output and population persistence as changes in average conditions.

Annual Return Rate of Adult Burrowing Owls in Canada is Influenced by Weather during Migration and on the Wintering Grounds

R. J. FISHER[1], **T. I. WELLICOME**[1,2], **R. G. POULIN**[3], **E. M. BAYNE**[1], **D.T. FLOCKHART**[4], **J. K. SCHMUTZ**[5], and **K. DE SMET**[6].

1. Department of Biological Sciences, CW 405, Biological Sciences Building, University of Alberta, Edmonton, Alberta T6G 2E9.
2. Environment Canada, Canadian Wildlife Service, 9250 – 49 St, Edmonton, Alberta T6B 1K5.
3. Royal Saskatchewan Museum, 2445 Alberta St., Regina, Saskatchewan S4P 4W7.
4. Department of Integrative Biology, University of Guelph, Guelph, Ontario N1G 2W1.
5. School of Environment and Sustainability, University of Saskatchewan, Saskatoon, Saskatchewan S7N 5A1.
6. Manitoba Conservation, Box 24, 200 Saulteaux Crescent, Winnipeg, Manitoba R3J 3W3.

Abstract: Adult survival rate is a key vital rate needed for estimating population growth for endangered species management. In addition, understanding when and where factors influencing adult survival occur may also help prioritize conservation actions. Using a long-term (5-15 years) and geographically widespread (study areas in Manitoba [MB], Saskatchewan [SK], and Alberta [AB] covering >27,000 km^2) mark-recapture dataset, our main objective was to quantify spatial and temporal variation in return and recapture rates of Burrowing Owls (*Athene cunicularia hypugaea*). Our second objective was to relate patterns of annual adult return rates to large-scale indices of weather on the wintering grounds, weather events on the owls' migration route (storms), and prey irruptions on the breeding ground. We banded 332 males and 407 females in SK, 174 males and 195 females in Alberta, and 76 males and 68 females in MB. Female return rate was 15% lower than that of males on all study sites likely due to high dispersal rates and not increased mortality. Owls in MB had the highest return rates compared with owls in AB or SK. Prey abundance (vole or grasshopper outbreaks) on the breeding ground had no influence on return rate; rather, the number of storms during migration and rainfall on the wintering grounds had the largest negative effects on owl return rate. Climate change projections for the United States indicate an increase in the intensity and frequency of storms which could have a negative effect on future Burrowing Owl return rates in Canada. Further research is needed to determine causal mechanisms behind reduced owl return rates in relation to weather patterns on their wintering grounds. It is clear that Canadian adult Burrowing Owl return rates are influenced by a multitude of factors during migration and overwintering, suggesting that any management actions must be coordinated amongst various jurisdictions.

BRINGING BACK THE BURROWING OWL TO BRITISH COLUMBIA: A STORY OF COMMUNITY CONSERVATION

L. MEADS[1], **D. BRODIE**[2], **A. MITCHELL**[3], and **M. MACKINTOSH**[4]
[1] South Okanagan Coordinator for the Burrowing Owl Conservation Society of BC. Email: lmeads81@gmail.com
[2] Field Director for the Burrowing Owl Conservation Society of BC. Email: dawnbrodie@telus.net
[3] Science Director for the Burrowing Owl Conservation Society of BC. Email: athene.aimee@gmail.com
[4] President of the Burrowing Owl Conservation Society of BC. Email: groundowl@yahoo.ca

Abstract: The Burrowing Owl (*Athene cunicularia*) is a Species-at-Risk in Canada and was originally extirpated from British Columbia (BC) in the 1980s. Its natural habitats are the grasslands and deserts in North America. In Canada, the populations of Burrowing Owls migrate in the fall to the southern United States and possibly Mexico. With a loss of native habitat, along with the decline in burrowing mammals the Burrowing Owl populations continue on a downward trend. Starting in 1990, volunteers initiated a comprehensive program for the re-introduction of captive bred owls to the wild, including captive breeding facilities, artificial burrow networks and field monitoring research. In 2000, the Burrowing Owl Conservation Society of BC was formally created to set program direction, finance the program and increase public awareness of grassland habitat. The Society now produces over 100 owls each year to release in the Nicola Valley and South Okanagan grasslands of BC. Three breeding facilities are located separately across the province. A large volunteer team prepares artificial burrows on the private ranch land, park land and First Nation properties. Improved release techniques, including soft-release caging, has resulted in greater numbers of wild-born broods and offspring. With more owls produced, the numbers of owls returning to BC are gradually increasing each year. We are currently working internationally to follow and protect the owls on their migration route which will help with their continued success in BC and Canada. The Burrowing Owl program is an example of an applied conservation project with strong community support.

ANNUAL DISPERSAL AND IMPLICATIONS FOR CONSERVATION OF BURROWING OWLS IN CANADA

GEOFFREY HOLROYD[1], HELEN TREFRY[2], and **JASON DUXBURY[3]**

[1] Environment Canada (retired), Box 33, Site 2, RR 2, Tofield, Alberta T0B 4J0. Email: geoffholroyd@gmail.com

[2] Canadian Wildlife Service (retired), Box 176, Site 1, RR 2, Tofield, Alberta T0B 4J0.

[3] Klohn Crippen Berger, Edmonton, Alberta.

Abstract: In Canada, the Western Burrowing Owl (*Athene cunicularia hypugaea*) is Endangered and its numbers are reduced to fewer than 1,000 pairs in Canada. The number of breeding pairs declined at about 22% per year through the 1990s even though over 700 landowners voluntarily protected over 37,000 hectares of grassland habitat. Burrowing Owl populations are also in decline in other parts of western North America. In 2012, no Burrowing Owls were found nesting in the Regina Plain (Ray Poulin pers. comm.). One of the factors implicated in the Burrowing Owl's decline is its apparent low recruitment. Return rates for banded birds are about 6% for hatch year owls and 30% for breeding owls. However banding studies are limited by the ability of observers to detect bands away from their study sites. Stable-isotope analysis provides a technique to investigate annual dispersal. We compared the stable-isotope signature of feathers collected from breeding adults to those collected from nestlings across western North America. Annual breeding dispersal distance for owls was approximately 400 km indicating many owls were dispersing beyond the boundaries of study areas where owls were banded. Our comparison of the origin of owls breeding in the Canadian Great Plains with those in adjacent northern states indicated that net emigration of owls from Canada approximates the decline of the Canadian population. High rates of dispersal maybe an evolutionary response to dynamic prairie ecology or to the advent of irrigated agriculture as postulated by USA researchers. The implications of these findings on Burrowing Owl conservation will be discussed. We also recommend implementation of the Commission on Environmental Cooperation's Conservation Action Plan for the Burrowing Owl through future of cooperation of agencies in Mexico, USA and Canada (http://cec.org/Storage/59/5173_NACAP-BurrowingOwl_en.pdf).

A CONSERVATION PROJECT TO INCREASE BURROWING OWL PRODUCTIVITY THROUGH FOOD SUPPLEMENTATION AT GRASSLANDS NATIONAL PARK

GEOFFREY HOLROYD[1], HELEN TREFRY[2], **PAT FARGEY[3]** and **ASHLEY WRUTH[3]**

[1] Environment Canada (retired), Box 33, Site 2, RR 2, Tofield, Alberta T0B 4J0. Email: geoffholroyd@gmail.com

[2] Canadian Wildlife Service (retired), Box 176, Site 1, RR 2, Tofield, Alberta T0B 4J0.

[3] Grasslands National Park, Parks Canada Agency, Box 150, Val Marie, Saskatchewan S0N 2T0.

Abstract: The decline and range contraction of the Endangered Burrowing Owl (*Athene cunicularia*) in Canada are well documented. Research indicates cumulative impacts are responsible, including high nest loss and low productivity. While females lay an average of nine eggs, of which eight hatch, in Grasslands National Park, the average brood size of successful nests is 3.8 young (1998-2012). When food is limited during the first few weeks following hatch, brood reduction occurs. However, research on the Regina Plain (Wellicome 2000) has shown food supplementation through the provisioning of extra mice during the first three weeks post-hatching can significantly increase fledglings (on average 79% excluding a high vole year when all nests did well). We document the results of a pilot project in 2012 to directly increase the number of young Burrowing Owls fledging in Grasslands National Park through food supplementation. Volunteers were recruited to feed 23 burrowing owl nests twice per week in June in designated Black-tailed Prairie Dog (*Cynomys ludovicianus*) colonies, while ten nests acted as controls. The experiment was negatively affected by overall high nest failure (64 %) when the area experienced below average temperatures and above average rainfall that caused early nest failures. However, the provisioned nests that succeeded (N=5) vs the controls (N=5) produced an average of 2.2 young more/successful nest (64% increase). With cautious optimism and modifications, the goal is to continue the feeding in 2013. We also encourage other burrowing owl landlords to join the project if they are able to visit nests twice per week through the month of June.

WINTER DESTINATIONS AND ECOLOGY OF 'CANADIAN BURROWING OWLS'

GEOFFREY HOLROYD[1]**, HELEN TREFRY**[2], **ENRIQUE VALDEZ**[3] and **JASON DUXBURY**[4]

[1] Environment Canada (retired), Box 33, Site 2, RR 2, Tofield, Alberta T0B 4J0. Email: geoffholroyd@gmail.com

[2] Canadian Wildlife Service (retired), Box 176, Site 1, RR 2, Tofield, Alberta T0B 4J0.

[3] Laboratorio de Ornitología, Universidad Autónoma de Nuevo León, México.

[4] Klohn Crippen Berger, Edmonton, Alberta.

Abstract: The winter destination and ecology of Burrowing Owls (*Athene cunicularia*) that breed in Canada was unknown when this study was initiated. We identified the winter locations of owls using aerial telemetry searches of south Texas and the Gulf Coast lowlands and central Mexico for signals from VHF transmitters that were attached to Burrowing Owls in Canada; using stable isotope analysis; using light data loggers and in 2010 to 2012 using 5 g-PTT satellite transmitters. We have combined these records with all band recoveries to provide an up to date picture of what is known about winter distribution of 'Canadian' Burrowing Owls. We studied the over-winter survival, diet and habitat of the owls in one study area in south Texas, and two in central Mexico. The winter day time roosts used by the owls included vegetation, natural burrows, arroyos and wood piles. Winter habitats around roosts were also highly variable, much less open than breeding habitat in Canada but always included at least 35% low vegetation within 1 km of roosts. In the winter predators included Barn Owls (*Tyto alba*) and Short-eared Owls (*Asio flammeus*). Another owl died due to earth moving equipment. Over-winter mortality was estimated at 17-30%. Survival in winter cannot explain why only 6% of juvenile owls return to Canadian study areas.

Continental Movements of Short-Eared Owls as Shown by Banding and Satellite Telemetry Demonstrates the Importance of Prairie Canada

CHRISTIAN ARTUSO, DEBBIE BADZINSKI, TRAVIS BOOMS, JIM R. DUNCAN, MARCEL A. GAHBAUER, GEOFFREY L. HOLROYD[1], JIM A. JOHNSON, PETER NYE, and **HELEN E. TREFRY**
[1]Box 33, Site 2, RR 2, Tofield, Alberta T0B 4J0. Email: geoffholroyd@gmail.com

Abstract: Short-eared Owls (*Asio flammeus*) breed from the arctic to southern U.S. and winter from southern Canada to central Mexico. This simple range description ignores the high variability in the occurrence of this species dependent on the abundance of small mammals, their primary food. Bird banding encounters provide limited information on the species movements. Their movements have been described as irruptive. Small, 9.5 g, solar powered satellite transmitters provide continuous and real-time information on the movements of Short-eared Owls. In the past five years transmitters have been placed on this species from Alaska to eastern North America. The transmitters indicate that some owls appear to have a 'migration', but many others are ephemeral with large scale breeding dispersal. This poster will summarize a wide variety of telemetry studies across the continent and the importance of prairie Canada as a breeding area in some years.

STATUS OF PEREGRINE FALCON IN CANADA

GEOFFREY HOLROYD[1] and **CANADIAN PEREGRINE FALCON RECOVERY TEAM**
[1] Environment Canada (retired), Box 33, Site 2, RR 2, Tofield, Alberta T0B 4J0. Email: geoffholroyd@gmail.com

Abstract: Peregrine Falcon (*Falco peregrinus*) populations across southern Canada were decimated by DTT prior to 1970. The release of captive bred peregrines in the 1980s and 1990s returned the falcon as a nesting species south of the treeline. Since 1970, surveys every five years across Canada have tracked the recovery of this species. Despite the continued recovery in most areas of Canada, the populations in prairie Canada, Labrador and Yukon have not continued to grow. Few pairs of falcons nest on natural sites in the prairies; rather they are clustered in urban areas. This poster will present the results of the 2010 national survey and discuss the results in the context of regional reintroductions and recovery.

The Prairie Falcon in Prairie Canada: A Declining 'Sensitive' Species

J. CAMPBELL[1], **R. MORSE**[2], **D. ZAZELENCHUK**[3], **D. PATON**[4], **H. TREFRY**[5], and **G. HOLROYD**[6]

[1] Pincher Creek, Alberta.

[2] Edmonton, Alberta.

[3] Kyle, Saskatchewan.

[4] Anatum Consulting, Blairmore, Alberta.

[5] Canadian Wildlife Service (retired), Box 176, Site 1, RR 2, Tofield, Alberta T0B 4J0.

Email: geoffholroyd@gmail.com

[6] Environment Canada (retired), Box 33, Site 2, RR 2, Tofield, Alberta T0B 4J0.

Abstract: The Prairie Falcon (*Falco mexicanus*) is listed as a Sensitive species in Alberta. A 2002 status report (Paton 2002) estimated the Alberta population to be 200-250 pairs. This is the bulk of the Canadian population with small numbers occurring in Saskatchewan and possibly British Columbia. Its dependence on a restricted number of river nesting sites and Richardson's Ground Squirrel (*Urocitellus richardsonii*) prey make it vulnerable to cumulative changes in an already endangered prairie landscape. Systematic surveys to determine population trends for the provinces are not currently done. However, surveys have been carried out on select portions of several Alberta and Saskatchewan rivers over the past decades by volunteer banders. We present occupancy and productivity trends collected from 1970 to 2012 and discuss regional and historical changes and challenges. We also compare occupancy of artificial nest sites.

MODELING HABITAT DISTRIBUTION OF FERRUGINOUS HAWK IN SASKATCHEWAN

ZHE LI
Fish and Wildlife Branch, Saskatchewan Ministry of Environment, 3211 Alberta St., Regina, Saskatchewan S4S 5W6.

Abstract: Ferruginous Hawk (*Buteo regalis*) is considered as Threatened species in Canadian prairie region by Nature Canada. In this study we modeled habitat distribution of Ferruginous Hawk in Saskatchewan using two methods – Mahalonobis Typicality (Mahal) and Maximum Entropy (Maxent) approaches. Ten environmental variables were used including growing season NDVI (GS-NDVI), annual mean temperature (AMT), annual minimum temperature (MINT), annual maximum temperature (MAXT); annual precipitation (PCP), elevation, slope, aspect, and potential land cover occurrence frequency (PLCOF). Results indicate that MAXT, PLCOF and MINT were the most important factors in determining the distribution of Ferruginous Hawk's habitat, which contributed a total of 82.9% among all the ten environmental variables. Independent occurrence testing sites and Receiver Operating Characteristic (ROC) method were used to validate our distribution suitability maps. High AUC values (the area under the ROC curve) of 0.912 and 0.963 were achieved with a threshold of 25% for both the two approaches respectively. Results indicate that both the two machine learning approaches are promising tools for species habitat modeling.

The Impact of Human Disturbance Stimuli on Ferruginous Hawk Nesting Behaviour

CAMERON J. NORDELL[1,3], **TROY I. WELLICOME**[1,2], and **ERIN BAYNE**[1]
[1.] Department of Biological Sciences, CW 405, Biological Sciences Building, University of Alberta, Edmonton, Alberta T6G 2E9.
[2.] Environment Canada, Canadian Wildlife Service, 9250 – 49 St, Edmonton, Alberta T6B 1K5.
[3.] 5520-142A Ave Edmonton, Alberta T5A 1J8.

Abstract: Human disturbance stimuli, in the form of industry, infrastructure, agriculture and recreation, permeate the Canadian prairies. Organisms which are unable to cope with the considerable human disturbance require special conservation effort. The Ferruginous Hawk (*Buteo regalis*) is listed as Threatened federally and Endangered in Alberta. Furthermore, Ferruginous Hawks have demonstrated reduced nesting success on urbanized landscapes and are thought to respond negatively to human presence at the nest. However, the actual behavioural impacts of these disturbance stimuli are largely speculative. Our study examines the fine scale response of Ferruginous Hawks to human disturbance stimuli by installing 28 video monitoring systems at Ferruginous Hawk nests across southern Alberta and Saskatchewan in 2012. We will use video recordings to assess precise behavioural responses to disturbance, such as latency to return and changes in prey delivery rates. Additionally, we documented Ferruginous Hawk flight initiation behaviours while monitoring 250 nests in 2012. We will present preliminary analyses which are underway, as well as future directions for our research in the 2013 field season.

HOME RANGE AND RESOURCE USE OF FERRUGINOUS HAWKS NESTING IN ASSOCIATION WITH ENERGY DEVELOPMENT

J. WATSON[1], **TROY WELLICOME**[1,2], and **ERIN BAYNE**[1]
[1] Department of Biological Sciences, CW 405, Biological Sciences Building, University of Alberta, Edmonton, Alberta T6G 2E9.
[2] Environment Canada, Canadian Wildlife Service, 9250 – 49 St, Edmonton, Alberta T6B 1K5.

Abstract: Studies have shown historical declines in Ferruginous Hawks (*Buteo regalis*) throughout Canada are linked to degradation of native grassland. Recent speculation suggests increased anthropogenic development may also play a role in continuing declines. Understanding the relationship between Ferruginous Hawks' movement patterns at several temporal and spatial scales may lead to important conclusions regarding home ranges and associated mitigation or conservation actions. Our goal is to study Ferruginous Hawk movements in an anthropogenic landscape using satellite telemetry. Adult males are targeted for transmitter attachment because they defend the nesting territory and depict the boundaries of the home range. In 2012, home ranges were estimated for seven hawks by the minimum convex polygon method ($\bar{x}$ = 14.99km2, SD = 14.87). Using telemetry data, we will analyze spatial and temporal use patterns, focusing on use of various habitat types (e.g., native grassland and cropland), soil and topography, and areas with high and low industrial impacts (e.g., oil and gas wells and transmission lines). In addition, at sites that undergo overwinter industrial development, we will compare use patterns before and after development. This will help us determine if and how hawks are affected by development over multiple breeding seasons. Future analysis will include resource selection analysis of topographic covariates including cover types, edge effects, and associations to water. This research will provide fundamental scientific advancement in the study of Ferruginous Hawks throughout the Canadian prairies. Conclusions from this study will also help guide management activities of remaining Ferruginous Hawk habitat.

THIRTY YEARS AFTER THE REINTRODUCTIONS BEGAN: DEMOGRAPHICS, HABITAT USE, AND GENETICS OF SWIFT FOXES IN CANADA AND NORTHERN MONTANA

AXEL MOEHRENSCHLAGER[1], **CYNTHIA MOEHRENSCHLAGER**[2], **SHELLEY ALEXANDER**[3], **CATHY CULLINGHAM**[4], **DAVID GUMMER**[5], and **PAT FARGEY**[6]

1 Centre for Conservation Research, Calgary Zoological Society, 1300 Zoo Rd., NE, Alberta T2E 7V6.

2 Wildlife Preservation Canada, Guelph, Ontario, N1H 6J2.

3 Department of Geography, University of Calgary, Calgary, Alberta T2N 1N4.

4 Department of Biological Sciences, University of Alberta, Edmonton, Alberta T6G 2E9.

5 Banff National Park, Parks Canada, Box 900, Banff, Alberta T1L 1K2.

6 Grasslands National Park, Parks Canada Agency, Box 150, Val Marie, Saskatchewan S0N 2T0.

Abstract: Although Swift Foxes (*Vulpes velox)* were once so abundant in Canada that 117,025 were trapped between 1853 and 1877, they were extirpated here and in Montana by 1938. Releases from 1983 – 1997 aimed to re-establish the species to Canada. Over the span of the last fifteen years three primary questions have emerged: 1) has the reintroduced population grown since releases ended?, 2) what habitats must be protected to enable long-term population recovery? and 3) given demographic and genetic considerations, is the population sustainable? We addressed these questions through live-trapping based population surveys which enveloped the expanding Swift Fox population in 1995/1996, 2000/2001, and 2005/2006; a fourth survey will occur in 2013/14. Replicated sites and methods in Canada and Montana revealed a consistent increase in the proportion of wild-born individuals, population distribution, and Swift Fox abundance. Over time, some extraneous long-distance movements beyond the known Swift Fox core have also become evident. Microsatellite analyses indicate increases over time in effective population size, diversity, and genetic structure. Population viability analyses suggest that the population may be self-sustaining in the absence of stochastic events, but cumulative combinations of disease outbreaks and habitat loss could still drive the population to extinction. Habitat selection, tested using both captures and camera-trap surveys, indicates Swift Foxes are consistently associated with dry, flat, homogeneous grasslands. Swift Fox habitat may be saturated in Canada, population connectivity may depend on corridors in Montana, and extensive areas of Canadian prairie may be candidates for Swift Fox critical habitat designation.

DIVERSE DIET AND HIGH PRODUCTIVITY SHOW THE ADAPTABILITY OF SWIFT FOXES IN SOUTH-EASTERN ALBERTA TO CHANGING ENVIRONMENTS.

HELEN TREFRY[1] and **GEOFFREY HOLROYD**[2]
[1] Canadian Wildlife Service (retired), Box 176, Site 1, RR 2, Tofield, Alberta T0B 4J0.
[2] Environment Canada (retired), [1] Box 33, Site 2, RR 2, Tofield, Alberta T0B 4J0. Email: geoffholroyd@gmail.com

Abstract: Swift Foxes (*Vulpes velox)* have been successfully reintroduced into Canada over the past 30 years and appear to be increasing at Onefour, Alberta, where we have documented them depredating Burrowing Owl (*Athene cunicularia*) nests. Little is known about their summer diet in Canada. In 2008 and 2009 we were able to monitor activity for five Swift Fox pairs with kits in south-eastern Alberta using motion-activated 'Reconyx' cameras. Of five dens sites located, two were re-used the following year. Each Swift Fox pair had three or four kits emerge with high survival before dispersal. Dispersal occurred quickly in mid-August when all foxes disappeared from the burrow system and did not return the following month. Females were in attendance at the den burrow full time during the first half of the summer, and then spent less time as the kits grew and became more active. Prey were identified on the camera images and from feathers that we collected during camera changes. Reconyx cameras did not capture all food deliveries and prey items could not always be identified to species. However the prey deliveries captured reveal a diverse diet and indicates the importance of a healthy varied prairie ecosystem to conserve this fox. The diet of some pairs was predominantly Richardson's Ground Squirrels (*Urocitellus richardsonii*) while others ate primarily birds or Sagebrush Voles (*Lemmiscus curtatus*). The flexibility in prey bodes well for the success of these reintroduced predators in a changing landscape. The role of the much maligned and poisoned ground squirrel is especially important for some pairs. While no poisoning of ground squirrels occurred in our study area, the Swift Fox would be very vulnerable to secondary poisoning of this prey elsewhere.

Dietary Overlap of Sympatric Ungulates and the Implications for Chronic Wasting Disease Transmission

A.A. SORENSEN, F.M. VAN BEEST, and **R.K. BROOK**
College of Agriculture and Bioresources, University of Saskatchewan, Saskatoon, Saskatchwan S7N 5A1.

Abstract: In the agriculture dominated landscapes of Western Canada, cervids make frequent use of natural forage and seeded crops on private farmland, resulting in damage to standing and baled crops. In Saskatchewan and Manitoba, crops are often consumed by White-tailed Deer (*Odocoileus virginianus*), Elk (*Cervus canadensis*), and Mule Deer (*O. hemionus*). Besides the obvious socio-economic concerns of crop damage, use of crops may facilitate cervids co-mingling and increase the risk of intra- and inter-specific transmission of chronic wasting disease. As chronic wasting disease is arguably the greatest threat to North American cervid populations, an in-depth examination of crop selection by these ungulates may mitigate the spread of this disease. The aims of our study are to: quantify spatio-temporal overlap in selection of agricultural crops by Elk, White-tailed Deer, and Mule Deer in Saskatchewan and Manitoba, identify specific crop types associated with overlap in distribution and use between species, and determine key environmental factors that influence resource selection. We are using an existing database of over 32,000 compensation claims paid to farmers for crop damage between 1994 and 2012.Over the period of our study, damage totals exceeded $27.5 million and there was a significant increase in damage (F-ratio 8.201e-11). Using these claims, we are conducting an ecological-niche factor analysis to relate environmental factors such as crop types and habitat variables within the species distribution to that of the surrounding landscape. By incorporating market value of crop types into conventional habitat suitability maps, we will also generate predictive maps quantifying regional risk of crop damage by cervids. Identifying such hotspots of species overlap and resource utilization will also inform and direct effective disease management strategies.

Mapping Elk Distribution: Participatory Model Building with Local Ecological Knowledge and Natural Science Data

M. PATTERSON, F. VAN BEEST and **R.K. BROOK**
Indigenous Land Management Institute and Department of Animal and Poultry Science, College of Agriculture and Bioresources, University of Saskatchewan, Saskatoon, Saskatchewan S7N 5A1.

Abstract: Once the most abundant cervid in North America, Elk (*Cervus canadensis*) populations were reduced by unregulated hunting and habitat loss. Although Elk numbers have partially recovered in Canada's parkland region, prairie populations are still threatened by habitat fragmentation, disease, and human-wildlife conflict. To successfully mitigate these threats, management agencies require a sound understanding of Elk ecology. Our research goal is to integrate local ecological knowledge with natural science data to better understand how Elk interact with the prairie-parkland of Canada, while also engaging knowledge holders in the research process. Local ecological knowledge is knowledge gained from experience living and working on the land. It can complement more conventional biological research projects. Local ecological knowledge enables community members to be engaged in research, and to have input in projects that affect them. To acquire local ecological knowledge, we held six workshop and focus group sessions in Saskatchewan and Manitoba with local experts. Participants completed an Elk habitat survey and took part in a participatory mapping exercise. While mapping, they were asked to identify locations Elk use. Our results indicate that Elk require access to forest cover and areas without hunting. Participatory mappings identified several key Elk herd locations that were not known from existing scientific data. Understanding how Elk are distributed across and interact with the landscape will provide guidance for potential management strategies and conservation initiatives. Integrating local ecological knowledge and natural science data allows a comprehensive understanding of Elk distribution, while offering communities the opportunity to engage in research and have an active role in deriving solutions about Elk related concerns.

WILDFIRE'S INFLUENCE ON WILDLIFE HABITAT SUITABILITY – BOREAL WOODLAND CARIBOU CASE-STUDY

DONALD E. HARRON
AltaLink Management Ltd, 2611-3 Ave., SE, Calgary, Alberta T2A 7W7.

Abstract: Wildfire rates are generally incorporated into forest sustainability modeling to help determine annual allowable cut. At the core of this modeling is the untested assumption that wildfire occurs randomly across the landscape. Utilizing the data-tables associated with the Manitoba Five-year Status Reports on Forestry this assumption was tested with respect to the age of forest consumed by wildfire. The recorded 25 year pattern of wildlife was projected forward for 300 years to determine the potential future forest composition. The results suggest that wildfire is not random, but it displays a regionally distinctive pattern in which some age classes burn at rates well in excess of random. These projected changes to the forest age structure were analyzed using features from the provincial Boreal Woodland Caribou Habitat Suitability model to project wildfire's long-term influence on potential habitat availability. The results were counter intuitive with higher annual wildfire rates resulting in an increase in the potential availability of prime Woodland Caribou (*Rangifer tarandus caribou*) habitat.

USING GRASSLAND BIRDS TO GUIDE AN ECOLOGICAL RESTORATION OF BISON

K. ELLISON and **S. ZACK**
The Wildlife Conservation Society, 301 North Willson Ave., Bozeman, Montana 59715 USA.

Abstract: For millennia, Bison (*Bison bison*) and fire were the predominant forces that shaped and maintained North American grasslands. Following the loss of these forces, and subsequent development and degradation associated with agricultural production, wildlife populations declined precipitously. Grassland birds have declined annually more than any other guild since populations were first measured in the 1960s. Since 1990, 17 grassland restoration efforts have reintroduced plains bison (*Bison bison bison*), for a total of 63 conservation herds. Yet, few managers have experience with bison and attempts at an Ecological Recovery require measureable outcomes. Our approach is to identify different grassland bird species as viable indicators for bison grazing management, as different bird species respond to different levels of grazing intensity, and presumably did so historically. There seems to be great potential to manage grazers to help restore heterogeneity in grassland habitats essential to Great Plains wildlife. Since 2009, we have used grassland birds (Sprague's Pipit *Anthus spragueii*, Baird's Sparrow *Ammodramus bairdii*, Chestnut-collared Longspur *Calcarius ornatus*, McCown's Longspur *Rhyncophanes mccownii*) as indicators of ecological recovery, and grazing management as a tool in grassland bird conservation (also engaging cattle-producers). Through grazing management with partners, we are attempting to re-create the habitat heterogeneity that will allow re-establishment of specific grassland bird species through adaptive management feedback. We also briefly discuss how bison wallowing, Prairie Dog towns (*Cynomys* spp.), fire, and native predators are also necessary elements toward a full ecological recovery of portions of the Great Plains with bison.

BAT ACTIVITY DURING AUTUMN AT A GRAVEL MINE IN CENTRAL ALBERTA

C.E. PRIESTLEY and **D.L.TAKATS PRIESTLEY**
STRIX Ecological Consulting, Box 1013, Tofield, T0B 4J0 Alberta. Email:chuck@strixecological.ca

Abstract: Of the nine bat species which occur in Alberta, four are considered 'Sensitive' and two are 'May Be at Risk'. These general status designations were given due to information gaps about population abundances and distributions, the association of some species with mature forests, and mortality risk at wind energy facilities during migration. On February 3, 2012 a subcommittee of the COSEWIC (Committee On Status of Endangered Wildlife In Canada) recommended that the Little Brown Myotis and Northern Myotis be designated Endangered in Canada. The reason cited was large-scale mortality of cave-hibernating bats caused by *Geomyces destructans*, the pathogen responsible for White-nose Syndrome. The need to understand bat ecology including their seasonal movements is critical. We studied autumn movements of bats at Lafarge's Onoway Wash Plant in central Alberta along Kilini Creek 44.8 km west of Edmonton. A Song Meter™ SM2Bat™ recorded bat activity 18 and 19 August 2011 and between 1 August and 10 October 2012. A total of 1712 bat passes were detected at the rate 1.12 bat passes per detector hour. Bat activity was highest in early August, diminished steadily through September and the last bat pass was detected 27 September 2012. Red Bat was last detected 16 August, Silver-haired Bat 29 August, Northern Myotis 30 August, Little Brown Myotis 20 September, Hoary Bat 22 September and the group Big Brown Bat/Silver-haired Bat 27 September 2012. The Big Brown Bat/Silver-haired Bat group detections made during September were suspected to be Big Brown Bats because there was a Big Brown Bat roost in the study area. This study provided information about migratory patterns of bats in autumn, a research area considered to be a 'high priority' by the Alberta Bat Action Team.

Background

Effective wildlife management requires information about the distribution, relative abundance and density of the wildlife populations (Mosher and Fuller 1996). In 2009, baseline data were collected at Lafarge Canada Inc's Onoway Wash Plant using vegetation, songbird, waterfowl and incidental vertebrate surveys. On-going wildlife monitoring programs were initiated in 2010 so that potential changes in wildlife use at the site could be investigated in the future and to gauge the impact of habitat enhancement projects undertaken. One of the valued ecosystem components identified at the Onoway Wash Plant for which on-going monitoring was initiated was the bat community.

Bats occupy unique ecological niches being nocturnal aerial insectivores which locate and hunt prey using echolocation. Most aerial insectivores, such as swallows, do not hunt mainly at night. For this reason, bats exert a disproportionately large predation pressure on nocturnal invertebrates. Bats are often associated with mature or old growth forests as structures within these habitats such as sloughing bark and cavities are used for roosting. Bats also often hunt in riparian areas, habitat which is important for many species.

Only three of the nine bat species that occur in Alberta are considered provincially 'Secure'. The Long-legged Bat (*Myotis volans*) is status 'Undetermined' due to lack of information. The Western Small-footed Bat (*M. ciliolabrum*) is considered 'Sensitive' because little is known about its population and its distribution tends to be clumped in prairie ravine habitats. The Northern Myotis (*M. septentrionalis*) was designated 'May Be at Risk' because their population sizes are unknown and they tend to prefer mature roosting trees. The Silver-haired Bat (*Lasionycteris noctivagans*), Hoary Bat (*Lasiurus cinereus*) and Eastern Red Bat (*Lasiurus borealis*) were considered 'Sensitive' because of mortality risk at wind farms during migration and a lack of information on their population abundances (Alberta SRD 2010). Little Brown Myotis (*M. lucifugus*) and Northern Myotis were designated Endangered in Canada on February 3, 2012 after an emergency status assessment was presented to a subcommittee of COSEWIC (Committee on the Status of Endangered Wildlife in Canada). The reason cited for recommending these designations was large-scale mortality of cave-hibernating bats caused by *Geomyces destructans*, the pathogen responsible for white-nose syndrome (WNS)(COSEWIC 2012). The spread of WNS was first detected in a cave in the northeastern United States in 2006 and has been expanding across the continent since then (Blehert et al. 2008). Current estimates of bat population declines in the northeastern USA since the emergence of WNS are approximately 80%. It has not yet been detected in Alberta but is expected to reach the province within the next few years.

In 2010 and 2011 bat work at Lafarge's Onoway Wash Plant focused on habitat enhancement. During those years 12 houses were installed and monitored regularly to determine whether they were occupied. In 2011 a bat inventory was conducted using trapping and acoustics monitoring at night (Vonhof 2006). During 2012 acoustics monitoring occurred in the latter part of the breeding period and throughout the autumn. Here we report results from the acoustics monitoring portion of the bat monitoring program at Lafarge's Onoway Wash Plant.

Methods

Onoway Wash Plant is in central Alberta 8.7 km southeast of Onoway and 14.3 km northwest of Stony Plain. The site is along Kilini Creek (also known locally as Kinnikinnick Creek). The area is in the Boreal Forest Natural Region and Dry Mixedwood Subregion (Natural Regions Committee 2006).

A Song Meter™ SM2Bat™ recorded bat activity 18 and 19 August 2011 and between 25 July and 10 October 2012. All sound files were converted to zero crossing format and noise files were filtered using Kaleidoscope™ from Wildlife Acoustics, Inc. Resulting sound files were analyzed using AnalookW™ version 3.8v. When possible, sound files were identified as Silver-haired Bat, Hoary Bat, Eastern Red Bat, Northern Myotis, or Little Brown Myotis. When sonogram characteristics were not suitable for more specific identification, sounds were categorized into *Myotis* spp. (Little Brown or Northern Myotis), EPFULANO (Big Brown or Silver-haired Bat), high frequency or low frequency groups. High frequency sounds are produced by Eastern Red Bat, Little Brown Myotis or Northern Myotis and low frequency sounds are from Big Brown Bat, Silver-haired Bat or Hoary Bat.

Results

During acoustic surveys, 1712 bat passes were detected. Of these, 998 were Little Brown Myotis, 252 were from the Big Brown/Silver-haired Bat group, 125 were in the high frequency bat group, 101 were Silver-haired Bat, 98 were from the group *Myotis spp*., 72 were Hoary Bat, 41 were Eastern Red Bat, 19 were from the low frequency bat group and six were Northern Myotis. Bat activity was highest in early August, diminished steadily through September and the last bat pass was detected 27 September 2012 (Figure 1). Red Bat was last detected 16 August, Silver-haired Bat 29 August, Northern Myotis 30 August, Little Brown Myotis 20 September, Hoary Bat 22 September and the group Big Brown Bat/Silver-haired Bat 27 September 2012. The Big Brown Bat/Silver-haired Bat group detections made during September were suspected to be Big Brown Bats because there was a Big Brown Bat roost in the study area. This study provided information about migratory patterns of bats in autumn, a research area considered to be a 'high priority' by the Alberta Bat Action Team.

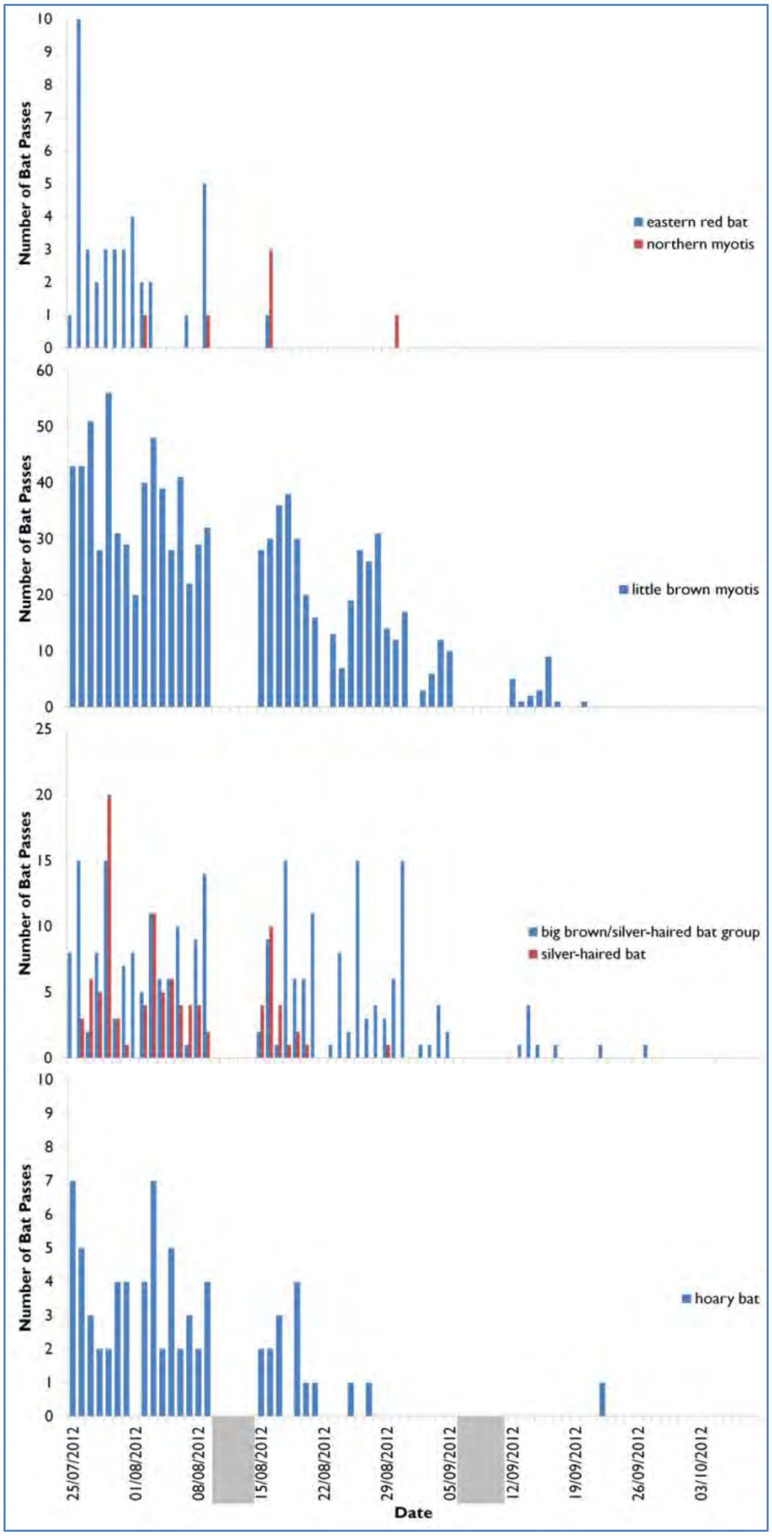


Figure 1. Bat detections during autumn at Onoway Wash Plant during 2012. The grey boxes along the x-axis represent periods when data were not collected due to detector failures.

Recommendations

Onoway Wash Plant continues to be an area of high bat use and Lafarge employees continue to observe bats on-site regularly. Future programs for bats should continue to focus on monitoring and habitat enhancement. There are a number of bat-focused programs which could occur at Onoway Wash Plant in the future. The following is a list of possible future work that could be done:

1. Continue to check for bat occupancy at bat houses installed at the site.
2. Conduct bat acoustic surveys during the spring, summer and autumn to learn about bat activity during all seasons when bats are active at the site.
3. Monitor bats using trapping to determine which species breed and move through the site. Acoustics data could be used to determine when trapping attempts would maximize capture probabilities. Trapping would provide definitive information about which species are present. While valuable for gauging bat activities levels, acoustic monitoring does not specifically identify all bats to species. For example, sounds made by Big Brown Bats cannot be distinguished from Silver-haired Bats.
4. There was interest expressed in doing a bat habitat enhancement project in partnership with local schools. This could be a possible extension of Lafarge's Community Engagement Program. Bat houses could be put up at the schools where presentations are made about Lafarge's Biodiversity Program. This would provide additional habitat for bats and students would have an opportunity to be actively involved with bat monitoring.

Acknowledgments

Funding for this project was provided by Lafarge Canada Inc. We thank Erin Donovan and Karrie-Lynne Watson of Lafarge for their assistance with project planning and implementation. On-site coordination and safety plan assistance from Randy Wenckowski and Doug Sullivan of Lafarge were appreciated. Thank you to Bryn Spence, Erin Low, Jonathan Martin-DeMoor, Jonathan Skinner and Loreley Will for help with field observations and bat box installations.

Literature Cited

Alberta Sustainable Resource Development. 2010. The general status of Alberta wild species 2010. Alberta Sustainable Resource Development, Fish and Wildlife Division website. http://www.srd.alberta.ca/FishWildlife/SpeciesAtRisk/GeneralStatusOfAlbertaWildSpecies/GeneralStatusofAlbertaWildSpecies2010/Default.aspx. Accessed November 10, 2012.

Blehert, D.S., A.C. Hicks, M. Behr, C.U. Meteyer, B.M. Berlowski-Zier, E.L. Buckles, J.T.H. Coleman, S.R. Darling, A. Gargas, R. Niver, J.C. Okoniewski, R.J. Rudd and W.B. Stone. 2008. Bat white-nose syndrome: an emerging fungal pathogen? Sciencexpress. Published online 30 October 2008; 10.1123/science.1163874. Accessed August 1, 2012.

Committee on the Status of Endangered Wildlife in Canada. 2012. COSEWIC Emergency Assessment of the Tri-colored Bat, Little Brown Myotis and Northern Myotis in Canada (February 2012). http://www.cosewic.gc.ca/eng/sct7/index_e.cfm#newsEA. Accessed August 1, 2012.

Ecoventure Inc. 2009. Tomahawk Biological Survey. Ecoventure Inc., Cochrane, Alberta. *For* Lafarge Canada Inc. 45pp.

Mosher, J. and M. Fuller. 1996. Surveying woodland hawks with broadcasts of great horned owl vocalizations. *Wildlife Society Bulletin* 24: 531-536.

Natural Regions Committee. 2006. Natural Regions and Subregions of Alberta. Compiled by D.J. Downing and W.W. Pettapiece. Government of Alberta. Pub. No. T/852. 264pp.

United States Geological Service. 2013. Disease information: white-nose syndrome (WNS). http://www.nwhc.usgs.gov/disease_information/white-nose_syndrome/. Accessed August 1, 2012.

Vonhof, M.J. 2006. Handbook of inventory methods and standard protocols for surveying bats in Alberta. Alberta Fish and Wildlife Division. Edmonton, Alberta. 63pp.

SESSION 8: ECOLOGICAL IMPACTS OF TOXIC CONTROLS ON PRAIRIE ECOSYSTEMS

ON THE MISUSE OF PESTICIDES TO CONTROL NORTHERN POCKET GOPHERS AND RICHARDSON'S GROUND SQUIRRELS IN AGRICULTURE AND THE PRESSING NEED FOR SUSTAINABLE SOLUTIONS

GILBERT PROULX
Alpha Wildlife Research & Management Ltd., 229 Lilac Terrace, Sherwood Park, Alberta T8H 1W3.
Email: gproulx@alphawildlife.ca

Abstract : Strychnine and chlorophacinone (anticoagulant) are two major pesticides used in the control of Northern Pocket Gophers and Richardson's Ground Squirrels in western Canada. Yet, scientific research has repeatedly demonstrated that these pesticides often failed to effectively control these rodent species and also had significant impacts on wildlife communities and the well-being of farming communities. Within the historical context of recurrent rodent population outbreaks in western Canada agricultural regions, there is a pressing need to develop and implement a series of solutions including 1) species-specific Integrated Pest Management (IPM) programs consisting of proven, safe and effective chemical and mechanical methods, natural control agents, and educational presentations and brochures; 2) the recruitment of successful producers and respected community leaders to implement IPM programs that take into consideration regional constraints; and 3) the enlistment of naturalist and conservation groups, and government agencies, to develop conservation programs that meet the needs of wildlife communities (including Species-at-Risk) and producers.

Introduction

In western Canada, the Northern Pocket Gopher (*Thomomys talpoides*; also known as mole) and the Richardson's Ground Squirrel (*Urocitellus richardsonii*; also known as gopher) are fossorial rodents which cause major losses to producers due to their feeding and digging activities. Both species have been the subject of extensive control campaigns with questionable results (e.g., Isern 1988; Marsh 1992; Nietfeld and Roy 1992). Today, strychnine and chlorophacinone (anticoagulant) are being recommended for the control of these rodents (e.g., Alberta Agriculture and Rural Development 2008) but, after extensive use for decades, the populations of these rodents have always been, and continue to be, beyond control (e.g., Nietfeld and Roy 1992, Saskatchewan Agriculture 2010).

During two Research & Control Programs on Northern Pocket Gophers (1993-2005) and Richardson's Ground Squirrels (2007-2010) in western Canada, I evaluated the efficacy of strychnine and chlorophacinone, and other rodenticides, to control these fossorial rodents. On the basis of these research programs, and studies conducted in similar ecosystems in the United States, I intend to demonstrate that these rodenticides often failed to effectively control Northern Pocket Gophers and Richardson's Ground Squirrels, and also impacted significantly on wildlife communities and the well-being of farming communities. Finally, I present preliminary Integrated Pest Management (IPM) programs where chemical and mechanical methods, cultural practices, and natural mortality factors can be used in conjunction with education programs and socio-political strategies to minimize damages caused by Northern Pocket Gophers and Richardson's Ground Squirrels.

Strychnine

Strychnine is an alkaloid which is a constituent of the seeds of the strychnine tree (*Strycnos nux-vomica*) of India and Indonesia (Brookes 1975). Strychnine was first registered in Canada in 1928 (Pest Management Regulatory Agency, PMRA, 2005) for the control of Richardson's Ground Squirrels, even though it was distributed in Saskatchewan as early as 1912 (Isern 1988). Because of its toxicity to a variety of species, its secondary persistence (Littrell 1990), and its misuse (Howell and Wishart 1969, Wobeser and Blakley 1987), strychnine became a source of concern for the public and professionals (Hegdal and Gatz 1977, Landals 1993, Owen-Carter 1993). In 1993, the Canadian Federal Government banned the popular liquid strychnine solution, and replaced it with ready-to-use (RTU) strychnine-treated oats. Farmers and politicians considered that liquid strychnine was the only effective poison to control Richardson's Ground Squirrel populations (Proulx 2010). In 2007, an Emergency Registration program of 2% liquid strychnine was granted by PMRA and became effective in 2008 (Wilk and Hartley 2008) for the control of a Richardson's Ground Squirrel population outbreak (Proulx 2010). The Emergency Registration required that 2% liquid strychnine be mixed with grain to formulate 0.4% freshly mixed (FM) baits. However, the ability of FM 0.4% strychnine-treated baits to control Richardson's Ground Squirrel populations had never been thoroughly tested in the Canadian Prairies (Proulx and Feldstein 1994, McKinnon and Mineau 2004).

Use in the Control of Northern Pocket Gophers

<u>Control Efficacy</u>

Underground baiting with strychnine alkaloid bait has long been used to control Nothern Pocket Gophers in agricultural fields (Tickes et al. 1982; Lewis and O'Brien 1986). In a compendium of control techniques, Goodwin Enterprises & Distributors Ltd. (Sundre, Alberta) reported excellent Northern Pocket Gopher control with grain coated with 0.25%, 0.31%, 0.5%, and 1.0% strychnine alkaloid, and claimed that strychnine was a relatively safe poison without secondary effect (Willis, undated). Strychnine baits are still being recommended today (Salmon and Baldwin 2012) and they are produced by various companies.

In Canada, using the 'open-hole' monitoring method to determine if resident Northern Pocket Gophers have died following poisoning (i.e., Northern Pocket Gophers do not leave their burrow system open; Engeman et al. 1993), Proulx (1998) found that control levels obtained by hand-baiting burrow systems with 0.4% strychnine-treated oats were less than 17% in spring and fall, and 36% in summer. Considering that poison baits must kill at least 70% of Northern Pocket Gophers in order to effectively control populations (Fagerstone et al. 1981), control levels obtained with 0.4% strychnine-treated oats were inadequate. Proulx's (1998) findings were in agreement with studies carried out on Botta's Pocket Gophers (*Thomomys bottae*) in the United States (Table 1). Lee et al. (1990) demonstrated that Botta's Pocket Gophers acquired physiological tolerance to strychnine, i.e., after they ingested a series of sub-lethal doses, they could tolerate increasingly higher doses of strychnine. The animals had or acquired a feeding strategy which enabled them to consume what normally is in excess of a lethal amount of strychnine by eating sub-lethal amounts periodically throughout a 24-hr period. Strychnine that was consumed in one feeding was excreted in urine or metabolized before another feeding (Lee et al. 1990). Finally, Proulx et al. (1995a) showed that Northern Pocket Gophers daily spent many hours maintaining their burrow system. Whether producers are baiting burrow systems by hand, with a mechanical applicator, or with a burrow builder, Northern Pocket Gophers recognize areas of their burrow system that have been modified, even slightly, by the introduction of the poison bait. Then they often mix or cover the poison bait with soil, or use bait and soil to plug the disturbed portion of the tunnel (Proulx 1998).

<u>Non-target and Secondary Poisoning</u>

Since Northern Pocket Gopher burrow systems are inhabited by several small mammal species (Vaughan 1961; Whittaker et al. 1991), many of them are poisoned (Proulx, personal observations) and may be eaten by scavengers and predators (see the Richardson's Ground Squirrel section below).

Table 1. Control efficiency of strychnine to control Northern Pocket Gophers.

Species	***Bait***	***Control efficiency (%)***	***Reference***
Northern Pocket Gopher	0.4% strychnine-treated oats	<17 in spring and fall 36 in summer	Proulx 1998
Botta's Pocket Gopher	0.35% strychnine-treated milo 0.5% strychnine-treated oats	≤10 ≤10	Tickes et al. 1982
Botta's Pocket Gopher	0.3% strychnine-treated wheat or wheat-barley-raisin mix 0.35% strychnine-treated wheat, or milo, or peanut-flavored milo 0.5% strychnine-treated oats or tablets 1.8% strychnine-treated milo	13 ≤12 ≤18 25	Tickes 1983

<u>Value as a Rodenticide</u>

Northern Pocket Gophers are mainly herbivores and do not favor seeds and grains used in the production of poison baits (Proulx 2002a). Therefore, strychnine baits are not in sync with Northern Pocket Gophers' feeding ecology. These baits will, however, be eaten by non-target species such as mice and voles, which will be eaten by carnivores and scavengers. Strychnine baits used for the control of Northern Pocket Gophers therefore has an impact on the whole community food web.

Forty years ago, in their 1973 review of Northern Pocket Gopher biology and management, Turner et al. (1973) stated that this rodenticide was no longer acceptable for use against Northern Pocket Gophers and recommended that more effective and safer compounds be sought. My findings in Canada (Proulx 1998) supported their conclusion that strychnine is not a valuable rodenticide for the control of Northern Pocket Gophers.

Use in the Control of Richardson's Ground Squirrels

Control Efficacy

During the 2007 drought in southwestern Saskatchewan, Proulx and Walsh (2007) controlled less than 40% of Richardson's Ground Squirrels with FM 0.4% strychnine-treated oat baits made from a 5-year-old concentrate. The low performance of baits in 2007 was possibly due to the staleness of strychnine that had been produced in 2002. Also, in 2008, using a freshly produced strychnine concentrate, Proulx et al. (2010a) controlled more than 70% of ground squirrels (Table 2). However, in 2009 and 2010, when green vegetation became more abundant, FM 0.4% strychnine-treated oats failed to control more than 70% of Richardson's Ground Squirrels (Table 2; Proulx et al. 2010b; Proulx 2011a). When the strychnine concentrate was not fresh, or when ground squirrels had access to abundant vegetation, strychnine was not effective to control ground squirrels. In spite of many attempts to improve the efficacy of the rodenticide by using different baits (Proulx et al. 2010a), various additives (Proulx 2011a), and different bait station models (Proulx 2011a), FM 0.4% strychnine-treated baits usually failed to control at least 70% of ground squirrels.

Proulx and Walsh (2007) and Proulx et al. (2009, 2010b) demonstrated that RTU 0.4% strychnine-treated oats were ineffective to control Richardson's Ground Squirrels. In most cases, control was less than 55% (Table 2).

Table 2. Control efficiency of strychnine to control Richardson's Ground Squirrels (FM: freshly mixed; RTU: ready-to-use).

Bait	***Control efficiency (%)***	***Reference***
FM Strychnine		
FM Nu-Gro 0.4% strychnine-treated oats made with 5-year old 2% liquid concentrate (2007 study)	38.1(spring)	Proulx et al. 2010a
FM Nu-Gro 0.4% strychnine-treated oats made with newly produced 2% liquid concentrate (2008 study)	73.1-95.4% (spring) 75.4 (summer)	
FM Nu-Gro 0.4% strychnine-treated canary seeds made with newly produced 2% liquid concentrate (2008 study)	63.9-84.5(spring) 83.4-92.2 (summer)	
FM Nu-Gro 0.4% strychnine-treated oats made with newly produced 2% liquid concentrate (2009 study)	69.6-85.8 (spring) 58.3-62.1 (summer)	Proulx et al. 2010b
FM Maxim 0.4% strychnine-treated oats made with newly produced 2% liquid concentrate (2009 study)	57.5 (spring) 51.3-58.3 (summer)	
FM Nu-Gro 0.4% strychnine-treated alfalfa pellets made with newly produced 2% liquid concentrate (2009 study)	60.7-66.3 (spring) 40.4-55.7 (summer)	
FM Nu-Gro 0.4% strychnine-treated oats made with newly produced 2% liquid concentrate (2010 study)	66.1-54.7 (spring)	Proulx 2011a

FM Maxim 0.4% strychnine-treated oats made with newly produced 2% liquid concentrate (2010 study) FM Nu-Gro 0.4% strychnine-treated oats made with newly produced 2% liquid concentrate + peanut oil and peanut butter (2010 study) FM Nu-Gro 0.4% strychnine-treated oats made with newly produced 2% liquid concentrate + corn syrup (2010 study) FM Nu-Gro 0.4% strychnine-treated oats made with newly produced 2% liquid concentrate + sunflower and canola oils (2010 study) FM Nu-Gro 0.4% strychnine-treated oats made with newly produced 2% liquid concentrate + salt and mineral mix (2010 study)	54.1-62.3 (spring) 58.2-59.2 52.6-84.2 67.3-71.1 75.7-77.8	
RTU Strychnine		
RTU Nu-Gro 0.4% strychnine-treated oats (2007 study)	≤53% (spring)	Proulx and Walsh 2007
RTU Nu-Gro 0.4% strychnine-treated oats (2008 study)	≤54% (spring) ≤26% (summer)	Proulx et al. 2009
RTU Nu-Gro 0.4% strychnine-treated oats (2009 study)	60.3--64.6 (spring) 27.1-53.6 (summer)	Proulx et al. 2010b

Non-target and Secondary Poisoning

Bait rejection at burrow entrances is particularly frequent with strychnine-treated oats and canary seeds during spring and summer (Proulx and Walsh 2007, Proulx et al. 2009). Proulx (2011b) reported a large number of songbirds and small mammals that fed on strychnine-treated baits found on the surface. Uresk et al. (1987) reported high losses of Horned Larks (*Eremophila alpestris*) when controlling Black-tailed Prairie Dogs (*Cynomys ludovicianus*) with strychnine baits. Wamock and Schwarzbach (1995) reported strychnine poisoning of Dunlin (*Calidris alpina*) and Killdeer (*Charadrius vociferous*). Non-target poisoning is aggravated by an improper placement of strychnine baits on surface rather than in rodents' burrow openings (Howell and Wishart 1969, Hegdal and Gatz 1977, Wobeser and Blakley 1987), a practice still in effect today. From 2007 to 2010, I observed farmers spreading strychnine-treated baits on surface, depositing piles of treated oats or barley near the entrance of all animal burrows, or mixing it with chlorophacinone-treated oats in bait stations.

Non-target and secondary poisoning has been repeatedly documented. Proulx (2011b) reported finding a deceased Northern Harrier (*Circus cyaneus*) in spring 2009 in a study plot treated with FM 0.4% strychnine baits. One Deer Mouse (*Peromyscus maniculatus*) was found in its stomach. An autopsy of the mouse revealed the presence of at least two strychnine-treated oat kernels. Mendenhall and Pank (1980) reported secondary poisoning of owls. James et al. (1990) observed American Crow (*Corvus brachyrhynchos*), Black-billed Magpie

(*Pica pica*), California Gull (*Larus californicus*), Northern Harrier, and Burrowing Owl (*Athene cunicularia*) feeding, or attempting to feed, on dead ground squirrels poisoned with strychnine. Each year, accidental human poisoning continues to be a problem (Eisemann and Petersen 2002).

Value as a Rodenticide

On the basis of Proulx et al.'s (2010a) extensive studies in Saskatchewan, freshly produced strychnine may be effective to control Richardson's Ground Squirrels during drought periods when green vegetation is scarce. However, when vegetation is green and abundant, even after a short rainy period during drought years, strychnine-treated baits are unreliable. Poor strychnine performance may be caused by poor bait acceptance, but also by bait shyness. Because strychnine has a bitter taste and acts rapidly even at sub-lethal doses, animals can associate the poison bait with their illness and curtail their feeding (Record 1978). Furthermore, Ling et al. (2009) suggested that Richardson's Ground Squirrels inhabiting fields treated with strychnine could develop resistance to toxins by enhancing the functional capacity of enzymes (hepathic cytochrome CYP450 system) responsible for detoxification (Ling et al. 2009).

Littrell (1990) believes that strychnine is the worst rodenticide for wildlife because of its toxicity to a variety of species and because of its secondary persistence. On the basis of my experience in southwestern Saskatchewan, I believe that strychnine may be useful to control Richardson's Ground Squirrel populations in specific areas, if users place fresh baits in their burrow systems and monitor the treated sites to collect the carcasses of poisoned animals. However, due to its general unreliability and misuse by farmers who spread poison baits across fields without discrimination and do not remove the carcasses of poisoned animals (which are eaten by predators and scavengers), I believe that this rodenticide should not be made available to the general public. Yet, despite its unreliability to control Richardson's Ground Squirrels, and its impact on wildlife communities, strychnine is now a registered rodenticide that is available to producers (Benoit 2012; also see http://rdcounty.ca/News/News-Releases/2-Liquid-Strychnine-Available-to-Red-Deer-County-Farmers-In-2012), and it is promoted as being the most effective poison to control ground squirrels by Conservative Party MP Leon Benoit (Morgan 2012).

Chlorophacinone

Since their introduction in the early 1950s, anticoagulant poisons have replaced many acute and hazardous poisons, and revolutionized control programs (Meehan 1984, Berdoy and Smith 1993). Their main advantage is that they do not induce 'bait or poison shyness'. They are slow acting and when symptoms of toxicosis develop, animals have already consumed a lethal dose (Nacham and Hartley 1975). In Canada, chlorophacinone is sold to control Northern Pocket Gophers and Richardson's Ground Squirrels.

Use in the Control of Pocket Gophers

Control Efficacy

Laboratory work where pocket gophers were fed only poisoned baits suggested that anticoagulants could be efficient rodenticides (Tunberg et al. 1984, Vossen and Gadd 1990). However, Proulx et al. (1994) found that Northern Pocket Gophers fed poor quality alfalfa ingested 6.1 to 17.5 mg chlorophacinone/kg (LD_{50} = 2.1 mg/kg for 0.25% concentrate) without adverse effects (Table 3). Proulx et al. (1994) concluded that several feedings with concentrations of chlorophacinone markedly higher than the recommended LD_{50} would be necessary to kill Northern Pocket Gophers feeding on fresh alfalfa. Tickes (1983) also found that chlorophacinone 0.005% on wheat or in paraffinized pellets failed to achieve any control over Botta's Pocket Gophers inhabiting alfalfa fields (Table 3). Vitamin K is a natural antidote to anticoagulants (Hadler and Buckle 1992; Miller 1984). Arjo and Nolte (2004) noted that green vegetation rich in vitamin K such as alfalfa may counteract the effect of anticoagulants on rodents. Since the control of Northern Pocket Gophers is conducted mainly in alfalfa fields, the use of chlorophacinone (and other similar anticoagulants) is not effective.

Table 3. Control efficiency of chlorophacinone to control alfalfa-fed Northern Pocket Gophers.

Species	***Bait***	***Control efficiency (%)***	***Reference***
Northern Pocket Gopher	Chlorophacinone on alfalfa	0	Proulx et al. 1994
Botta's Pocket Gopher	Chlorophacinone on wheat	0	Tickes 1983
	Chlorophacinone in paraffinized pellets	0	

Non-target and Secondary Poisoning

Along with some pocket gophers, mice and voles inhabiting in or near pocket gopher burrow systems treated with chlorophacinone baits will be poisoned. Because anticoagulants are slow acting, Northern Pocket Gophers and non-target species feeding on chlorophacinone-treated baits may be captured and eaten by predators. These predators that are exposed to sub-lethal doses of anticoagulants would be expected to continue to hunt and consume additional poisoned prey, and die of secondary poisoning (Hosea 2000). Secondary poisoning would therefore be a threat to known predators of Northern Pocket Gophers: Long-tailed Weasel (*Mustela frenata*; Proulx and Cole 1998, Proulx 2000), Great Horned Owl (*Bubo virginianus*) and Long-eared Owl (*Asio otus*) (Stewart and Barss 1985), Swainson's Hawk (*Buteo swainsoni*; Bechard 1982), Ferruginous Hawk (*Buteo regalis*; Schmutz 1987) and others.

Value as a Rodenticide

Chlorophacinone is not a valuable rodenticide for the control of Northern Pocket Gophers because 1) it is mixed with grains and seeds that pocket gophers do not feed on; and 2) it has little or no effect on pocket gophers feeding on alfalfa. Yet, chlorophacinone is still registered in Canada as an effective rodenticide for Northern Pocket Gophers.

Use in the Control of Richardson's Ground Squirrels

Control Efficacy

Extensive research in southwestern Saskatchewan showed that, in most cases, chlorophacinone-treated oats or winter wheat control more than 70% of Richardson's Ground Squirrels in spring (Proulx et al. 2009, 2010b; Table 4). In summer, control efficacy may vary among grasslands, but often is above 70%. In alfalfa fields, however, in spring and summer, chlorophacinone-treated oats or winter wheat usually control less than 70% of Richardson's Ground Squirrels (Proulx et al. 2009, 2010b; Table 4).

Table 4. Control efficiency of chlorophacinone to control Richardson's Ground Squirrels.

Bait	***Control efficiency (%)***	***Reference***
Grasslands		
Chlorophacinone-treated oats placed in burrow openings or in bait stations (spring 2008)	73-100	Proulx et al. 2009
Chlorophacinone-treated winter wheat in burrow openings (spring 2008)	72-95	
Chlorophacinone-treated canary seeds placed in burrow openings (spring 2008)	83-92	
Chlorophacinone-treated oats placed in burrow openings or in bait stations (summer 2008)	50-75	
Chlorophacinone-treated winter wheat in burrow openings (summer 2008)	67	
Chlorophacinone-treated oats placed in burrow openings (spring 2009)	75-86	Proulx et al. 2010b
Chlorophacinone-treated winter wheat in burrow openings (spring 2009)	79-93	
Chlorophacinone-treated oats placed in burrow openings (summer 2009)	86	
Chlorophacinone-treated winter wheat in burrow openings (summer 2009)	93-100	
Alfalfa fields		
Chlorophacinone-treated oats placed in burrow openings (summer 2008)	40-51	Proulx et al. 2009
Chlorophacinone-treated winter wheat in burrow openings (summer 2008)	67	
Chlorophacinone-treated oats placed in burrow openings (spring 2009)	59-67	Proulx et al. 2010b
Chlorophacinone-treated winter wheat in burrow openings (spring 2009)	59-75	
Chlorophacinone-treated oats placed in burrow openings (summer 2009)	61-93	
Chlorophacinone-treated winter wheat in burrow openings (spring 2009)	61-93	

Non-target and Secondary Poisoning

Proulx (2011b) reported the loss of small mammals and songbirds that fed on baits, and the secondary poisoning of small carnivores that fed on Richardson's Ground Squirrels that were poisoned by chlorophacinone-treated baits. From 2007 to 2010, I often saw chlorophacinone-treated baits not being applied as per instructions. The use of spreaders (Figure 1), bait stations in all agricultural fields even when ground squirrels were absent (Figure 2), and overflowing or improper bait stations (Figure 3) was frequent in southwestern Saskatchewan. In 2008 and 2009, the registered Rozol® chlorophacinone product was also being sold as Rozol+ by an exterminator who modified the original product by adding mineral oil and peanut butter. This modified chlorophacinone was not more effective than the original Rozol® to control Richardson's Ground Squirrels (Proulx et al. 2010b) but, because of the presence of peanut butter in the grain mixture, domestic dogs fed directly on baits and were poisoned (Proulx, unpublished observations).

Value as a Rodenticide

Chlorophacinone-treated grains are effective to control Richardson's Ground Squirrels in grasslands. They are not effective in alfalfa fields because vitamin K, which is abundant in alfalfa, counteracts the effect of chlorophacinone. Because of its misuse by farmers, chlorophacinone poses a threat to wildlife communities.

Figure 1. This farmer used a spreader to distribute chlorophacinone-treated baits across the field, southwestern Saskatchewan, 2010.

Figure 2. Improper bait stations made of discarded chemical containers in fields that were not inhabited by Richardson's Ground Squirrels, southwestern Saskatchewan, 2009 and 2010.

Figure 3. Overflowing and improper bait stations used by farmers in southwestern Saskatchewan, 2009 and 2010.

Why do Farmers Continue to Use Strychnine and Chlorophacinone?

The efficiency of strychnine and chlorophacinone to control Northern Pocket Gophers has been overestimated in the past due to poor assessments of populations before and after treatment. Because the presence of pocket gophers in agricultural fields can be confirmed by the presence of dirt mounds, it has been suggested that pocket gopher populations could be monitored with mound counts to determine treatment efficiency (e.g., Anthony and Barnes 1983, Baldwin 2011). The technique consists in counting and destroying dirt mounds before treatment, and counting new mounds after treatment with poison baits. Post-treatment counts are then used as an index of activity and, by extrapolation, as an index of population densities. Using this approach, Lewis and O'Brien (1986) concluded that 1% and 1.7% strychnine-laced alfalfa baits could achieve 78% and 69% control, respectively. However, pocket gopher mounding is a highly variable activity (Miller 1948, Laycock 1957, Miller and Bond 1960) and can be misleading (Engeman et al. 1993). Proulx et al. (1995b) showed that the proportion of newly built mounds was dependent on the time of year, and was markedly higher in August-September than in June-July. This was likely due to a dispersal of young from the maternal burrows and a gradual change in above-ground movements coinciding with a change in vegetation (Miller and Bond 1960, Proulx et al. 1995a). Also, some pocket gophers produce more mounds than others. Therefore, assessing the efficacy of strychnine baits to control Northern Pocket Gophers on the basis of mound counts in summer may be misleading and give the false impression that strychnine is effectively controlling pocket gophers.

Controlling Richardson's Ground Squirrels with strychnine is almost a tradition in the Canadian Prairies. Since the beginning of the 20th century, the Saskatchewan Government has subsidized the utilization of strychnine to control Richardson's Ground Squirrels during each and every drought period (Isern 1988). Controlling ground squirrels became a recurring event sponsored by politicians. However, since strychnine failed to provide farmers with long-term relief from ground squirrel population outbreaks, it became obvious that this rodenticide was unreliable (e.g., Isern 1988). The use of strychnine was taught to children who, in turn, taught it to their own children.

Farmers do not know about the inefficacy of chlorophacinone to control Northern Pocket Gophers and Richardson's Ground Squirrels in alfalfa fields. Salesmen do not mention it to buyers, and PMRA's registration does not indicate that it is inefficient in alfalfa fields. Because chlorophacinone is sold as a pocket gopher and a ground squirrel rodenticide, farmers do not consider its impact on other vertebrates. In 2008, the exterminator selling Rozol+ to Saskatchewan farmers to control ground squirrels distributed information sheets stipulating that his product posed no secondary poisoning problems like strychnine (Schultz 2008).

Finally, the use of rodenticides by farmers is poorly monitored by either PMRA or provincial government agencies. There are no inspectors to verify that 1) concentrated solutions are properly mixed with grains or seeds; 2) poison baits are properly used in burrow systems instead than on surface; 3) bait stations (if such stations are allowed) are adequate; 4) bait mixtures are not modified by adding unregistered products or mixing more than one rodenticide together; and 5) farmers use poison baits in a responsible manner, with concerns for Species-at-Risk. The latter point is particularly interesting since large amounts of money have been expended in the past to ensure the future of endangered species such as the Burrowing Owl and the Swift Fox (*Vulpes velox*). Unfortunately, to my knowledge, no Conservation Officer monitors the use of rodenticides in regions inhabited by Species-at-Risk.

Impact of Strychnine and Chlorophacinone on Farmers

Sixteen years ago, in Manitoba, applying strychnine baits annually to control Northern Pocket Gophers cost at least CAN $30/ha (DeWandel et al. 1997). Because poisoning leaves behind an important proportion of the pocket gopher population that may reproduce and compensate for losses induced by baits, costs associated with poison baiting may be high in the long-term.

During the 2009 wet summer and in presence of green vegetation, Proulx et al. (2009, unpublished data) treated, on average, 85 Richardson's Ground Squirrel burrow openings with one bottle of 2% strychnine concentrate (approximately $9/bottle). They achieved <65% control (Proulx et al. 2010b). Proulx et al. (2009, unpublished data) used 15g of chlorophacinone-treated oats per burrow opening in alfalfa fields, and they achieved <70% control (Proulx et al. 2009, 2010b). Treating entire sections (260 ha/section) of green vegetation (namely alfalfa) with more than 1000 ground squirrel burrow openings would cost several thousands of dollars without successful management.

Impact of Strychnine and Chlorophacinone on Wildlife Communities

It is known that strychnine and chlorophacinone kill many non-target small mammals and songbirds which feed on poison baits, and predators that feed on dead or dying animals (Proulx 2011b). Also, in southwestern Saskatchewan, Proulx and MacKenzie (2012) investigated the relative abundance of American Badgers (*Taxidea taxus*) and Red Fox (*Vulpes vulpes*) in two study areas with similar road access and crops, but with different levels of poisoning. In the study area with relatively low poisoning (19.6% of the area traversed by roads), there were 2.2 times more American Badgers per km of road and 6.4 times more Red Foxes per km than in the study area with high poisoning (89.7% of the area). The use and misuse of poisons resulted in a loss of predators and impoverished wildlife communities.

The Need for Integrated Pest Management

There is a need to establish Integrated Pest Management (IPM) programs in which population monitoring, preventive cultural practices, and various control methods (mechanical, chemical, physical, and biological) are strategically coordinated to maintain rodent population densities at acceptable pest levels (Witmer and Proulx 2010). In order to be acceptable, an IPM program must control at least 70% of rodent populations. Otherwise, the annual productivity of young will compensate for losses resulting from control activities, and populations densities will likely continue to increase over time. On the basis of Proulx's (2002b) assessment of Northern Pocket Gopher control methods, selected methods must:

1. remove most of the breeders before the birth or emergence of young-of-the-year;
2. eliminate immigration, usually associated with the dispersal of young-of-the-year from adjacent areas;
3. be applicable independently of the quality and quantity of surrounding vegetation, and under diverse environmental conditions;
4. include a population monitoring strategy;
5. be species-selective;
6. be safe for humans to implement;
7. be socially acceptable; and
8. be financially available.

A Proposed IPM Program for Northern Pocket Gophers

An IPM program for Northern Pocket Gophers hinges on the implementation of the border control strategy where killing traps are used to remove resident pocket gophers and to intercept invaders in perimeter traplines (Table 5; see Proulx 1997a for details). It also involves natural predators, mainly birds of prey and Long-tailed Weasels. In order to maintain predators in their fields, farmers must create shelter belts and rock piles to provide small carnivores with cover protection and dens, and large trees to provide birds of prey with nest sites. Post fences usually provide raptors with appropriate perches.

The success of an IPM program depends on an effective population monitoring program that allows farmers to recognize signs of re-invasion by Northern Pocket Gophers. The presence of mounds and earth plugs (see Proulx 1997b, 2002b) indicates that pocket gophers have reinvaded empty burrow systems.

In the past, the efficacy of the border control strategy was publicized through education pamphlets that were distributed to farmers (Proulx 1996). This control technique was used by many farmers for a few years. However, pesticide companies continued to promote their products and they claimed that poisons were faster to apply and more efficient than trapping. After a few years, farmers reverted to the use of poisons (Proulx, personal notes). Educating farmers about the efficacy of control methods must be repeated year after year, and ineffective control methods must also be denounced yearly. I recommend that municipalities organize regional meetings for farmers. At these meetings, specialists who have worked with the species to be controlled, and have scientifically tested different control methods, should explain the ecology and management of species, the advantages and disadvantages of various control methods, and answer questions. During these meetings, it is important to involve local, successful farmers who have used the recommended control techniques or who endorse the proposed IPM program. Farmer and naturalist associations, PMRA, and provincial government agencies should work in concert to produce a website where farmers may find factual information about the control of rodents in various crops and at different times of year, and about other techniques such as field rotations and habitat management for predators. The website needs to be updated regularly to make sure that the information is current and relevant.

Finally, in order to control Northern Pocket Gophers over landscapes, I recommend that farmers meet and develop a strategy to work together at the implementation of an IPM program. Working together, farmers can implement methods such as the border control strategy, reduce their costs, and better control re-invasions from adjacent fields.

Table 5. Proposed IPM program for Northern Pocket Gophers.

Activity type	***Method***	***Requirement***	***Advantage***
Chemical control	None	-	This saves money to farmers
Mechanical Control	Border control strategy (Proulx 1997a) with killing box traps (Proulx 1997b).	Control must be initiated in spring before the birth of the young of the year, and maintained during the growing periods to intercept invaders in perimeters traplines.	The trapping technique is selective, safe to people, more acceptable than harmful poisons, and cheaper in the long-term.
Cultural	Maintain or establish shelterbelts along fences	The shrub border must be thick and with grasses to protect pocket gopher predators in their movements.	While the shrub border will retain snow, it will entice terrestrial and avian predators to visit fields that may be invaded by pocket gophers.
Natural Control Agents	Protect predator communities, namely birds of prey and Long-tailed Weasels.	Protection cover for terrestrial predators and perches for birds of prey must be present.	Predators help in capturing invading pocket gophers during summer, and to kill them in winter when trapping cannot be conducted.
Population Monitoring	Border control strategy (Proulx 1997a)	The border control strategy includes a monitoring strategy that allows farmers to identify re-invasion by pocket gophers.	This allows farmers to maintain control over their fields.
Education	Pamphlets and websites to explain the biology and control of pocket gophers to farmers.	Pamphlets must be made available before the beginning of the growing season to allow farmers to acquire necessary control equipment and develop a strategy for their own fields.	Farmers can find out about the true efficacy of products, eliminate ineffective poisons, and implement an effective multi-faceted control program.
Community Approach	Involving neighbors and local councils at meetings to establish a community-wide control program.	Meetings must be conducted before the growing season to put in place a strategy for the whole community.	Farmers would help each other in the control of populations and the maintenance of complex communities with natural predators.

A Proposed IPM Program for Richardson's Ground Squirrels

An IPM program for Richardson's Ground Squirrels encompasses many different control methods (Table 6). However, farmers should not initiate a program to control Richardson's Ground Squirrels until they have determined the extent of the infestation. Concentrations of ground squirrels at the edge of a field does not justify poisoning the whole field. The use of site-specific poisons such as aluminum phosphide allows one to kill ground squirrels in their burrow system while the animals are sleeping (see Proulx et al. 2011a for methodology). If some animals escape treated burrow systems, they pose no danger for predators and scavengers. If the ground squirrel infestation is over large areas, farmers may use strychnine and chlorophacinone (not in alfalfa fields) but they must implement a strict protocol to treat burrow systems and retrieve animals that are dying or are dead on surface. Because it is particularly difficult to find carcasses in fields with taller grass (e.g., McKinnon et al. 2002), I recommend that farmers treat small portions of their field, particularly those with the highest ground squirrel densities. This will allow farmers to assess the efficacy of the poison (since some rodenticides such as strychnine may not be reliable under specific environmental conditions) and to be more successful in their search of carcasses over smaller areas.

Although more research should be conducted on shooting, this control technique has long been used by farmers in the last decades (Proulx, personal observations). It allows farmers to be highly selective in the removal of animals. When controlling large populations, farmers may consider amalgamating two different methods. For example, shooting could be followed by a treatment with aluminum phosphide. Then, there is little risk of secondary poisoning while controlling large populations.

Finally, natural control by predators must be included in the IPM program. Proulx et al. (2011b) showed that American Badgers, Long-tailed Weasels, and Red Fox were effective ground squirrel predators. Michener (1979) and Proulx et al. (2011b) suggested that Long-tailed Weasels could control more than 50% of Richardson's Ground Squirrels in spring and early summer. Lokemoen and Duebbert (1976) reported the presence of Richardson's Ground Squirrel remains in 96% of Ferruginous Hawk regurgitation pellets. Schmutz et al. (1980) found that ground squirrels averaged 89% of the total prey items for Ferruginous Hawks during the nestling period. Schmutz and Hungle (1989) found that Richardson's Ground Squirrels represented 82% of prey items of Swainson's Hawks. In Alberta, Richardson's Ground Squirrels represented 68% of preys brought by Prairie Falcons (*Falco mexicanus*) at nests (Hunt 1993). All these predators have a significant impact on ground squirrel populations. It is therefore advantageous to farmers to establish shelters for these animals at the edge and within their fields.

As with Northern Pocket Gophers, education tools, the enlistment of successful producers, and a community approach are vital for the development of an effective IPM program for Richardson's Ground Squirrels.

Table 6. Proposed IPM program for Richardson's Ground Squirrels.

Activity type	***Method***	***Requirement***	***Advantage***
Chemical control	Aluminum phosphide (Proulx et al. 2011a) where ground squirrels exceed >5 animals/ha over relatively small areas, and where there is a risk of poisoning predators. Chlorophacinone in grasslands and strychnine in alfalfa fields, with strict placement of baits in burrows and daily removal of carcasses and moribund animals, to control ground squirrel population outbreaks over large areas	Control must be conducted early in early spring to remove male adults, and in late spring to remove female adults. Chemical control should be conducted immediately after severe rainstorms when many animals have already perished because of hypothermia or drowning (Proulx 2012).	Removing breeders in the spring would reduce the number of juveniles during summer.
Mechanical Control	Shooting to selectively remove ground squirrels.	Control must be initiated in spring before the births of the young of the year. Shooting must be conducted even when the controlled population has been largely reduced in numbers.	Shooting is highly selective, safe to people, more acceptable than harmful poisons, and protects predator populations.
Cultural	Maintain grasslands with ≥15cm-high vegetation to reduce invasion by ground squirrels (Proulx et al. 2012).	A strict rotation system must be implemented to avoid over-grazing by cattle. Grassland vegetation should be diversified to survive droughts and floods.	Maintaining healthy fields with tall vegetation reduces the need for ground squirrel control over summer, and provides predators with cover when hunting for ground squirrels and other rodents.
Natural Control Agents	Protect predator communities, namely birds of prey, American Badgers and Long-tailed Weasels.	Protection cover for terrestrial predators and perches for birds of prey must be present.	Predators help in capturing resident and invading ground squirrels. Badgers are particularly efficient to control ground squirrels in winter when other control methods cannot be implemented.

Activity type	*Method*	*Requirement*	*Advantage*
Population Monitoring	The densities of ground squirrels can be monitored using Proulx et al.'s (2012) 280-m-long transect method. Regular field visits allow farmers to confirm the presence of ground squirrels in their fields.	Better knowing the location of ground squirrel concentrations allow farmers to select appropriate control techniques and to act rapidly before the juveniles of the year emerge from burrow systems.	This allows farmers to maintain control over their fields.
Education	Pamphlets and websites to explain the biology and control of Richardson's Ground Squirrels to farmers.	Pamphlets must be made available before the beginning of the growing season to allow farmers to acquire necessary control equipment and develop a strategy for their own fields.	Farmers can find out about the true efficacy of products, eliminate ineffective poisons, and implement an effective multi-faceted control program.
Community Approach	Involving neighbors and local councils at meetings to establish a community-wide control program.	Meetings must be conducted before the growing season to put in place a strategy for the whole community.	Farmers would help each other in the control of populations and the maintenance of complex communities with natural predators.

Registration and Enforcement

The registration of products used in the chemical control of rodents, and the enforcement of the baiting directions and use restrictions, are important to minimize rodenticide misuse and abuse. The effectiveness of a rodenticide, and its registration, must be based on scientific assessments carried out in the field. If a registered product is found to be ineffective to control a species under specific conditions, its registration should be reviewed by PMRA. A federal-provincial system needs to be established so that farmers can report when, where and how they plan to use a rodenticide. Provincial and Federal Conservation Officers and PMRA Inspectors could then visit treated sites and confirm that poison baits have been properly used. Inspectors should travel rural areas and recognize improper applications of poison baits on surface or with the use of inadequate bait stations. The use of poisons, and the implementation of IPM programs, requires that government authorities keep a strong watch on people who misuse rodenticides and falsely claim that they are following the recommendations of IPM programs.

Finally, there is a need to integrate IPM and Species-at-Risk programs. Where the presence of Species-at-Risk is known, federal and provincial Conservation Officers should work together to ensure that actions to control Northern Pocket Gophers and Richardson's Ground Squirrels do not endanger the future of Species-at-Risk at the local level.

Discussion

Much has been learned about poison efficacy and selectivity during the Northern Pocket Gopher and Richardson's Ground Squirrel control research programs. These research programs led to the development of the border control strategy for Northern Pocket Gophers (Proulx 1997a), the confirmation that aluminum phosphide was an effective control method for Richardson's Ground Squirrels (Proulx et al. 2011a), and the identification of predators that can contribute significantly to the control of pocket gophers and ground squirrels population densities (Proulx 2000, Proulx et al. 2011a). The IPM programs proposed in this paper integrate these findings and those from other research programs over several years. The proposed IPM programs are based on a state-of-the-art understanding of the biology of the rodent species, and on factual information about control methods. However, these IPM programs still need to be tested under different environmental conditions to determine how and when to use control methods to effectively control rodent populations and avoid destroying non-target populations and predator communities. Not one of the control methods for Northern Pocket Gophers and Richardson's Ground Squirrels will work alone. Even with the border control strategy for pocket gophers, there is a need to maintain Long-tailed Weasels to control Northern Pocket Gopher in winter. Although tall vegetation will help maintain low densities of Richardson's Ground Squirrels, aluminum phosphide will be needed in areas with larger concentrations of animals.

None of the methods identified in IPM programs will succeed in controlling pocket gophers and ground squirrels during population outbreaks (Witmer and Proulx 2010). An IPM program must be perceived as a preventive approach to avoid population outbreaks. It is therefore necessary to continuously monitor populations at landscape level, and determine how and when an IPM program needs to be implemented to avoid population outbreaks.

Season after season, and year to year, farmers have used large quantities of strychnine and chlorophacinone baits to control Northern Pocket Gophers without success. One would think that these repeated uses and poor control performances would suffice to convince farmers to use alternative methods. However, old ways die hard! When farmers complain that trapping is labour-intensive, they fail to recognize that applying poison baits also takes time, and it is a waste of time if these poisons do not work well. The use of strychnine to control Richardson's Ground Squirrels and the use of chlorophacinone in alfalfa fields are examples of poor registration standards and undue political interference in the practice of pest control. Fortunately, with the proposed IPM programs, errors of judgement and poor poison management practices can be corrected. Knowing that healthy predator communities can control more than 50% of rodent populations, farmers can change their attitude towards American Badgers, Long-tailed Weasels and Red Foxes and find ways to accommodate their needs and benefit from their hunting activities. Education is often enough to convince farmers to change their ways. However, for those farmers who are concerned only with making profits at all costs, enforcement may be necessary to ensure they implement control alternatives.

Registering strychnine, even though it is unreliable and non-selective, is an example of a lack of logic within our governments. Indeed, every year millions of dollars are spent on the assessment of the status of species and the development of recovery programs often involving the re-introduction of Species-at-Risk. At the same time the government allows farmers to endanger Species-at-Risk with poison baits that are ineffective towards the intended target species. PMRA, provincial agriculture departments, and Environment Canada need to work together to ensure that IPM programs are being used instead of devastating poisons.

In conclusion, registering poisons and developing prescription labels on how to use them will not ensure the long-term control of Northern Pocket Gopher and Richardson's Ground Squirrel populations, and the protection of predators and Species-at-Risk. The long-term control of these rodents and the conservation of wildlife in agricultural regions are tied to the successful development and implementation of IPM programs, along with an effective registration of chemical products, and the proper enforcement of bait application directions to minimize the misuse of poisons.

Literature Cited

Alberta Agriculture and Rural Development. 2008. Control of pocket gophers and ground squirrels. Agdex 684-1. Available at http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/agdex897 (Accessed 21 November 2012).

Anthony, R. M., and V. G. Barnes, Jr. 1983. Plot occupancy for indicating pocket gopher abundance and conifer damage. Pages 247-255 *in* D. E. Kaukeinen, editor. Proceedings Vertebrate Pest Control and Management Materials. Fourth Symposium ASTM STP 817, American Society for Testing and Materials, Philadelphia, Pensylvania.

Arjo, W. M, and D. L. Nolte. 2004. Assessing the efficacy of registered underground baiting products for mountain beaver (*Aplodontia rufa*) control. *Crop Protection* 23: 425-430.

Baldwin, R. A. 2011. Developing an IPM program for controlling pocket gophers and voles in alfalfa. Proceedings 2011 Western Alfalfa & Forage Symposium, Las Vegas, Nevada.

Bechard, M.J. 1982. Effect of vegetative cover on foraging site selection by Swainson's Hawk. *Condor* 84: 153-159.

Benoit, L. 2012. Benoit's 14-year campaign against gophers successful. News Release, House of Commons, Ottawa, Ontario, Canada.

Berdoy, M., and P. Smith. 1993. Arms race and rat race: adaptations against poisoning in the brown rat. *Revue Ecologique (Terre et Vie)* 48: 215-228.

Brookes, V. J. 1975. Poisons. R. E. Krieger Publ. Co., Huntington, New York.

DeWandel, M., R. Baydack, G. Bonnefoy, D. Campbell, J. Dubois, and B. Troutt. 1997. Economic impacts of the northern pocket gophers (*Thomomys talpoides*) on forage production in Manitoba. Burrowing Rodent Damage Control Workshop, 18-20 March, Edmonton, Alberta. Pages 45-78.

Eisemann, J. D., and B. E. Petersen. 2002. Human poisonings and rodenticides: evaluation of incidents reported to the American Association of Poison Control Centers. Proceedings Vertebrate Pest Conference 20: 290-294.

Engeman, R. M., D. L. Campbell, and J. Evans. 1993. A comparison of 2 activity measures for northern pocket gophers. *Wildlife Society Bulletin* 21: 70-73.

Fagerstone, K., G. Matschke, and D. Elias. 1981. Radiotelemetry to evaluate effectiveness of a new fumigant cartridge for controlling ground squirrels. Proceedings 3rd International Conference Wildlife Biotelemetry, Laramie, New York. Pages 20-25.

Hadler, M. R., and A. P. Buckle. 1992. Forty-five years of anticoagulant rodenticides – Past, present and future trends. Pages 149-155 *in* J. E. Borrecco and R. E. Marsh, editors. Proceedings 15th Vertebrate Pest Conference, Newport Beach, California.

Hegdal, P. L., and T. A. Gatz. 1977. Hazards to seed eating birds and other wildlife associated with surface strychnine baiting for Richardson's ground squirrels. Environmental Protection Agency report under Interagency Agreement EPA-IAG-D4-0449.

Hosea, R. C. 2000. Exposure of non-target wildlife to anticoagulant rodenticides in California. Pages 236-244 *in* T. P. Salmon and A. C. Crabb, editors. Proceedings 19 Vertebrate Pest Conference, University of California, Davis.

Howell, J., and W. M. Wishart. 1969. Strychnine poisoning in Canada geese. *Bulletin Wildlife Disease Association* 5: 119.

Hunt, L. E. 1993. Diet and habitat use of nesting Prairie Falcons (*Falco mexicanus*) in an agricultural landscape in southern Alberta. M.Sc. Thesis. University of Alberta, Edmonton, Alberta.

Isern, T. D. 1988. Gopher tales: A study in Western Canadian pest control. *Agriculture Historical Review* 36: 188-198.

James, P.C., J. A. Fox, and T. F. Ethier. 1990. Is the operational use of strychnine to control ground squirrels detrimental to burrowing owls? *Journal of Raptor Research* 24: 120-123.

Landals, D. C. 1993. Vet attacks availability of poisons. Alberta Farm & Ranch, July-August: 6-8.

Laycock, W. A. 1957. Seasonal periods of surface activity of the pocket gopher. *Journal of Mammalogy* 38: 132-133.

Lee, L. L., W. E. Howard, and R. E. Marsh. 1990. Acquired strychnine tolerance by pocket gophers. Pages 87-90 *in* L. R. Davis and R. E. Marsh, editors. Proceedings of 14th Vertebrate Pest Conference, Davis, California.

Lewis, S. R., and J. O'Brien. 1986. The effectiveness of strychnine laced alfalfa on pocket gopher activity in Diamond Valley, Nevada. Pages 116-19 *in* T. P. Salmon, editor. Proceedings 12th Vertebrate Pest Conference, Davis, California.

Ling, B., J. Alcorn, B. Laarveld, and A. A. Olkowski.2009. Toxin metabolism potential in Richardson's ground squirrels (*Urocitellus richardsonii*) in the context of chemical control of this pest. *Journal of Pest Science* 82: 273-281.

Littrell, E. E. 1990. Effects of field vertebrate pest control on nontarget wildlife (with emphasis on bird and rodent control). Pages 59-61 *in* L. R. Davis and R. E. Marsh, editors. Proceedings of 14th Vertebrate Pest Conference.

Lokemoen, J. T., and H. F. Duebbert. 1976. Ferruginous hawk nesting ecology and raptor populations in northern South Dakota. *The Condor* 78: 464-470.

Marsh, R. E. 1992. Reflections on current (1992) pocket gopher control in California. Pages 289-295 in J. E. Borrecco and R. E. Marsh, editors. Proceedings of 15th Vertebrate Pest Conference, University of California, Davis.

McKinnon, D.T., and P. Mineau. 2004. Effectiveness and non-target impact of zinc phosphide and various concentrations of strychnine in controlling Richardson's ground squirrels in Saskatchewan. Unpublished report, Saskatchewan Environment, Regina, Saskatchewan.

McKinnon, D.T., P. Mineau, L.D. Knopper and C. Wilk. 2002. Strychnine poisoning of non-target species resulting from ground squirrels control. Unpublished report, Saskatchewan Environment, Regina, Saskatchewan.

Meehan, A. P. 1984. Rats and mice: their biology and control. Rentokil Ltd., Felcourt, East Grinstead, W. Sussex, Great Britain, Mimeograph.

Mendenhall, V. M., and L. F. Pank. 1980. Secondary poisoning of owls by anti-coagulant rodenticides. Wildlife Society Bulletin 8: 311-315.

Michener, G. R. 1979. Yearly variations in the population dynamics of Richardson's ground squirrels. *Canadian Field-Naturalist* 93: 363-370.

Miller, J. G. 1984. The treatment of accidental anticoagulant toxicity in the canine. Pages 99-100 *in* D. O. Clark, editor. Proceedings of 11th Vertebrate Pest Conference, Sacramento, California.

Miller, M. A. 1948. Seasonal trends in burrowing of pocket gophers (*Thomomys*). *Journal of Mammalogy* 29: 38-44.

Miller, R. S., and H. E. Bond. 1960. The summer burrowing activity of pocket gophers. *Journal of Mammalogy* 41: 469-475.

Morgan, J. 2012. Benoit reflects on a packed 2012. Lloydminster Source. http://www.lloydminstersource.com/News/tabid/68/entryid/2748/Default.aspx , accessed January 2013.

Nacham, M., and P. Hartley. 1975. Role of illness in producing learned taste aversions in rats: A comparison of several rodenticides. *Journal Comparative Physiology and Psychology* 89:1010-1018.

Nietfeld, M. T., and L. D. Roy. 1992. Alberta pocket gopher survey, 1990. Alberta Environmental Centre report, Vegreville.

Owen Carter, T. 1993. No more strychnine. Alberta Report, July: 20.

Pest Management Regulatory Agency (PMRA). 2005. Re-evaluation of strychnine. Mimeograph PACR2005-08, Ottawa, Ontario.

Proulx, G. 1996. Biology and control of the northern pocket gopher (*Thomomys talpoides*) in Alberta. Leaflet, Counties' Pocket Gopher Control Research Program, County of Red Deer, Alberta, 6 pages.

Proulx, G. 1997a. A northern pocket gopher (*Thomomys talpoides*) border control strategy: promising approach. *Crop Protection* 16: 279-284.

Proulx, G. 1997b. A preliminary evaluation of four types of traps to capture northern pocket gophers, *Thomomys talpoides*. *Canadian Field-Naturalist* 111: 640-643.

Proulx, G. 1998. Evaluation of strychnine and zinc phosphide baits to control northern pocket gophers (*Thomomys talpoides*) in alfalfa fields in Alberta, Canada. *Crop Protection* 17: 135-138.

Proulx, G. 2000. Winter movements of long-tailed weasels in alfalfa fields inhabited by northern pocket gophers. Pages 13-15 *in* B. K. Calverley, editor. Proceedings First Alberta North American Waterfowl Management Plan Biodiversity Conference, Edmonton, Alberta

Proulx, G. 2002a. The northern pocket gopher. I – Knowing the species. Wildlife Control Technology 9: 18-21

Proulx, G. 2002b. Effectiveness of trapping to control northern pocket gophers in agricultural lands in Canada. Proceedings Vertebrate Pest Conference 20: 26-31.

Proulx G. 2010. Factors contributing to the outbreak of Richardson's ground squirrel populations in the Canadian Prairies. Proceedings Vertebrate Pest Conference 24: 213-217.

Proulx, G. 2011a. The 2010 Richardson's ground squirrel research & control program. Alpha Wildlife Research & Management Ltd. report submitted to Saskatchewan Association Rural Communities (SARM), Regina, Saskatchewan.

Proulx, G. 2011b. Field evidence of non-target and secondary poisoning by strychnine and chlorophacinone used to control Richardson's ground squirrels in southwest Saskatchewan. Pages 128-134 *in* D. Danyluk, editor. Patterns of Change. Proceedings of the 9th Prairie Conservation and Endangered Species Conference, February 2010. Critical Wildlife Habitat Program, Winnipeg, Manitoba.

Proulx, G. 2012. High spring mortality of adult Richardson's ground squirrels, *Urocitellus richardsonii*, associated with a severe rainstorm in southwest Saskatchewan. *Canadian Field-Naturalist* 126: 148-151.

Proulx, G., M. J. Badry, P. J. Cole, R. K. Drescher, A. J. Kolenosky, and I. M. Pawlina. 1994. Evaluation of chlorophacinone and selenium to kill northern pocket gophers (*Thomomys talpoides*). Alpha Wildlife Research & Management Ltd. report, Counties' Pocket Gopher Control Research Program, County of Red Deer, Alberta. 10 pages.

Proulx, G., M. J. Badry, P. J. Cole, R. K. Drescher, A. J. Kolenosky, and I. M. Pawlina. 1995a. Summer activity of northern pocket gophers, *Thomomys talpoides*, in a simulated natural environment. *Canadian Field-Naturalist* 109: 210-215.

Proulx, G., M. J. Badry, P. J. Cole, R. K. Drescher, A. J. Kolenosky, and I. M. Pawlina. 1995b. Summer above-ground movements of northern pocket gophers, *Thomomys talpoides*, in an alfalfa field. *Canadian Field-Naturalist* 109: 256-258.

Proulx, G., and P. J. Cole. 1998. Identification of northern pocket gopher, *Thomomys talpoides*, remains in long-tailed weasel, *Mustela frenata longicauda*, scats. *Canadian Field-Naturalist* 112: 345-346.

Proulx, G., and P. Feldstein. 1994. The control of the Richardson's ground squirrel in agriculture: current techniques and future needs. Alpha Wildlife Research & Management Ltd. report submitted to Alberta Agriculture, Food and Rural Development, Edmonton, Alberta.

Proulx, G., and N. MacKenzie. 2012. Relative abundance of American badger (*Taxidea taxus*) and red fox (*Vulpes vulpes*) in two landscapes with high and low rodenticide poisoning levels. *Integrative Zoology* 7: 41-47.

Proulx, G., N. MacKenzie, B. Proulx, and K. MacKenzie. 2011b. Relationships among predators, prey and habitat use in southern Saskatchewan, spring & summer 2010. Alpha Wildlife Research & Management Ltd. report submitted to Saskatchewan Association Rural Communities (SARM) and Saskatchewan Agriculture Development Fund, Regina, Saskatchewan.

Proulx, G., K. MacKenzie, and N. MacKenzie. 2012. Distribution and relative abundance of Richardson's Ground Squirrels, *Urocitellus richardsonii*, according to soil zones and vegetation height in Saskatchewan during a drought period. *Canadian Field-Naturalist* 126: 103-110.

Proulx, G., N. MacKenzie, K. MacKenzie, B. Proulx, and K. Stang. 2010b. The Richardson's ground squirrel (*Urocitellus richardsonii*) research & control program 2009-2010. Alpha Wildlife Research & Management Ltd. report submitted to Saskatchewan Association Rural Communities (SARM), Regina, Saskatchewan.

Proulx, G., N. MacKenzie, K. MacKenzie, and K. Walsh. 2011a. Efficacy of aluminum phosphide tablets to control Richardson's ground squirrel (*Urocitellus richardsonii*) populations in southern Saskatchewan, Canada. *Crop Protection* 30: 1039-1042.

Proulx, G., N. MacKenzie, K. MacKenzie, K. Walsh, B. Proulx, and K. Stang. 2010a. Strychnine for the control of Richardson's ground squirrels: efficiency and selectivity issues. Proceedings Vertebrate Pest Conference 24: 125-128.

Proulx, G., and K. Walsh. 2007. Effectiveness of aluminium phosphide, strychnine, and chlorophacinone to control Richardson's ground squirrels (*Urocitellus richardsonii*) in spring, in southern Saskatchewan. Alpha Wildlife Research & Management Ltd. report submitted to Pest Management Regulatory Agency, Ottawa, Ontario.

Proulx, G., K. Walsh, N. MacKenzie, and K. MacKenzie. 2009. Assessment of the effectiveness of Rozol®, Phostoxin®, Strychnine, RoCon®, and various treatments to control Richardson's ground squirrels

(*Urocitellus richardsonii*) in southern Saskatchewan, in spring and summer 2008. Alpha Wildlife Research & Management Ltd. report submitted to Saskatchewan Agriculture Development Fund, Regina, Saskatchewan.

Record, C. R. 1978. Ground squirrel and prairie dog control in Montana. Proceedings Vertebrate Pest Conference 8: 93-97.

Salmon, T. P., and R. A. Baldwin. 2009. Pests ain gardens and landscapes; Pocket gophers. Available at http://www.ipm.ucdavis.edu/PMG/PESTNOTES/pn7433.html. Accessed 23 November 2012.

Saskatchewan Agriculture. 2010. OC 146/2010 - The Pests Declaration Amendment Regulations, 2010, Regina, Saskatchewan.

Schmutz, J. K. 1987. The effect of agriculture on Ferruginous and Swainson's hawks. *Journal of Range Management* 40: 438-440.

Schmutz, J. K., and D. J. Hungle. 1989. Population of ferruginous and Swainson's hawks increase in synchrony with ground squirrels. *Canadian Journal of Zoology* 67: 2596-2601.

Schmutz, J. K., S. M. Schmutz, and D. A. Boag. 1980. Coexistence of three species of hawks (*Buteo* spp.) in the prairie-parkland ecotone. *Canadian Journal of Zoology* 58: 1075-1089.

Schultz, T. 2008. Rozol tips. Edmonton Exterminators Informa-tion Sheet provided to Mankota farmers, Mankota, Saskatchewan.

Stewart, W. J., and J. M. Barss. 1985. Predation by three owl species on northern pocket gophers of different body mass. *Oecologia* 67: 76-81.

Tickes, B. R. 1983. Gopher control in alfalfa. Proceedings 13th Conference Alfalfa Symposium, University of California, Davis, California.

Tickes, B. R. , L. K. Cheatham, and J. L. Stair. 1982. A comparison of selected rodenticides for the control of the common valley pocket gopher (*Thomomys bottae*). Pages 201-204 in R.E. Marsh, editor. Proceedings of 10th Vertebrate Pest Conference, University of California, Davis, California.

Tunberg, A. D., W. E. Howard, and R. E. Marsh. 1984. A new concept in pocket gopher control. Pages 7-16 in Proceedings of 11th Vertebrate Pest Conference, University of California, Davis, California.

Turner, G. T., R. M. Hansen, V. H. Reid, H. P. Tietjen, and A. L. Ward. 1973. Pocket gophers and Colorado mountain rangeland. Colorado State University Experimental Station, Fort Collins, Bulletin No. 554S.

Uresk, D. W., R. M. King, A. D. Apa, M. S. Deisch, and R. L. Linder. 1987. Rodenticidal effects of zinc phosphide and strychnine on nontarget species. Pages 57-63 in 8th Great Plains Wildlife Damage Control Workshop Proceedings.

Vaughan, T. A. 1961. Vertebrates inhabiting pocket gopher burrows in Colorado. *Journal of Mammalogy* 42: 171-174.

Vossen, P., and P. Gadd. 1990. A comparison of several pocket gopher baits in the field. Proceedings Vertebrate Pest Conference 14: 91-94.

Wamock, N., and S. E. Scwarzbach. 1995. Incidental kill of dunlin and killdeer by strychnine. *Journal of Wildlife Diseases* 31: 566-569.

Whittaker, J. C., E. List, J. R. Tester, and D. P. Christian. 1991. Factors influencing meadow vole, *Microtus pennsylvanicus*, distribution in Minnesota. *Canadian Field-Naturalist* 105: 403-405.

Wilk, C., and S. Hartley. 2008. Management of Richardson's ground squirrel. Agriview, Regina, Saskatchewan. Website: http://www.agriculture.gov.sk.ca?agriview_March_08_7.

Willis, D. W. Undated. Characteristics of a pocket gopher. Mimeograph. Goodwin Enterprises, Sundre, Alberta, Canada

Witmer, G., and G. Proulx. 2010. Rodent outbreaks in North America. Pages 253-267 *in* G. R. Singleton, S. R. Belmain, P. R. Brown, and B. Hardy, editors, Rodent outbreaks – ecology and impacts. International Rice Research Institute, Metro Manila, Philippines.

Wobeser, G. A., and B. R. Blakley. 1987. Strychnine poisoning of aquatic birds. *Journal of Wildlife Diseases* 23: 341-343.

ANTICOAGULANT RODENTICIDES ARE PERVASIVE CONTAMINANTS OF TERRESTRIAL BIRDS OF PREY

J. ELLIOTT, **S. HINDMARCH**, **L. WILSON** and **F. MAISONNEUVE**
Pacific Wildlife Research Centre, Science and Technology Branch, Environment Canada, c/o Center for Wildlife Ecology, Simon Fraser University, Burnaby, BC V5A 1S6.

Abstract: Previous studies, including our own, have reported a high incidence of liver residues of commonly used second generation anticoagulant rodenticide (SGAR) compounds, in raptors, especially rodent-eating hawk and owl species. A proportion of birds tested commonly exhibit symptoms of anti-coagulant poisoning. In the present study we widened the scope of sampling to include other hawk and falcon species. Of 130 raptors analyzed using high resolution GC/MS/MS from a recent survey of birds collected between 2005 -2011, from a predominantly agricultural and/or urban landscape, 94% had detectable liver residues of at least one SGAR compound. Barred (*Strix varia*) and Great Horned Owls (*Bubo virginianus*) had the highest incidence of exposure and the greatest residue concentrations. The mechanism by which this occurs might be partly explained by a shift in the diet of Barred and Great Horned Owls, as a concurrent diet study showed that the consumption of rats and house mice coincides with increased urbanization within home ranges. In particular urban Barred Owls had the largest proportion of rats in their diet, with some individuals' diet consisting primarily of rats. The shift in the diet of owls living in urbanized areas may potentially lead to an increased risk of secondary SGAR poisoning. However, 5 of 5 Peregrine Falcons (*Falco peregrinus*) and 5 of 5 Sharp-shinned Hawks (*Accipter striatus*) tested had residues of at least two SGAR compounds, indicating pervasive contamination of the food chains of terrestrial birds of prey. The process by which smaller avian prey of falcons and accipiter hawks are contaminated is not known. Temporal trends and spatial patterns of SGAR contamination will be discussed within the context of prairie ecosystems.

Editor's note: Due to unforeseen circumstances, this talk was not given at the conference. The abstract is included in case any readers want to contact the authors about the topic.

SESSION 9: FISHERIES MANAGEMENT

ENGAGING ANGLERS IN NATIVE TROUT RECOVERY IN SOUTHERN ALBERTA: THE STEWARDSHIP LICENSE PILOT PROJECT

J.E. EARLE and **J.D. STELFOX**
Fisheries Management Branch, Alberta Environment and Sustainable Resource Development, Cochrane, Alberta.
Phone: 403-851-2211, Email: Jennifer.Earle@gov.ab.ca

Abstract: Brook Trout (*Salvelinus fontinalis*), although not native to Alberta, are present in many montane and foothills waters as a result of extensive stocking. In southern Alberta, Brook Trout populations have generally increased while native Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) and Bull Trout (*Salvelinus confluentus*) populations have declined. Attempts to conserve and restore native salmonids often require removing or reducing non-native species. The Stewardship Licence Pilot Project, initiated by Fish and Wildlife in 2009, is a collaborative project with Trout Unlimited Canada. The objectives of the project are to: 1) remove, by angling, as many Brook Trout as possible from specified streams so as to facilitate a recovery of the native trout populations, 2) increase public awareness about the importance of fish identification and the threat that invasive, non-native salmonids pose to native salmonids and 3) encourage stakeholder participation in recovery of native trout populations. In order to participate in the project, anglers must annually pass a three-species fish identification test and have completed one supervised outing. In 2012, outings were conducted on seven streams in three drainages in the Bow and Oldman River watersheds. Angler hours increased from 53 in the first year to 1,100 in 2012. The number of Brook Trout harvested increased from 104 in 2009 to 2,064 in 2012. A summary of the first several years of the project, including findings of interest, will be presented. The value and future of this project and other stewardship initiatives aimed at native fish will be discussed.

Living with a Cutthroat, Life at the Edge – A Westslope Cutthroat Trout Riparian Health and Multi-Stakeholder Engagement Project

KATHYRN HULL[1,2] **and NORINE AMBROSE** [1,3]

[1] The Alberta Riparian Habitat Management Society (Cows and Fish), 2nd Floor, YPM Place, 530 - 8th Street South, Lethbridge, Alberta T1J 2J8. Website: www.cowsandfish.org

Email: [2] khull@cowsandfish.org; [3] nambrose@cowsandfish.org

Abstract: Reduced to less than 10% of its' historic range, Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisii*) is now confined to a few, isolated headwater reaches in Alberta's eastern slopes. Native pure stocks of Westslope Cutthroat Trout are designated as Threatened under Alberta's *Wildlife Act* and the federal *Species at Risk Act*. Given the importance of riparian areas to this species, maintaining riparian health in these remaining reaches is a priority for its continued survival. In 2011 and 2012, The Alberta Riparian Habitat Management Society (Cows and Fish) conducted 32 riparian health inventories (RHIs) in priority Westslope Cutthroat Trout streams in southwestern Alberta (as far north as the Ghost River watershed). This baseline riparian health data will be used to help broaden awareness among land user groups and land managers about this Threatened native trout species and its habitat requirements. The goal is to encourage collaborative beneficial land use practices to aid in its recovery. Study results will support ongoing joint federal and provincial recovery efforts by identifying habitat issues and informing land use management and habitat protection or enhancement projects in priority conservation areas.

Introduction

In 2011 and 2012, the Alberta Riparian Habitat Management Society (Cows and Fish) conducted riparian health inventories (RHIs) along streams and rivers with native pure or near pure strains of Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisii*) populations in the south eastern slopes of Alberta. The main intent of this project is to assess and generate awareness about the current condition of priority Westslope Cutthroat Trout riparian habitat and provide suggestions to land managers for ways to maintain or improve this habitat. Engaging diverse stakeholders and partners to work together where multiple land uses overlap is integral to implementing such improvements. The project was initiated by Cows and Fish in collaboration with Alberta Environment and Sustainable Resource Development (AESRD), Fisheries and Oceans Canada (DFO), the Alberta Conservation Association (ACA) and Trout Unlimited Canada (TUC). Funding for this project was provided through grants administered by ACA and through financial support provided by the Government of Canada (Environment Canada's Habitat Stewardship Program). This project was also made possible through grants and in-kind support provided by AESRD, Alberta Agriculture and Rural Development, the Alberta Beef Producers and other Cows and Fish members and supporters.

Once plentiful in Alberta, the historical range of Westslope Cutthroat Trout formerly extended from the upper headwaters of the Bow River watershed above Bow Lake in Banff National Park, downstream to the plains downstream of Calgary (Costello 2006). In the Oldman River watershed, original native range extended from the headwater falls below Cache Creek downstream to the plains, including all of the major tributaries to the

Oldman River (the Livingstone, Crowsnest, Castle and Belly Rivers and Willow Creek) (Costello 2006, The Alberta Westslope Cutthroat Trout Recovery Team 2013). There has since been a dramatic decline in the abundance and distribution of Westslope Cutthroat Trout in Alberta due to the cumulative effects of over fishing, introduction of non-native trout, habitat loss and degradation (e.g., from road construction, agriculture, mining, deforestation, off-highway vehicle impacts, damming and dewatering, urbanization etc.) and eutrophication or water pollution of cutthroat trout-bearing streams (The Alberta Westslope Cutthroat Trout Recovery Team 2013). In a significant portion of their original range, Westslope Cutthroat Trout have hybridized with introduced Rainbow Trout (*Oncorhynchus mykiss*) or have been out-competed by non-native species like Brook Trout (*Salvelinus fontinalis*). Today, genetically pure native populations occur in a small portion of the species' historical range. As a consequence, native stocks of Westslope Cutthroat Trout are presently listed as Threatened in Alberta under the provincial *Wildlife Act* and have recently been up-listed to Threatened under the federal *Species At Risk Act* (as of March 2013; The Alberta Westslope Cutthroat Trout Recovery Team 2013).

Project Area Description

RHI locations for this project were identified and selected in consultation with fisheries experts from AESRD, DFO, ACA and TUC. RHI sites were strategically selected on watercourses where recent fisheries assessments have confirmed the presence of genetically pure or near pure (95% purity or higher) Westslope Cutthroat Trout populations. In total, 32 RHI sites were assessed by Cows and Fish in 2011 and 2012 on 22 foothills and montane streams in the Bow River and Oldman River watersheds. RHI data previously collected by Cows and Fish in 2005 and 2010 from five native pure Westslope Cutthroat Trout streams in these watersheds were also included in the final dataset. The combined total project area encompassed 24.3 km of bank length and approximately 63 ha of riparian habitat on 27 streams. Most of the project area is on provincially owned Public Land, within multi-use Alberta Forest Reserve lands managed by AESRD, including several Public Land Use Zones and provincial grazing allotments. Primary land uses in the project area include recreation, livestock grazing, logging, and oil and gas exploration. Many sub-basins within the project area are popular with non-motorized (horseback riding, hiking and biking) and motorized recreational users (various types of off-highway vehicles).

Methods

Riparian Health Inventory polygons encompass a minimum of two channel meander cycles. Delineation of riparian polygon extent is done based on soil, vegetation and topographic indicators of riparian extent. Riparian Health ratings are determined from field examination of the following 11 parameters: 1) total vegetation cover; 2) invasive species (i.e., *noxious* and *prohibited noxious* weeds listed in Alberta's *Weed Control Act*) cover and density distribution; 3) disturbance-caused herbaceous species cover; 4) preferred tree and shrub establishment and regeneration (seedling and sapling presence); 5) intensity of wildlife or livestock browse utilization and the amount of woody plant removal by Beaver (*Castor canadensis*) or human cuttings; 6) standing decadent and dead woody cover; 7) streambank rootmass protection; 8) human-caused bare ground cover; human-caused physical (structural) alterations to the 9) streambank and 10) soil profile of the remainder of the riparian area; and 11) channel incisement (i.e., downward erosion of the stream channel). Each parameter is scored according to a categorical system as described by Fitch *et al.* (2009) and Cows and Fish (2013). Final riparian health ratings of 'healthy', 'healthy, but with problems' and 'unhealthy' are assigned to sites with overall parameter scores of >80%, 60-79%, and <60%, respectively (Fitch *et al.* 2009). Additional biophysical information is collected during the inventory to help monitor changes in the plant community and soil/hydrology characteristics of the riparian site over time. For monitoring purposes, benchmark photographs facing upstream and downstream are taken at each end of the stream reach. Additional photographs are taken where warranted to document features of interest or concern (e.g., weed infestations, bank erosion etc.).

Results and Discussion

The average riparian health rating for the 37 RHI sites evaluated as part of this project is 85% ('healthy'). The majority of sites (67%) rated as 'healthy' and only one site rated as 'unhealthy' (Figure 1).

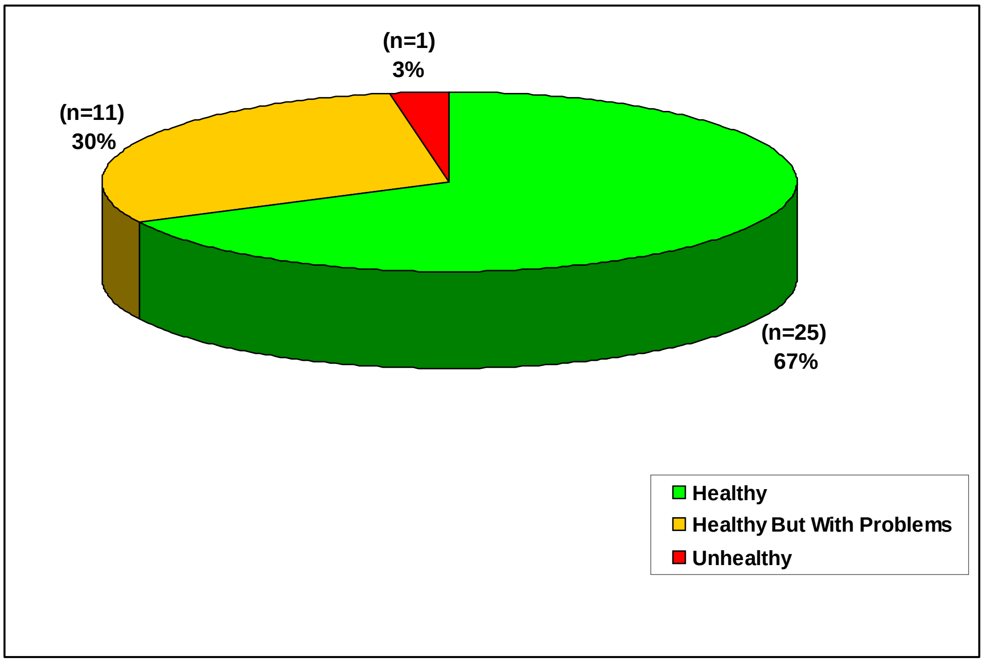


Figure 1. 2011 and 2012 Westslope Cutthroat Trout Project Area Riparian Health Results (n = 37*) (**includes data from 5 native pure Westslope Cutthroat Trout stream reaches assessed by Cows and Fish in the Ghost River and Oldman River watersheds in 2010 and 2005, respectively*).

Most of the 'healthy' sites represent steep-sided mountain streams with a very narrow riparian area. By contrast, most of the sites in the 'healthy, but with problems' and 'unhealthy' categories are more easily accessible to livestock or humans due to more gently sloping terrain and wider floodplains. This difference is represented in Figure 2 which shows that by area, only 49% (approximately 31 ha) of the riparian habitat extent evaluated is in the 'healthy' category.

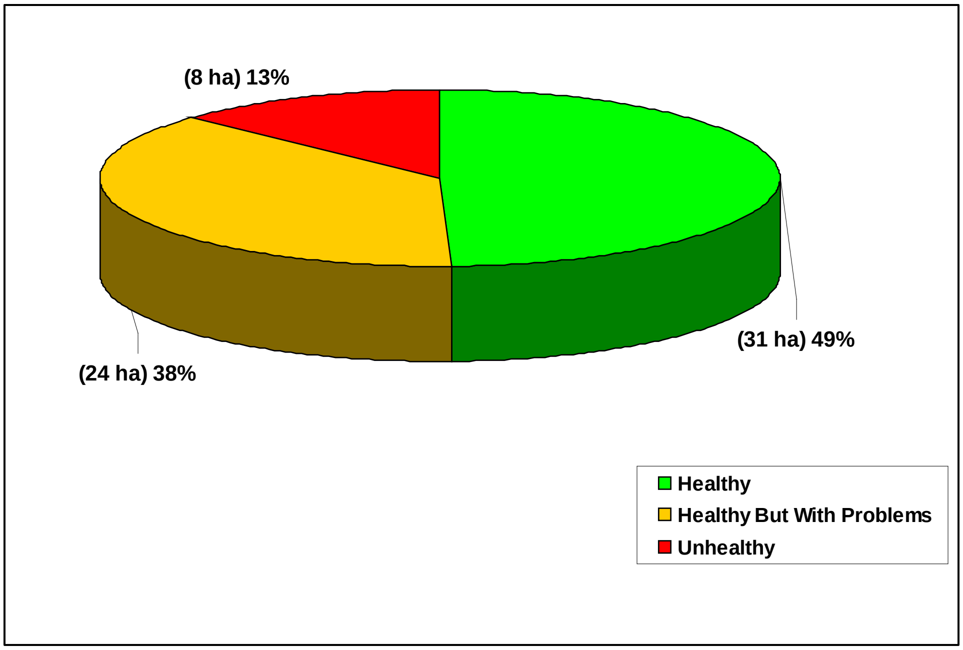


Figure 2. 2011 and 2012 Riparian Health Results by Area (n = 37*)(**includes data from 5 native pure Westslope Cutthroat Trout stream reaches assessed by Cows and Fish in the Ghost River and Oldman River watersheds in 2010 and 2005, respectively*).

With some exceptions, most sites we assessed have over 95% vegetation cover in the riparian area, healthy levels of establishment and regeneration of native trees and shrubs, low levels of woody vegetation removal by Beavers or humans, and low levels of dead and decadent trees and shrubs (**Figure 3**). These vegetation parameters indicate that riparian tree and shrub communities in the study area are providing erosion protection, stream shading and water filtration functions of benefit to Westslope Cutthroat Trout and overall water quality (Costello 2006; The Alberta Westslope Cutthroat Trout Recovery Team 2013**)**. One of the vegetation health concerns we observed are high levels of disturbance-caused plants (Figure 3) such as Common Dandelion (*Taraxacum officinale*), Kentucky Bluegrass (*Poa pratensis*) and Clover (*Trifolium* spp.). These types of non-native introduced plants encroach quickly along disturbed vehicle and cattle trails, pipeline corridors or random camping areas. Also of concern is the presence of invasive plants in the project area, including six *noxious* weeds: Blueweed (*Echium vulgare*), Canada Thistle (*Cirsium arvense*), Common Mullein (*Verbascum thapsus*), Ox-eye Daisy (*Chrysanthemum leucanthemum*), Perennial Sow-thistle (*Sonchus arvensis*) and Tall Buttercup (*Ranunculus acris*); and one *prohibited noxious* weed, Orange Hawkweed (*Hieracium aurantiacum*). Ox-eye Daisy, with occurrence in 11 of the RHI sites, is the most prevalent and abundant invasive species in the project area, particularly in portions of the Castle River watershed. Once these types of aggressive weeds become established, this can lead to permanent changes to native riparian plant communities. Often, one of the negative consequences of this to Westslope Cutthroat Trout is loss of streambank rootmass protection and accelerated rates of bank erosion because invasive and disturbance-caused plants often have shallow creeping roots that are not adequate for maintaining bank stability.

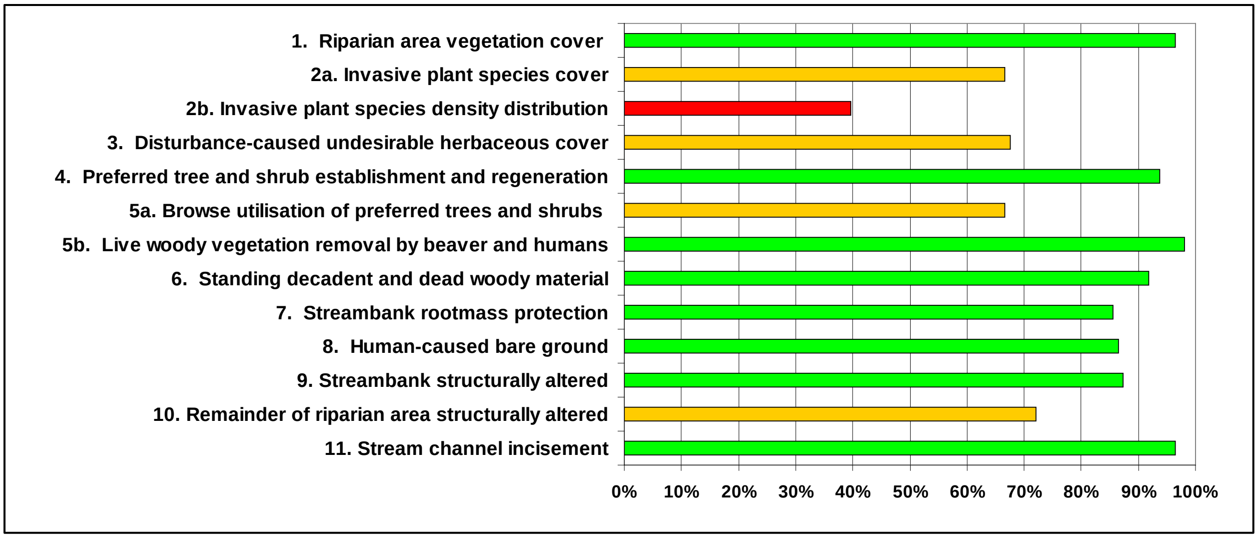


Figure 3. 2011 and 2012 Westslope Cutthroat Trout Riparian Health Parameter Average Scores (n = 37*) **includes data from 5 native pure Westslope Cutthroat Trout stream reaches assessed by Cows and Fish in the Ghost River and Oldman River watersheds in 2010 and 2005, respectively.*

Soil and hydrology riparian health parameters rated 'healthy' on average for most sites, except for human-caused physical alterations to the remainder of the riparian area (not including the streambank) (Figure 3). We observed minor to severe levels of human-caused physical alterations to this area in 18 of the 37 sites mainly due to motorized recreational use, but also due to land uses such as random camping, livestock use and road or pipeline construction activities to a lesser extent. With the exception of six fire-impacted reaches in the Castle River watershed most sites meet or exceed the 'healthy' rootmass protection threshold (i.e., >85% or more of bank length protected by deeply rooted native plants). In addition, most sites have limited amounts of human-caused bare ground and only localized streambank structural alterations associated with off-highway vehicle and livestock crossings. However, this misrepresents the substantial impact localized crossings can have on water quality, particularly when these crossings impact fine-textured loamy soils and where they are associated with steep vertical upland trails that continually contribute sediment into streams if there are no erosion controls in place. In the short term, excessive sediment loads from eroding trails or deforested landscapes can smother and suffocate trout eggs and spawning habitat and degrade important food production areas and rearing refuges for young fish (Costello 2006). In the long-term, sediment loads beyond natural levels can become entrained or embedded in the stream bottom substrate, negatively influencing trout spawning habitat (Costello 2006). Additional study of sedimentation concerns within priority Westslope Cutthroat Trout habitat reaches is therefore recommended.

Public Engagement and Management Recommendations

Since many of the priority Westslope Cutthroat Trout sites we examined are in a healthy condition, a priority is to maintain these sites so further loss of high quality riparian habitat does not occur. Ongoing and potential increasing land use activities may put these healthy sites at risk. Cohesive and collaborative efforts to plan and manage land uses in these areas will be important for improving riparian health and maintaining existing healthy sites in an ecologically functioning condition. Ongoing dialogue and collaboration with multiple user groups is a necessary part of this planning process. To assist with this effort, one of the components of the current project was to hold a series of multi-stakeholder workshops and field tours in 2012 and ongoing into 2013, aimed at bringing together various land user groups and land managers in the Westslope Cutthroat Trout project area. The workshops aim to broaden awareness of Westslope Cutthroat Trout habitat requirements and threats and to encourage collaborative beneficial land use practices to aid in the recovery of this species and their habitat. Additionally, one-on-one interactions and riparian habitat improvement action plans have been developed for each of the grazing allotment holder and land manager participants in this project. Efforts are ongoing to assist with implementation of select riparian habitat improvement projects in 2013 and 2014. Due to multiple land use pressures within remnant Westslope Cutthroat Trout habitats, long-term efforts to protect and improve their habitat need to be focused at a watershed level and will ultimately require cooperation and collaboration from multiple user groups.

Recommendations to maintain and improve riparian habitat in the project area include maintaining native plant communities, especially trees and shrubs, in addition to monitoring and controlling invasive weeds, carefully monitoring and managing forestry, recreational activities and industrial land use in and adjacent to sensitive riparian habitats, and continuing to appropriately manage and monitor livestock grazing impacts. Water quality monitoring is also suggested to aid in cumulative effects assessment and management planning of other watershed land use activities (e.g., logging, industrial developments and recreation) with potential to impact Westslope Cutthroat Trout and their habitat.

Literature Cited

Costello, A.B. 2006. Status of the Westslope Cutthroat Trout (*Oncorhynchus clarkii lewisi*) in Alberta. Prepared for Alberta Sustainable Resource Development and Alberta Conservation Association. Alberta Wildlife Status Report No. 61. Edmonton, Alberta.

Cows and Fish (Alberta Riparian Habitat Management Society). 2013. Alberta Lotic Wetland Inventory Form User Manual and Lotic Wetland Inventory Form (Current as of 5/24/2013). Lethbridge, Alberta. http://cowsandfish.org/riparian/health.html. Accessed October 1, 2013.

Fitch, L., B.W. Adams and G. Hale, 2009. Riparian Health Assessment for Streams and Small Rivers - Field Workbook. Second Edition. Cows and Fish Program, Lethbridge, Alberta

The Alberta Westslope Cutthroat Trout Recovery Team. 2013. Alberta Westslope Cutthroat Trout Recovery Plan: 2012-2017. Alberta Environment and Sustainable Resource Development, Alberta Species At Risk Recovery Plan No. 28. Edmonton, Alberta.

SPAWNING DEMOGRAPHICS OF BULL TROUT IN THE UPPER RED DEER RIVER DRAINAGE, 2009 – 2011

KEVIN FITZSIMMONS
Alberta Conservation Association, Box 1420, Cochrane, Alberta T4C 1B4.

Executive Summary

Insufficient information on the abundance, life history strategy and spawning demographics of Bull Trout (*Salvelinus confluentus*) in the upper Red Deer River drainage complicates management of the species. Coupled with the lack of information are impacts on Bull Trout from increased land use and recreational angling in the drainage. We conducted a three-year study of the abundance, life history strategy and spawning demographics of Bull Trout in the upper Red Deer River drainage. In the first program year (2009) we investigated the abundance of juvenile/resident Bull Trout and spawning use of Pinto Creek. In our second year (2010) we assessed the magnitude and timing of Bull Trout spawning in Pinto Creek and assessed other prioritized streams in the upper Red Deer River drainage for spawning use by Bull Trout. Finally in our third year (2011) we assessed the magnitude and timing of Bull Trout spawning in Sheep Creek.

In 2009 we captured 85 Bull Trout in Pinto Creek with backpack electrofishing gear. Estimated total Bull Trout abundance was 4,714 (95% CI = 1,644–14,916), and the adult resident Bull Trout (fish ≥ 250 mm fork length) abundance was 413 (95% CI = 146–1,024). We documented 56 Bull Trout redds in 13 km of Pinto Creek, indicating its importance as a spawning stream.

In 2010 we captured 43 adult Bull Trout in Pinto Creek using a fish trap, 8 moving upstream from North Burnt Timber Creek into Pinto Creek and 35 migrating downstream out of Pinto Creek. We also documented 17 Bull Trout redds in 8 km of Sheep Creek, indicating its importance as a spawning location.

In 2011 we captured 41 Bull Trout in Sheep Creek using backpack electrofishing. Estimated Bull Trout abundance was 1,097 (95% CI = 384–3,648), and the adult resident Bull Trout abundance was 198 (95% CI = 72–489). We captured 7 Bull Trout moving upstream through our fish trap on Sheep Creek and 17 Bull Trout moving downstream. We counted 68 redds in Pinto Creek and 44 redds in Sheep Creek, confirming their importance as Bull Trout spawning streams.

At nine microsatellite DNA loci studied, Brook Trout alleles were found in 3.4% of Bull Trout. This is evidence of low-level hybridization and this introgression of Brook Trout genes into Bull Trout populations should be monitored.

Microsatellite DNA analysis supports three Bull Trout populations in the upper Red Deer River drainage, consisting of: 1) fish from the upper Red Deer River and Scalp Creek, 2) fish from Sheep Creek and 3) fish from Pinto Creek and North Burnt Timber Creek. Genetic assignment estimated that 11% of sampled Bull Trout were migrants from another population. In some instances migrants were from geographically close populations, in other instances they were from geographically distant populations. This finding reinforces the importance of stream connectivity for Bull Trout in the upper Red Deer River drainage. Data collected through this project will aid in making informed management decisions regarding the Bull Trout populations in the upper Red Deer River drainage.

Acknowledgements

For assistance with data collection I acknowledge the long and sometimes trying hours put in by Alberta Conservation Association employees Patricia Halowinski, Kelly Hooey, Chad Judd, Jennifer Oko, Mike Rodtka, and Emily Turton. Additional field help was provided by Alberta Conservation Association employees Peter Aku, Jason Blackburn, Ariane Cantin, Marco Fontana, Troy Furukawa, Brendan Ganton, John Hallett, Brad Hurkett, David Jackson, Clayton James, Tyler Johns, Bill Patterson, Corey Rasmussen, Diana Rung, Mike Uchikura, and Shane Wood. Thanks to Jennifer Earle and Jim Stelfox, Alberta Sustainable Resource Development, for field assistance and project support. Alberta Sustainable Resource Development kindly allowed us use of the Red Deer Fire Base during field activities. Thanks to Dr. Eric Taylor at the University of British Columbia for provision and analysis of microsatellite DNA data. Helpful reviews on drafts of this document were provided by Peter Aku, Mandy Couve, and Mike Rodtka. Funding for this project was provided by Shell Canada, Suncor Energy and Alberta Conservation Association.

Introduction

Insufficient information on the abundance, life history strategy and spawning demographics of Bull Trout (*Salvelinus confluentus*) in the upper Red Deer River drainage complicates management of the species. The current status of the upper Red Deer River Bull Trout population is '*At risk'* (of extirpation), with the short-term trend indicating a population in decline (Alberta Sustainable Resource Development and Alberta Conservation Association 2009). Impacts on Bull Trout from timber harvest, oil and gas development, off-highway vehicle use, and from increased angling pressure are concerns in this drainage. For instance, Ripley et al. (2005) indicated Bull Trout abundance to be negatively affected by timber harvest and road density. Furthermore, delayed maturity and greater catchability of Bull Trout may result in high hooking mortality that can prevent population recovery, or lead to population decline despite protection by provincial catch-and-release fishing regulations (Paul et al. 2003; Post et al. 2003).

The objectives of this study were to:

1. inventory and estimate the abundance and spatial distribution of juvenile and resident Bull Trout in two streams in the upper Red Deer River drainage that are believed to be major spawning locations (Pinto and Sheep creeks),
2. evaluate the magnitude and timing of fluvial Bull Trout out-migrations from Pinto and Sheep creeks (streams believed to contain both resident and fluvial life forms of Bull Trout),
3. assess Bull Trout spawning activity in prioritized streams in the upper Red Deer River drainage, and
4. through molecular techniques, describe the genetic structure of the Bull Trout population in the upper Red Deer River drainage.

Describing Bull Trout abundance, life history strategy, and identifying spawning habitat in the upper Red Deer River drainage is fundamental to the management and conservation of the species. Data collected through this project will aid in the informed management of Bull Trout in the upper Red Deer River drainage.

Study Area

We defined our study area as the upper Red Deer River and its major tributaries, downstream of Banff National Park to the confluence with Burnt Timber Creek (Figure 1). The downstream limit of our study area was selected based on elevation (elevation strongly influences summer water temperature) and stream gradient criteria, both of which have been demonstrated to influence Bull Trout occupancy in the region (Post and Paul 2001). The boundary of Banff National Park was the upstream limit of our study area, as beyond this point Bull

Trout are managed by Parks Canada. Located within the Upper Foothills, Montane, and Subalpine Natural Subregions (Natural Regions Committee 2006), resource exploration and extraction and motorized and non-motorized recreational activities are the major land uses in the area.

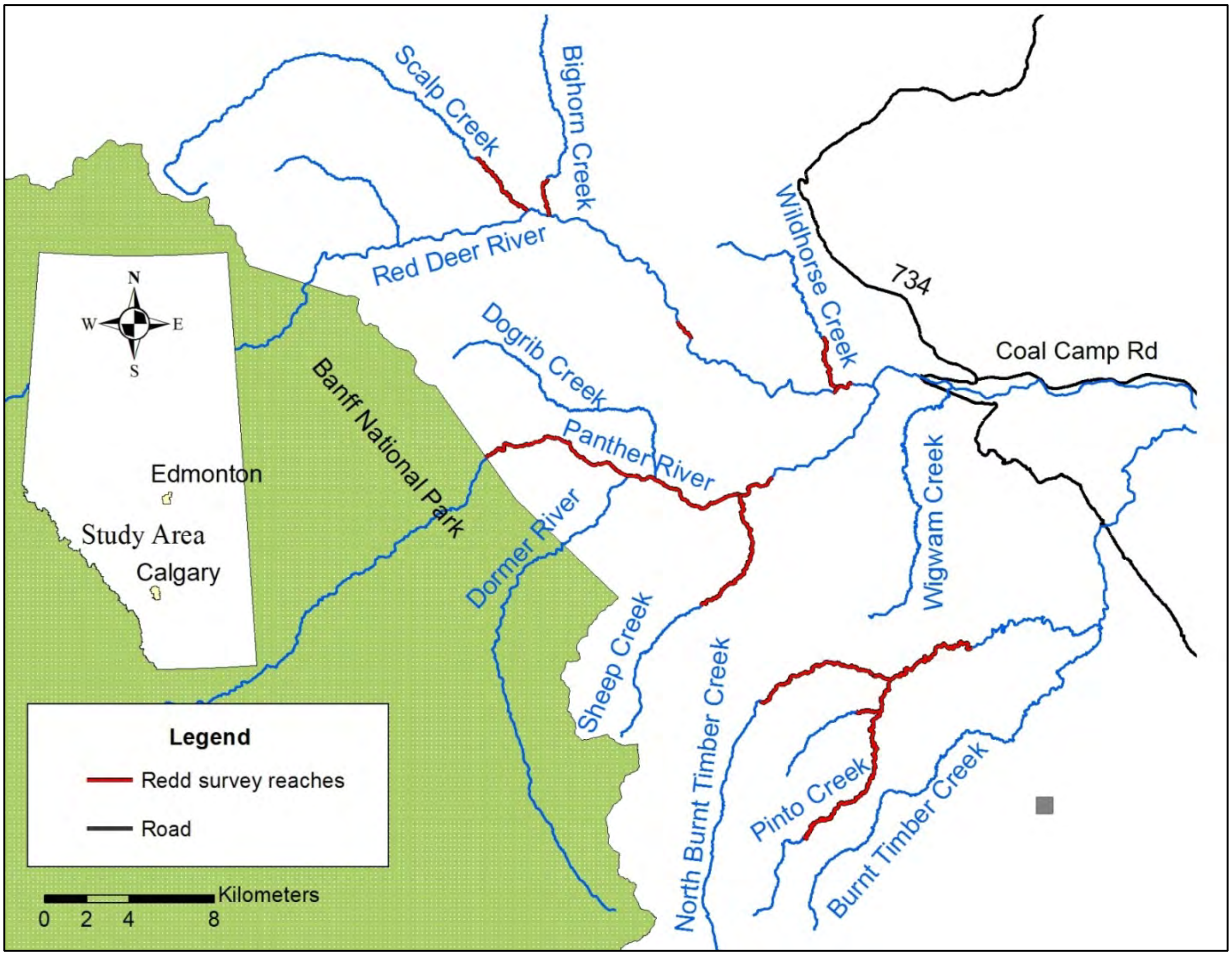


Figure 1. Location of study streams and redd survey reaches, in the upper Red Deer River drainage.

Materials and Methods

Abundance and spatial distribution of Bull Trout in Pinto and Sheep creeks

We used single-pass backpack electrofishing, in an upstream direction, to capture fish at five locations along Pinto Creek from 28 – 30 July 2009 and from eight locations along Sheep Creek from 5 – 7 July 2011 (Figure 2). Sampling sites were 250 m long except for Sites 2 and 5 on Sheep Creek, where electrofishing was stopped at 50 m and 236 m, respectively due to personal protective equipment malfunctions. We electrofished with a Smith-Root model LR-20 backpack electrofisher outputting a pulsed direct current (voltage 250–350 V, frequency 35–40 Hz). At all sites we recorded the geographic location using a GPS unit (UTM, NAD 83, Zone 11), measured stream wetted width in 50-m intervals, and enumerated all fish captured by species. Fish were measured (fork length (FL), mm), and a small piece of their adipose fin was clipped for DNA analysis and then fish were returned to the creek.

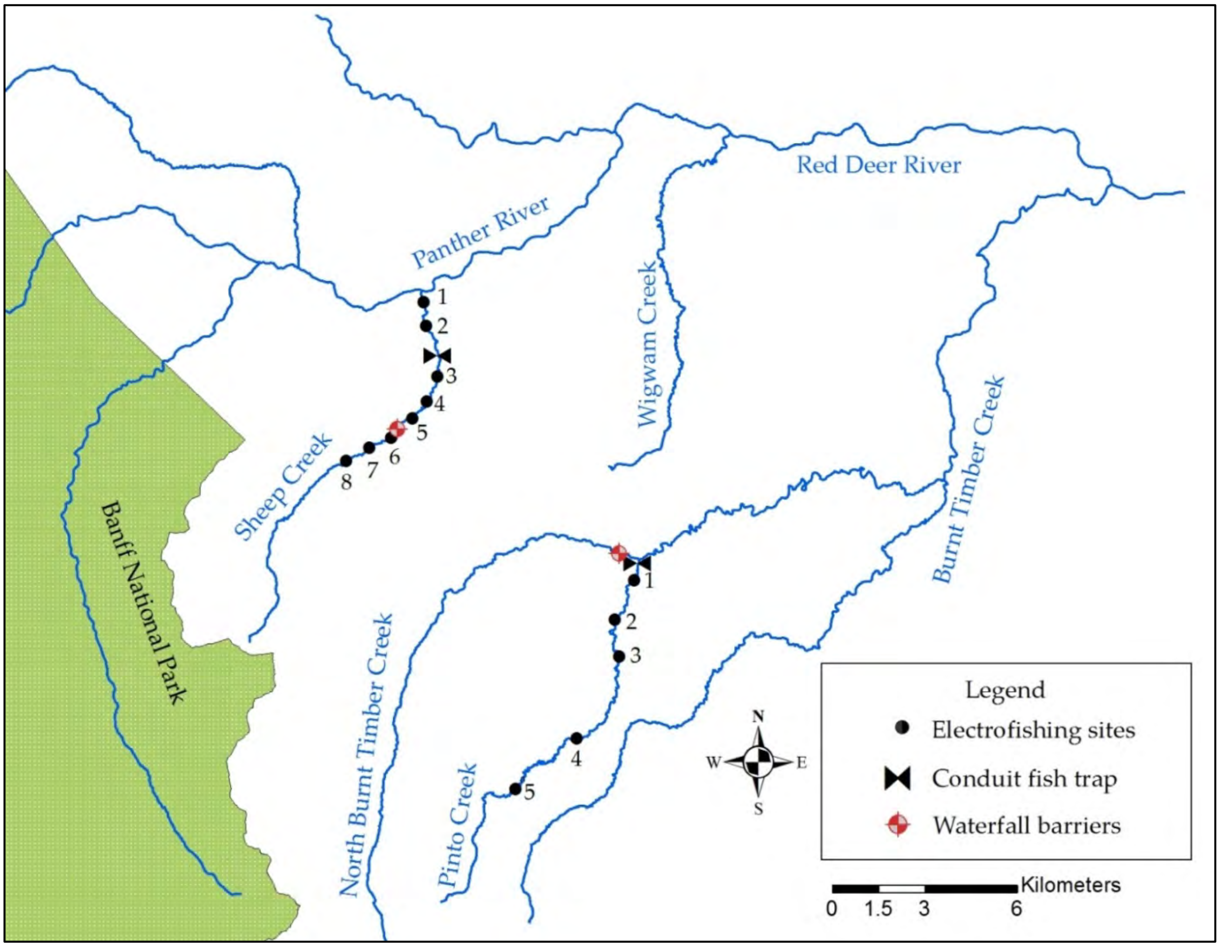


Figure 2. Location of backpack electrofishing sites and conduit fish traps in Pinto and Sheep creeks.

Our electrofishing capture data from Pinto and Sheep creeks, along with previously acquired capture efficiencies (q) from Canyon Creek, an unnamed tributary to Canyon Creek (Fitzsimmons 2008a), and an unnamed tributary to Waiparous Creek (Fitzsimmons 2008b), were used to estimate Bull Trout abundance. These data were input into spatial models following the methods of Paul and Dormer (2005) to estimate the total Bull Trout abundance (juvenile and resident adult) and the abundance of resident adult Bull Trout (≥ 250 mm FL) in Pinto and Sheep creeks. In this process we modelled uncertainty in q with the beta distribution. The beta distribution ranges in values from 0 to 1, appropriate for describing q, and its parameters (α and β) are defined by the mean and the standard deviation of the values of q derived from mark-recapture estimates. The parameters of the beta distribution are defined as:

$$\alpha = \bar{x}\left(\frac{\bar{x}\,(1-\bar{x})}{v}\right) - 1$$

$$\beta = (1-\bar{x})\left(\frac{\bar{x}(1-\bar{x})}{v} - 1\right)$$

where $\bar{x}$ and v are the mean and variance, respectively, of the estimates of q.

Bull Trout abundance at each electrofishing site was estimated using the observed catch at each site, a value of *q* drawn at random from the modeled distribution of *q* and the negative binomial distribution. In this step we estimated the number of fish expected to have been missed at each site while electrofishing with a fixed *q*, and total fish abundance was expressed as the observed catch plus the number of fish expected to have been missed. Finally, Bull Trout abundance over the entire length of a study stream was estimated using a nonparametric generalized additive model with the estimated fish abundance from each site and each site's distance upstream from its mouth as model input data. The model estimated fish abundance in 1 km increments along study streams and when summed provides an estimate of fish abundance in the stream. To obtain a mean population estimate and 95% confidence intervals (CI), 10,000 replicates were performed. Electrofishing capture efficiencies were estimated using the program MARK (Cooch and White 2008) and abundance modelling was performed using the R software program (R Development Core Team 2011).

Magnitude and timing of fluvial Bull Trout migrations

We used a conduit weir and box type fish trap, similar to that described by Hvenegaard and Thera (2001) to assess the magnitude and timing of post-spawn Bull Trout migrations out of Pinto and Sheep creeks. In 2011, we attached a mesh cone to the inside of the fish trap opening, to reduce the number of escaping fish. To minimize any influence on spawning fish health and behaviour, we installed the trap once the majority of migratory Bull Trout were suspected to be upstream of the trap location. Our trap was deployed to allow upstream migrating fish to enter it, while acting as a barrier to downstream migration.

In 2010 the trap was installed on Pinto Creek, near the confluence with North Burnt Timber Creek. In 2011 we installed the same trap on Sheep Creek, approximately 3 km upstream of the confluence with Panther River (Figure 2). We operated the trap in Pinto Creek, from 2 September to 5 October 2010 and in Sheep Creek, from 6 to 27 September 2011. The trap was checked daily (except for Pinto Creek where 9, 14, and 15 September were missed due to staff not working those days) and any debris accumulated on the upstream side of the trap was removed. Downstream migrating fish were captured by dip netting, seine netting or electrofishing at the trap face or in the pools immediately upstream of the trap where fish were congregating. Captured fish were measured for FL (mm) and weight (g), scanned for previously implanted passive integrated transponder (PIT) tag, and a small piece of their adipose fin was clipped for DNA analysis. Untagged fish were implanted with a PIT tag in their dorsal sinus. Fish were moved upstream or downstream of the trap based on their original direction of travel. We removed the fish trap on 5 October 2010 after our catch diminished to three fish in ten days and in 2011 the trap was removed once we failed to capture a Bull Trout for four consecutive days.

Bull Trout redd surveys

We identified Bull Trout spawning habitat in the upper Red Deer River drainage by conducting redd surveys in mid-to late-September and early October of 2009, 2010, and 2011. Surveys were conducted on Pinto, an unnamed tributary to Pinto, Bighorn, Sheep, Scalp, North Burnt Timber, and Wildhorse creeks and the Panther River (Figure 1, Table 1). Survey reaches in 2010 (Figure 1) were selected from an aerial reconnaissance in the winter of 2010 which identified areas influenced by groundwater upwelling that presented as open water areas. Surveys were conducted with an observer on the left and right bank of the stream recording the geographic location of observed (UTM, NAD 83, Zone 11) number of redds in the immediate area, and the category of red:

definite redd: an area cleaned with a pit and tailspill area recognizable, not in an area normally cleaned by stream hydraulics, or

probable redd: a cleaned area that may be due to stream hydraulics but a pit and tailspill area are recognizable, or an area that does not appear clean, but has a pit and a tailspill.

Bull Trout microsatellite DNA analysis

A total of 267 Bull Trout tissue samples were collected, by angling, electrofishing and at fish traps, from the upper Red Deer River and nine of its tributaries (Table 2). Samples were collected in 2009, 2010, and 2011 and were stored either dry in sample envelopes or in 99% anhydrous ethanol. Tissue samples were sent to Dr. Taylor at the University of British Columbia for microsatellite DNA analyses. Nine microsatellite loci were included in our study; *Sfo*18 (Angers et al. 1995), *Sco*102, 105, 106, (S. Young, WA Dept. Fish and Wildlife, Olympia, WA, unpublished data), 215, 216, 220 (DeHaan and Ardren 2006), *Smm*22 (Crane et al. 2004), and *Omm*1128 (Rexroad et al. 2001). Polymerase chain reactions were completed with dye-labeled primers in 10 μl volumes of 10 mM Tris-HCl (pH 8.3), 1.5 mM $MgCl_2$, 0.8 mM dNTPs, and 0.1 units of Taq polymerase in MJ PTC 100 and 200 thermocyclers using cycling parameters outlined in Warnock et al. (2010) and visualized using a Beckman-Coulter CEQ 8000 automated genotyper.

Sample size, mean number of alleles, and observed and expected heterozygosity were summarized for each sample site using FSTAT 2.9 (Goudet 2001). At seven of the 13 sampling sites we had sample sizes sufficient for further population level analysis (>20, Table 2). For these analyses, GENEPOP 3.3 (Raymond and Rousset 2001) was used to assess if a significant difference between one or more populations existed. Subsequent to finding a significant inter-population result, all pairwise combinations of populations were tested to detect where significant differences occurred. Population structure, or the number of distinct genetic groupings was assessed with the program STRUCTURE (Pritchard et al. 2000) using a Bayesian clustering analysis, with the prior sample location knowledge option, to model population structure from 1 to 9 theoretical populations. An information theoretic approach was then used to score candidate models relative to each other and to select the most supported model of population structure given the available data. Migration was assessed using the program GENECLASS (Piry et al. 2004) to test whether individuals sampled within a location belonged to the population (were born into it) or were migrants. Lastly, the program COLONY (Jones and Wang 2009), which implements methods based on sibship frequencies and linkage disequilibrium, was used to estimate the effective number of breeding individuals (N_B) in each population. For further details of microsatellite DNA analysis see Taylor (2012).

Results

Abundance and spatial distribution of Bull Trout in Pinto and Sheep creeks

During mid-summer electrofishing surveys in Pinto Creek, we captured 85 Bull Trout ranging in size from 72 to 338 mm FL (Figure 3). In addition to Bull Trout, we captured Mountain Whitefish (*Prosopium williamsoni*; n = 4) at Sites 1, 2, and 3 (Figure 2). Estimated total Bull Trout abundance in Pinto Creek was 4,714 (95% CI = 1,644–14,916) and adult resident Bull Trout abundance was 413 (95% CI = 146–1,024). Our spatial models indicated that estimated Bull Trout abundance increased from the mouth upstream, peaking approximately 9 km upstream (527 Bull Trout per kilometer), then decreased to the uppermost electrofishing site (Figure 4).

During mid-summer electrofishing in Sheep Creek, we captured 41 Bull Trout ranging in size from 66 to 338 mm FL (Figure 3). Estimated total Bull Trout abundance in Sheep Creek was 1,097 (95% CI = 384–3,648) and adult resident Bull Trout abundance was 198 (95% CI = 72–489). Bull Trout abundance in Sheep Creek decreased from the mouth upstream to an impassable waterfall barrier approximately 7 km upstream (Figure 4). No fish were captured or observed at Sites 6, 7, and 8 above the waterfall barrier (Figure 2).

Magnitude and timing of fluvial Bull Trout migrations

From 2 September to 5 October 2010, our fish trap captured 8 Bull Trout moving upstream from North Burnt Timber Creek into Pinto Creek and 35 moving downstream from Pinto Creek into North Burnt Timber Creek (Figure 5). Peak Bull Trout movement (58 % of migrating fish) out of Pinto Creek was from 13 – 17 September 2010. The 43 individual Bull Trout we captured ranged in size from 262 to 630 mm FL (Figure 6) and included 17 males, 13 females, and 13 of undetermined sex.

From 6 to 27 September 2011 we captured 7 Bull Trout moving upstream through our trap on Sheep Creek and 17 moving downstream (Figure 5). Peak Bull Trout movement (63 % of migrating fish) out of Sheep Creek was from 12 – 16 September 2011. The 24 individual Bull Trout we captured ranged in size from 256 to 575 mm FL (Figure 6); and included nine males, five females and ten of undetermined sex.

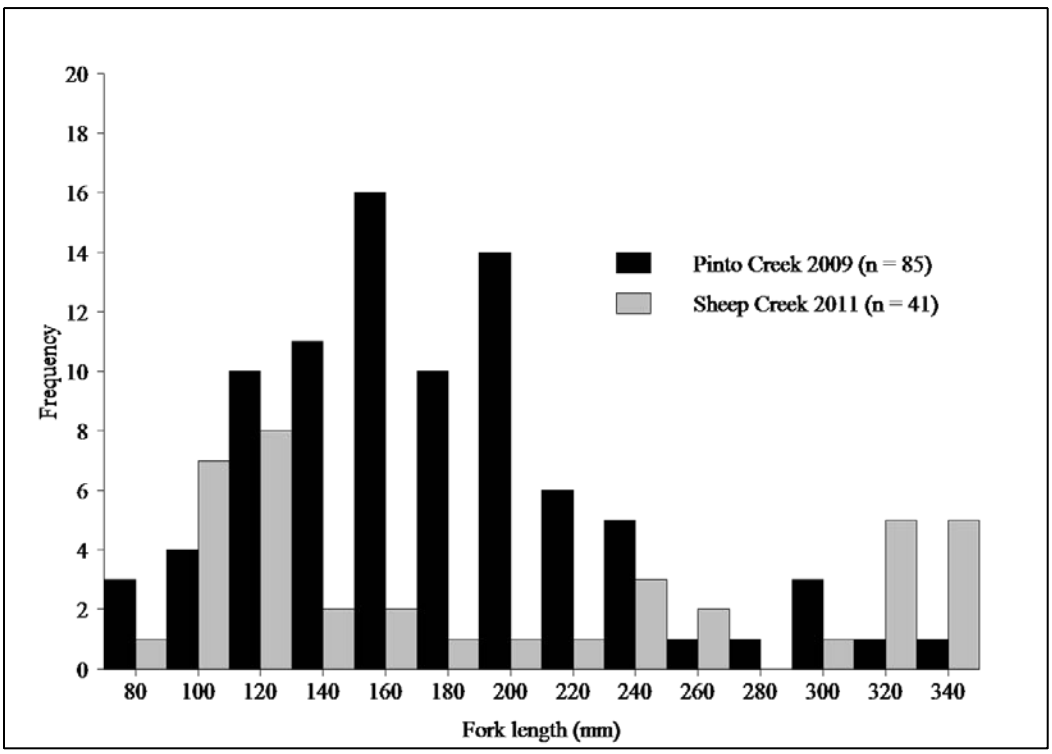


Figure 3. Length-frequency distribution of juvenile/resident Bull Trout captured during mid-summer backpack electrofishing in Pinto Creek (2009) and Sheep Creek (2011).

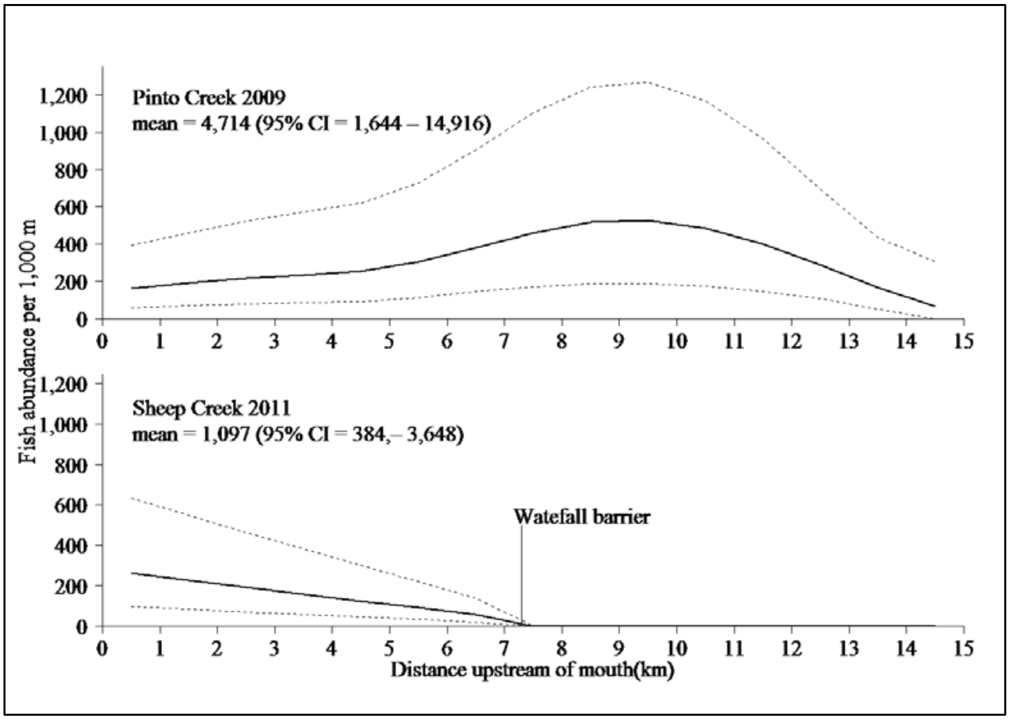


Figure 4. Estimated total abundance and spatial distribution of Bull Trout in Pinto Creek (2009) and Sheep Creek (2011) in mid-summer. Shown is the mean of all estimates (solid line) and the 95% confidence intervals (dotted lines).

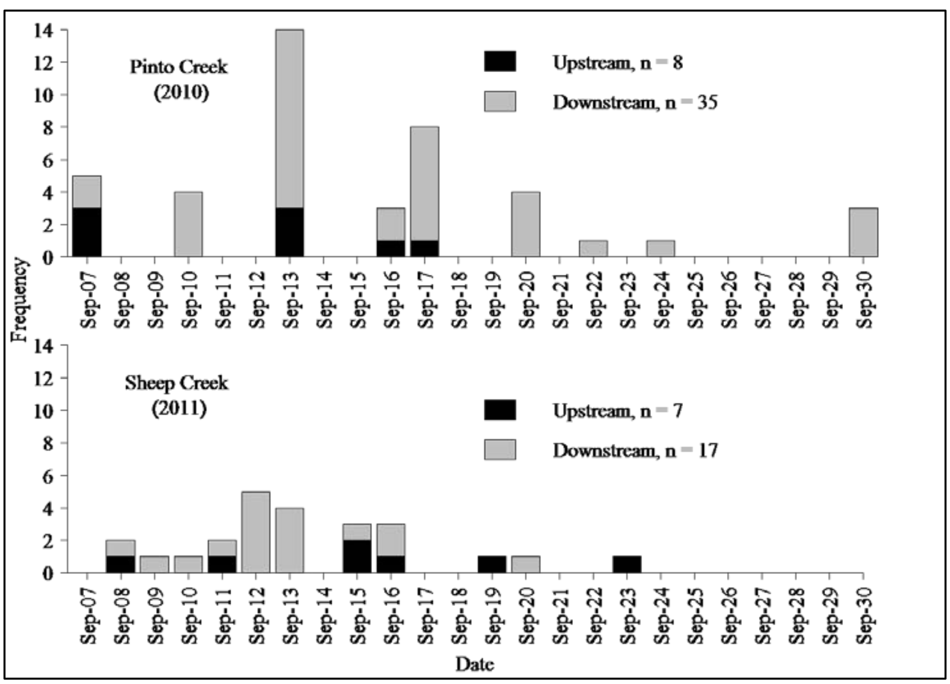


Figure 5. Upstream and downstream movement of new Bull Trout captures at the conduit fish trap in Pinto Creek (2010) and Sheep Creek (2011). For comparison, the x-axis has been standardized to September 30. The Pinto Creek fish trap was removed on 5 October 2010 and the Sheep Creek trap was removed on 27 September 2011.

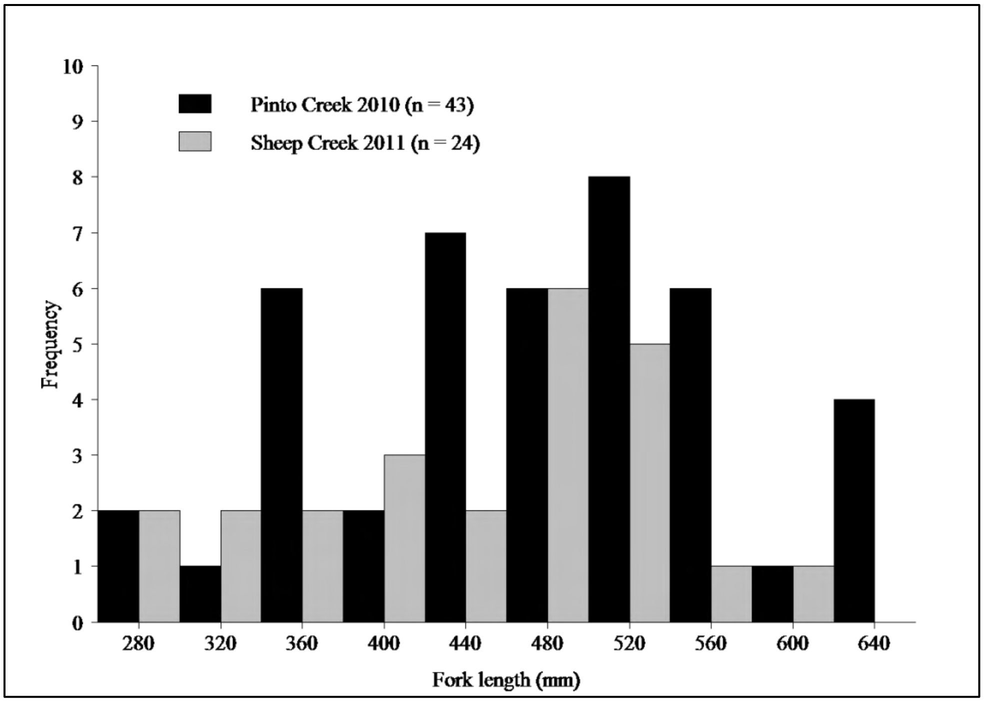


Figure 6. Length-frequency distribution of Bull Trout captured in the conduit fish traps in Pinto Creek (2010) and Sheep Creek (2011).

Bull Trout redd surveys

In 2009, 2010, and 2011 we completed redd surveys on 100 stream kilometers throughout the upper Red Deer River drainage and observed 237 definite Bull Trout redds (Figure 7; Table 1). High density of Bull Trout redds were found in Sheep Creek (2011 - 5.7 redds/km), Pinto Creek (2011 - 5.2 redds/km; 2009 - 4.3 redds/km) and an unnamed tributary to Pinto Creek (2009 - 3.8 redds/km).

In Sheep Creek, in 2011, the relationship between observed redd count and fluvial Bull Trout count (assumed to be spawning adults) was 1.83 redds per adult fish. This is contrasted by the ratio of 0.5 redds per adult (one redd per spawning female) found by Mushens et al. (2003) in Smith-Dorrien Creek, and generally expected of most fluvial Bull Trout populations. This greater ratio of redds to spawning fish is likely explained by resident Bull Trout spawning in Sheep Creek. This is supported by observations of resident sized (300 mm FL) fish digging a redd immediately upstream of the fish trap on Sheep Creek in September 2011. The relationship between redd count and fluvial Bull Trout count was not estimated for Pinto Creek (2010) as redd surveys on Pinto Creek in 2010 were incomplete.

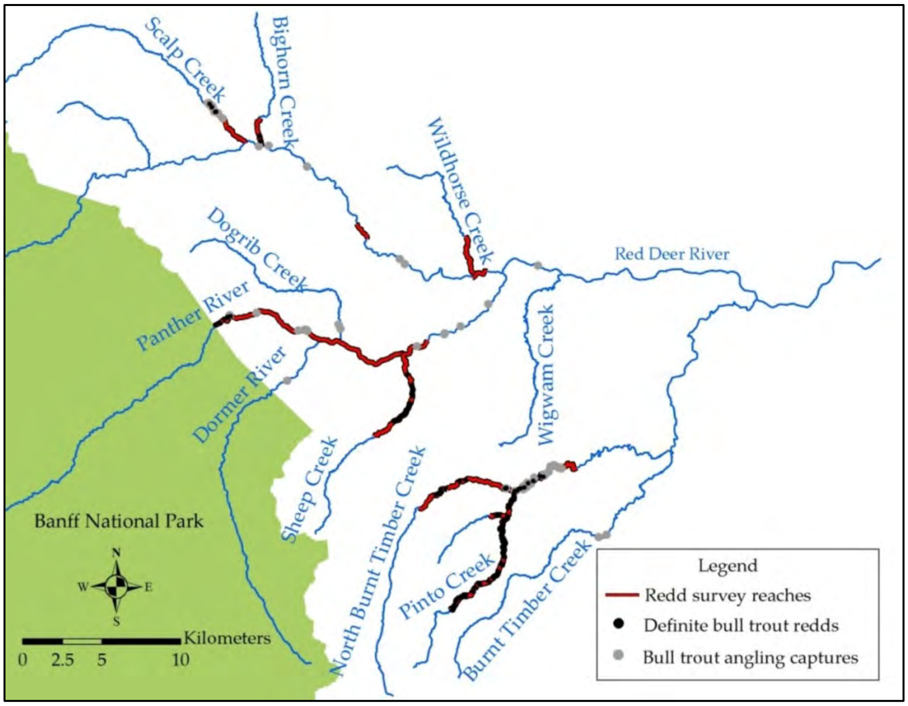


Figure 7. Location of definite Bull Trout redds and Bull Trout angling sites in the upper Red Deer River drainage.

Table 1. Summary of redd surveys completed in the upper Red Deer River drainage (2009, 2010, 2011).

Date	Waterbody	Survey start		Survey end		Redd count[a]		Length of survey reach (km)	Definite redds per km
		Easting	Northing	Easting	Northing	D	P		
28 Sep 2010	Bighorn Creek	600989	5731872	600915	5733664	0	0	2.0	0.0
22,29,30 Sep 2010	North Burnt Timber Creek	618864	5710932	611835	5709777	3	6	9.3	0.3
23,24,25 Sep 2011	North Burnt Timber Creek	620861	5711499	613964	5710814	18	0	14.4	1.3
14 Sep 2010	Panther River	611402	5719416	597999	5720482	11	0	16.5	0.7
22 Sep 2009	Pinto Creek	617057	5710019	613016	5702552	56	7	13.1	4.3
22 Sep 2010	Pinto Creek	617037	5710029	616260	5707562	9	1	3.4	2.6
15,16,17 Sep 2011	Pinto Creek	617057	5710019	613016	5702552	68	4	13.1	5.2
22 Sep 2010	Scalp Creek	599928	5732132	599928	5732132	2	0	4.1	0.5
22 Sep 2011	Scalp Creek	599928	5732132	599928	5732132	4	0	4.1	1.0
22 Sep 2010	Sheep Creek	609744	5714691	608246	5713483	17	0	7.7	2.2
20,26 Sep 2011	Sheep Creek	609744	5714691	608246	5713483	44	8	7.7	5.7
22 Sep 2009	Unnamed Creek	616563	5708491	615559	5708453	5	1	1.3	3.8
06 Oct 2010	Wildhorse Creek	614564	5723804	613986	5726071	0	0	3.2	0.0

[a] D= definite redd, P = probable redd.

Bull Trout microsatellite DNA analysis

A total of 267 Bull Trout tissue samples collected from 13 locations in the upper Red Deer River drainage were included in our microsatellite DNA analysis (Table 2). At the nine microsatellite loci analyzed, allele frequency ranged from 2 to 33. Within sample locations, the average number of alleles and the expected heterozygosity (two measures of genetic diversity) were comparable throughout the drainage (Table 2). The highest diversity occurred in samples collected from the upper Red Deer River and Burnt Timber Creek below the barrier and the lowest diversity occurred in the Sheep Creek resident/juvenile fish (Table 2). Brook Trout (*S. fontinalis*) alleles occurred in eight fish (3.4% of the sample and were found in upper Red Deer River n=2, Panther River n=1, Scalp Creek n=3, and North Burnt Timber Creek below barrier n = 2); however, they occurred only at one locus and these fish were heterozygous (one Bull Trout allele and one Brook Trout allele at the locus).

Table 2. Sample size (N), mean number of alleles (N_a), observed (H_o) and expected (H_e) heterozygosity for 13 sample locations in the Upper Red Deer River drainage.

Sample location[a]	N	N_a	H_o	H_e
URD	39	9.1	0.623	0.626
PFL	41	7.1	0.601	0.593
PRJ	30	6.9	0.593	0.616
SFL	21	7.3	0.487	0.551
SRJ	37	6.7	0.583	0.565
SCL	30	8.7	0.585	0.626
NBTB	35	9.1	0.603	0.644
DOG	1	1.6	0.556	0.556
BGH	1	1.6	0.750	0.750
DOR	2	2.6	0.444	0.685
PAN	15	6.4	0.593	0.602
NBTA	12	5.4	0.593	0.622
BTC	3	2.7	0.481	0.526

[a] URD = upper Red Deer, PFL = Pinto Creek fluvial, PRJ = Pinto Creek resident/juvenile, SFL = Sheep Creek fluvial, SRJ = Sheep Creek resident/juvenile, SCL = Scalp Creek, NBTB = North Burnt Timber Creek below barrier, DOG = Dogrib Creek, BGH = Bighorn Creek, DOR = Dormer River, PAN = Panther River, NBTA = North Burnt Timber Creek above barrier, BTC = Burnt Timber Creek.

Estimated genetic variance among locations in the upper Red Deer River drainage, F_{st} (ϑ) = 0.026, indicating a significant difference between one or more of the seven locations where sample sizes were large enough (>20) for population level analysis (n= 233). Genetic variance differed significantly, (Pairwise comparison, $P \leq 0.0137$) among all locations except between; Scalp Creek and Upper Red Deer River; Pinto Creek resident/juvenile and Pinto Creek fluvial; North Burnt Timber Creek below barrier and Pinto Creek resident/juvenile; North Burnt Timber Creek below barrier and Pinto Creek fluvial, and Sheep Creek resident/juvenile and Sheep Creek fluvial (Table 3). The greatest intra-location differences were between Sheep

Creek resident/juvenile and Pinto Creek resident/juvenile as well as North Burnt Timber Creek below barrier and Sheep Creek resident/juvenile. The lack of significant differences between fluvial and resident/juvenile fish in both Pinto and Sheep creeks likely indicates that they occupy the same spawning area, while the greater significant difference between Sheep Creek and Pinto Creek and North Burnt Timber Creek below barrier is indicative of the geographic separation of the streams (Figure 1).

Table 3. Pairwise comparisons of Bull Trout genetic variance, F_{st} (ϑ), from sample locations in the upper Red Deer River drainage. Significant differences, with $P \leq 0.0137$, are corrected for multiple pairwise comparisons. Underlined comparisons are not significant.

Sample location[a]	URD	PRJ	SFL	SCL	PFL	NBTB	SRJ
URD	-	0.0348	0.0289	0.0064	0.0205	0.0289	0.0346
PRJ		-	0.0413	0.0320	0.0052	0.0109	0.0444
SFL			-	0.0281	0.0280	0.0361	0.0171
SCL				-	0.0208	0.0352	0.0375
PFL					-	0.00151	0.0389
NBTB						-	0.0415

[a] URD = upper Red Deer, PRJ = Pinto Creek resident/juvenile, SFL = Sheep Creek fluvial, , SCL = Scalp Creek, PFL = Pinto Creek fluvial, NBTB = North Burnt Timber Creek below barrier, SRJ = Sheep Creek resident/juvenile.

Population structure analysis run on samples from the seven locations with sufficient sample sizes indicates support for three genetic populations in the upper Red Deer River drainage with the following groupings:

Pinto Creek (resident/juvenile and fluvial) and North Burnt Timber Creek below barrier,
Sheep Creek (resident/juvenile and fluvial), and
upper Red Deer River and Scalp Creek.

A *post-hoc* analysis in the program STRUCTURE with populations fixed to three and including all 267 fish samples was run to assign fish from locations with low sample sizes to one of the three population groupings. Results indicate that Bull Trout from Panther and Dormer rivers and Dogrib Creek were most similar to the Sheep Creek (resident/juvenile and fluvial) population grouping. Bull Trout from Burnt Timber Creek and North Burnt Timber Creek above the barrier were most similar to the Pinto Creek (resident/juvenile and fluvial) and North Burnt Timber Creek below the barrier grouping.

Of the 233 Bull Trout samples included in the population level analysis (Table 2), 11.1% (26 fish) had less than a 0.05 probability of belonging to the population from which they were sampled, suggesting they were migrants from another population. This finding emphasizes the importance of connectivity between streams in the upper Red Deer River for the persistence of Bull Trout. Variation in microsatellite DNA allowed for the assignment of migrants to their most likely population of origin. These results indicate that while some individuals were migrants from local geographic population sources, others were from geographically distant population sources (Table 4). In particular, four individuals sampled in Scalp Creek and two sampled in Sheep Creek were genetically assigned to the Pinto Creek population, representing a minimum distance (from stream mouth to steam mouth) of 65 km and 78 km, respectively between these distant populations. At all sample locations, with the exception of Sheep Creek, at least one migrant was from an unknown population source. This indicates a possible unidentified population in the area or a population with too small of a sample size to characterize the population.

Sibship frequency methods of estimating the effective number of breeding individuals (N_B) in each population consistently produced more conservative estimates with tighter confidence intervals than did linkage disequilibrium methods (Table 5). It should, however, be noted that estimates of N_B are more informative when used to track this parameter over time (years), and should not be interpreted as point estimates. It should also be noted that N_B estimates represent an estimate of the number of breeding fish that produced the samples we collected at each location. This estimate includes parents of fish born into a population at a sampling location as well as parents of migrants into the location. Therefore, estimates for locations with higher rates of migration would be inflated beyond what would be expected for the individuals that actually breed in that location. For example, Scalp Creek had a high degree of migration, and this likely increased the value of N_B beyond what the stream actually supports as a spawning population.

Table 4. Sample location and source location of Bull Trout migrants into sampling location.

Sample location[a]	Source location of migrants into sampling location (n)
URD	UKN (1)
PRJ/PFL	NBTB (1), UKN (1)
SRJ/SFL	SCL (2), URD (3), PRJ/PFL (2)
SCL	UKN (2), URD (1), PRJ/PFL (4), SRJ /SFL(2), NBTB (1)
NBTB	SCL (4), UKN (1), PRJ/PFL (1)

[a] URD = upper Red Deer, PFL = Pinto Creek fluvial, PRJ = Pinto Creek resident/juvenile, SFL = Sheep Creek fluvial, SRJ = Sheep Creek resident/juvenile, SCL = Scalp Creek, NBTB = North Burnt/Timber Creek below barrier, UKN = unknown

Table 5. Linkage disequilibrium (LD) and sibship assignment (SA) estimates of the effective number of breeding individuals in seven sampling locations in the Upper Red Deer River drainage with sample sizes were large enough (>20 individuals, see Table 2) for population level analysis.

Sample location[a]	LD (95% CI)	SA (95% CI)
URD	81 (49 – 186)	41 (27 – 68)
PFL	38 (26 – 62)	32 (21 – 54)
SFL	104 (37 – ∞)	34 (18 – 72)
SCL	111 (48 – ∞)	29 (16 – 53)
PRJ	74 (37 – 445)	29 (17 – 53)
NBTB	36 (24 – 59)	37 (22 – 67)
SRJ	97 (45 –2184)	30 (18 – 52)

[a] URD = upper Red Deer, PFL = Pinto Creek fluvial, SFL = Sheep Creek fluvial, SCL = Scalp Creek PRJ = Pinto Creek resident/juvenile, NBTB = North Burnt Timber Creek below barrier, SRJ = Sheep Creek resident/juvenile

Summary

In the upper Red Deer River drainage, fluvial Bull Trout life history forms have been demonstrated in Sheep and Pinto creeks, and a resident life history form is suspected in both streams. Microsatellite DNA analysis supports three population groupings in the Upper Red Deer River drainage consisting of; 1) fish from the upper

Red Deer River and Scalp Creek, 2) fish from Sheep Creek, and 3) fish from Pinto Creek and North Burnt Timber Creek. Genetic analysis indicated migration between close and distant populations in the upper Red Deer River drainage, emphasizing the importance of stream connectivity in this drainage.

Literature Cited

Alberta Sustainable Resource Development and Alberta Conservation Association. 2009. Status of Bull Trout (*Salvelinus confluentus*) in Alberta, Update 2009. Wildlife Status report No. 39, produced by Alberta Sustainable Resource Development, Edmonton, Alberta, Canada. 48 pages.

Angers, B., L. Bernatchez, and L. Desgroseillers. 1995. Specific microsatellite loci for brook charr reveal strong population subdivision on a microgeographic scale. *Journal of Fish Biology* 47 (Suppl. A): 177–185.

Cooch, E., and G. White. 2008. Program MARK: a gentle introduction. Available at: http://www.phidot.org/software/mark/docs/book 797 pages.

Crane, P.A., C.J. Lewis, E.J. Kretschmer, S.J. Miller, W.J. Spearman, A.L. DeCicco, M.J. Lisac, and J.K. Wenburg. 2004. Characterization and inheritance of seven microsatellite loci from Dolly Varden, *Salvelinus malma*, and cross-species amplification in Arctic char, *S. alpinus*. *Conservation Genetics* 5: 737-741.

DeHaan, P., and W. Ardren. 2006. Microsatellite loci for use in Bull Trout population genetics. *Molecular Ecology* 15: 172-189.

Fitzsimmons, K. 2008a. Monitoring Bull Trout and cutthroat trout populations in Canyon and Prairie Creek drainages, Elbow River, Alberta, 2005. Data report, D–2008–010, produced by the Alberta Conservation Association, Cochrane, Alberta, Canada. 27 pages + Appendix.

Fitzsimmons, K. 2008b. Assessment of trout abundance and distribution in the Waiparous Creek drainage, Alberta, 2006. Data Report, D-2008-011, produced by the Alberta Conservation Association, Cochrane, Alberta, Canada. 39 pages +Appendix.

Goudet, J. 2001. FSTAT version 2.9.3.1 Updated from Goudet, J., 1995. *Journal of Heredity* 86: 485-486.

Hvenegaard, P.J., and T. Thera. 2001. Monitoring the Bull Trout (*Salvelinus confluentus*) spawning run in Lynx Creek, a tributary to the Kakwa River, west central Alberta. Pages 147-151 in M.K. Brewin, A.J. Paul, and M. Monita. Bull Trout II conference proceedings. Produced by Trout Unlimited Canada, Calgary, Alberta.

Jones, O., and J. Wang. 2009. COLONY: a program for parentage and sibship inference from multilocus genotype data. Molecular Ecology Resources 10: 551–555.

Mushens, C.J., F.D. Johnston, and J.R. Post. 2003. Population dynamics of the Lower Kananaskis Lake Bull Trout: 1995-2000 final report. Produced by Alberta Conservation Association and TransAlta Utilities, Department of Biological Sciences, University of Calgary, Calgary, Alberta. 134 pages.

Natural Regions Committee. 2006. Natural regions and subregions of Alberta. Publication No. T/852, produced by the Government of Alberta, Edmonton, Alberta. 254 pages.

Paul, A.J., and C.G. Dormer. 2005. Effect of a severe flood on the cutthroat trout population of Silvester Creek, Alberta. Produced by the Department of Biological Sciences, University of Calgary, Calgary, Alberta. 49 pages.

Paul, A.J., J.R. Post, and J. Stelfox. 2003. Can anglers influence the abundance of native and nonnative salmonids in a stream from the Canadian Rocky Mountains? *North American Journal of Fisheries Management* 23: 109–119.

Post, J.R., and A.J. Paul. 2001. Spatial distribution of native and nonnative salmonids in streams of the Eastern Slopes of the Canadian Rocky Mountains. *Transaction of the American Fisheries Society* 130: 417–430.

Post, J.R., C. Mushens, A. Paul, and M. Sullivan. 2003. Assessment of alternative harvest regulations for sustaining recreational fisheries: Model development and application to Bull Trout. *North American Journal of Fisheries Management* 23: 22–34.

Piry, S., A. Alapetite, J.M. Cornuet, D. Paetkau, L. Baudouin, and A. Estoup. 2004. GENECLASS2: a software for genetic assignment and first-generation migrant detection. *Journal of Heredity* 95: 536-539.

Pritchard, J.K., M. Stephens, and P. Donnelly. 2000. Inference of population structure using multilocus genotype data. Genetics 155: 945-959.

R Development Core Team. 2011. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available at: http://www.R – project.org/.

Raymond, M., and R.R. Rousset. 2001. GENEPOP, Version 3.3, Population genetics software for exact tests and ecumenism. Available at: http://www.cefe.cnrs-mop.fr/.

Rexroad, C.E.I., R.L. Coleman, A.M. Martin, W.K. Hershberger, and J. Killefer. 2001. Thirty-five polymorphic microsatellite markers for rainbow trout (*Oncorhynchus mykiss*). *Animal Genetics* 32: 317-319.

Ripley, T., G. Scrimgeour, and M. Boyce. 2005. Bull Trout (*Salvelinus confluentus*) occurrence and abundance influenced by cumulative industrial developments in a Canadian boreal forest watershed. *Canadian Journal of Fisheries and Aquatic Science* 62: 243 –2442.

Taylor, E.B. 2012. Microsatellite DNA analysis of populations of Bull Trout (*Salvelinus confluentus*) in the upper Red Deer River drainage, Alberta. University of British Columbia, Vancouver, B.C., Canada. 25 pages.

Warnock, W.G., J.B. Rassmusen, and E.B. Taylor. 2010. Genetic clustering methods reveal Bull Trout (*Salvelinus confluentus*) fine-scale population structure as a spatially-nested hierarchy. *Conservation Genetics* 11: 1411-1423.

DESCRIBING CRITICAL HABITAT FOR AQUATIC SPECIES-AT-RISK IN THE PRAIRIE PROVINCES

SHERRY NUGENT
Species-at-Risk Coordinator, Fisheries and Oceans Canada, 7646-8 Ave NE, Calgary, Alberta T2E 8X4.

Abstract: Fisheries and Oceans Canada (DFO) is responsible for the protection of aquatic Species-at-Risk. Defining Critical Habitat is an important step in the regulatory listing and recovery process. This ensures the species' unique habitat requirements are clearly understood and defined. Many Canadians may not be aware what critical habitat really means or what implications it may have once published on the Public Registry. This presentation discusses the concept of critical habitat with emphasis on aquatic species, what protection it provides for a species, and what it can mean to a user of the resource.

SESSION 10: ECOLOGICAL GOODS AND SERVICES

AN ECOSYSTEM SERVICES APPROACH FOR IMPROVED DECISION-MAKING WITHIN ALBERTA ENVIRONMENT AND SUSTAINABLE RESOURCE DEVELOPMENT.

G. KERR and A. NEUPANE
Ecosystem Services Program, Alberta Environment and Sustainable Resource Development, 9820-106 St., Edmonton, Alberta T5K 2J6. Email: Gillian.kerr@gov.ab.ca

Abstract: Ecosystem services (ES) are the benefits that nature provides to society such as scenic landscapes, flood mitigation and recreation opportunities. However, these services can be underestimated in resource management decisions. The Government of Alberta, led by Environment and Sustainable Resource Development, is testing the ecosystem services approach to understand better how such approach can assist in planning, policy development, and decision making. Over the 2010 and 2011 period, the Government of Alberta, in collaboration with a number of expert groups, undertook a project - Ecosystem Services Approach Pilot on Wetlands. This project focused on assessing the benefits that people acquire from wetlands in a qualitative, quantifiable and comparable way. While the pilot focused on wetlands, the concept of ES supports other resource management decisions in Alberta. This presentation and paper come directly from the results and reports generated by this pilot. The intent is to provide insights into ES as a concept and approach to support land-use decisions through an overview of the ten-year ES Roadmap and the results from the pilot project.

Introduction

Ecosystem services (ES) are the benefits that nature provides to people. Some benefits, such as crops, fish, and fresh water are familiar and tangible; whereas, other types of benefits are often take for granted, such as the ability of forests to regulate carbon and mitigate climate change, or the filtration and purification of water by wetlands. Ecosystem services are crucial to human well-being and make important contributions to economic prosperity.

Alberta Environment and Sustainable Resource Development (AESRD) has been exploring and testing the applicability of adopting an ES approach to better inform natural resource and environmental management decisions. The ES approach allows ministries and stakeholders to explore and understand the interdependencies that exist between resource management decisions and the environment. Identifying and understanding these connections during decision-making, and not as a consequence of past decisions, will enable decision-makers to make more informed decisions. In turn, this will ultimately improve our landscape management outcomes.

An Ecosystem Services Approach

An ES Approach recognizes the environment as an asset, one that generates services and benefits like water purification, provision of recreational spaces, and climate regulation. Some of these benefits are inputs into economic production – e.g., reliable quality water supply for irrigation. Despite this linkage between environmental assets and benefits, environmental and economic management decisions are viewed to be separate processes.

Using an ES Approach in natural resource and environment management decisions presents an opportunity to make explicit the ‘trade-offs’ inherent in decision making (Figure 1). The ES Approach highlights the potential conflicts between different ES themselves (wood provision or climate regulation), between different beneficiaries (private gain by some, public loss to many), at different scales (local costs, provincial benefits), and across different time horizons. An ES Approach can support a better informed natural resource and environmental management system because it is:

- A forum for recognizing social and economic values associated with environmental assets;
- A framework to link social and economic outcomes to environmental outcomes;
- A comprehensive approach that integrates all environmental media to support policy/decision-making and planning; and
- An illustration of society’s dependence on ES for human well-being (e.g., clean water, fresh air, and food).

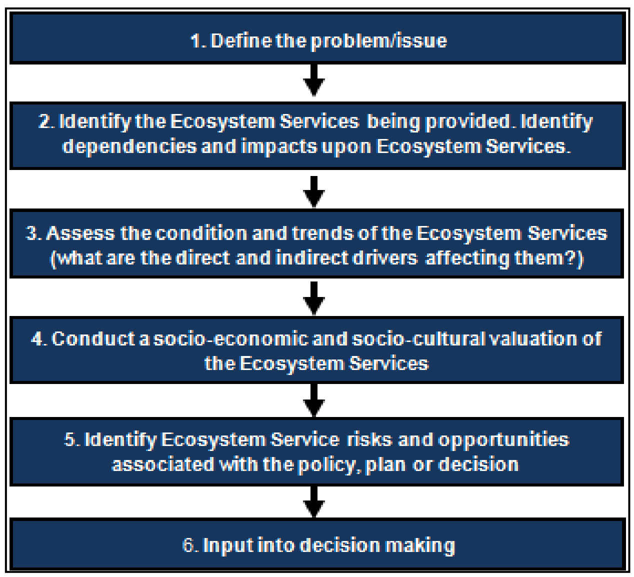


Figure 1. Ecosystem Services Pilot – ES approach

The ES Pilot 2010-2011

The Ecosystem Services Approach Pilot on Wetlands (ES Pilot) was part of the AESRD Department’s ten-year ES Roadmap. The goal was to focus on a specific area and Natural Resource and Environmental issue to apply the ES Approach. The completion and results are a progression in understanding and applying an ES Approach to support NRE decision-making within the Government of Alberta.

The Alberta wetland approvals process was selected as the focal area for the pilot. Wetlands are an integral component of Alberta’s diverse landscapes and provide a wide variety of ES. Wetlands can provide water filtration and groundwater recharge, contribute to flood prevention, and provide habitat for numerous species of interest to naturalists and hunters alike. When wetlands are altered, drained, or degraded, a cost can be incurred by society if ES that were previously provided at no cost by wetlands need to be replaced by built infrastructure such as storm water ponds. Examples of costs include:

- increased water treatment costs
- irrigation water shortages
- increased stormwater infrastructure costs, including construction, operations, maintenance and monitoring
- threats to biodiversity, which is the foundation for many ES
- increased insurance costs due to flooding
- decreased property value due to degraded aesthetic qualities
- decreased recreational opportunities

These costs are not accounted for in infrastructure development decisions because they are not known or not part of decision-making processes. There can also be a considerable time lag between the impact of a development decision and the resulting effects on the function of wetland ecosystems, making the incorporation of these impacts into decision-making even when desired, difficult.

Wetland loss has been particularly acute in the Calgary municipal area due to residential, commercial and industrial developments. It is estimated that this area may have lost as much as 90% of its wetlands since pre-settlement times (Calgary State of the Environment Report, 2006). The pilot focused on an area covering 274 km^2, encompassing an eastern portion of the City of Calgary, an area of Rocky View County and the Town of Chestermere. The area was chosen because of the large number of wetlands and current land use pressures where residential development is having an impact on the ES that are supplied by the landscape.

Key decision-makers including Alberta Environment, the City of Calgary and Rocky View County involved with wetland applications and approvals were selected to guide the pilot work to ensure the results were relevant to them. The decision-makers helped the ES Pilot team to identify, frame, and prioritize, key gaps in the Wetlands Approval Process to focus the pilot assessment work. These gaps included:

- There is insufficient evidence to support avoidance, minimization and compensation decisions on wetlands.
- There is insufficient consideration of cumulative effects and long-term consequences of decision-making.
- There is limited ability to communicate the 'values' of wetlands.

The outcome for the pilot was the development and operationalization of an ES Approach to provide a tool to enhance decision making. Nested with the outcome were three specific objectives:

- Test and demonstrate how an ES Approach can be used to support decision making by explicitly demonstrating the 'trade-offs' between development and ES benefits provided by wetlands;
- Support wetland management in the province by providing additional information to support potential compensation decisions related to land-use development; and
- Identify information and capacity gaps for ES assessment to support future ES work.

Meeting these objectives involved conducting various biophysical, economic and social cultural assessments on wetland ES. These assessments were then used to understand the role and function of wetlands within the study area. The focal ES chosen for assessments were selected through a series of ES Pilot Team working sessions. Four ES within the proposed development site were considered top priority for greater understanding: water storage/supply, flood control, carbon storage and water purification/quality. Additional ES (e.g., pollination, cultural ES) were described and investigated in terms of their contributions to local society, but their condition (e.g., quality, quantity and distribution) was not assessed in detail across the entire study area, due to time, data and resource constraints.

The ES Pilot engaged a broad selection of stakeholders, including ES beneficiaries. The beneficiaries identified cultural ES as high priorities for management in survey responses and workshop discussions. In particular, aesthetic enjoyment and science and education opportunities were identified as ‘highly value’ benefits provided by wetlands. Biodiversity was also identified by multiple stakeholders as being of high importance, however, biodiversity is considered to be a necessary underlying condition for the production of ES but not an ES itself.

Information generated by the ES Pilot provides a baseline of knowledge about wetland ES in the study area that decision-makers can apply in the wetland approval process. Some of the highlights from the assessment results include:

- The total water storage capacity of all wetlands in the study area was estimated at 36.3 million m^3.
- An analysis of water storage capacity by Stewart & Kantrud (1971) of wetland classification showed that because there is a large number of wetlands that are ephemeral wetlands (Class I or II), their contribution to water storage on the landscape is substantial, even if individually they hold less water than permanent Class III-V wetlands.
- The estimated total storage capacity lost as a result of wetland drainage between 1965 and the present is 9.2 million m^3. This represents a 20% decrease in available water storage capacity in the study area (Government of Alberta 2012).
- All wetlands in the case study area contribute to flood control. There were no clear trends found for flood control values by Stewart & Kantrud or size classes, suggesting that high or low flood control depends more on landscape context than on class or size of wetlands.
- The cost of replacing natural wetlands with built infrastructure was estimated from the total area of engineered wetlands that would be required to provide the same flood control services that are currently supplied by natural wetlands. A replacement cost of all wetlands was estimated at about $338 million. This corresponds to an estimated $2 million per year in economic losses when the historical rate of wetland area loss is applied.
- The estimated cost of restoring all wetlands on the landscape would be $57 million. This corresponds to an estimated $342,275 per year in restoration costs if the historical rate of wetland loss is applied (0.6% between 1960s and 2005).
- The majority (87%) of wetland complexes within Shepard Slough have a medium to high capacity to purify water, estimated using a water purification model.
- Recreation survey results showed the potential value for recreation from wetlands in the study area to be approximately $4,390,000 per year. This result is based on an estimate of 114,685 wetland visitors each year, each spending $38.28 for a day trip.

Discussion

The results from the assessment allowed the ES Pilot to address the gaps in the Wetland Approvals Process. For example, the pilot project identified that many of the ES provided by wetlands are excluded in current requirements for municipal Biophysical Impact Assessments and Wetland Impact Assessments and as such, multiple ES are neglected from decision-making. In addition, wetlands provide multiple ES simultaneously, which is important when considering avoidance or compensation options for wetlands. Critically, the ES pilot demonstrated that although a wetland is degraded, it can still be high functioning and provide a number of ES and benefits and should still be accounted for in ES cost considerations. The information collected from the ES

Pilot could inform trade-offs and also help to highlight 'hot spot' areas to avoid in the planning and development process.

The ES pilot allowed the decision-makers to explore information on the cumulative effects of wetland loss and potential consequences of long-term decision-making. The loss of wetlands in the case study area over the past 50 years has led to a substantial cumulative loss of multiple ES including flood control, water purification/ filtration and water storage. In particular, areas that have historically seen large losses in water storage are more likely to also experience changes in ES such as retention of soil moisture, microclimate and flood control because water storage is fundamental to the delivery of other ES benefits.

An important contribution of the ES pilot was the ability to demonstrate multiple 'values' of wetlands in the case study area. The results demonstrated that all classes of wetlands in the case study area contribute benefits, regardless of size or magnitude of current degradation. Even small wetlands were seen to provide essential services such as water purification and flood control, sometimes in conjunction with adjacent and connected wetlands. To complement typical aquatic environment and hydrology information used by decision-makers, the pilot incorporated socio-cultural information on how people value different ES in the study area. Studies conducted for the pilot demonstrate that even the most abstract cultural benefits (e.g., heritage benefits) are consistently rated as being of 'high' or 'medium' importance to people. Local perceptions of wetland importance may therefore provide information to wetland planning and approval decisions, as these cultural values provide a picture of some of the societal values of wetlands that are difficult to measure.

Conclusion

The concept of ES is still in its infancy, but has been recognized globally (MEA 2005, Ranganathan et al. 2008, TEEB 2011) as a useful tool for communicating the value of sustainable landscape management to support development and the long-term well-being of people. Ecosystem Services are becoming increasingly important for governments and business leaders to address in decision-making. The Government of Alberta took a leadership role in completing the pilot project to explore the use of ES approach to support natural resource and environmental management and to assist wetland approvals staff. However, continued research, development, and incorporation of the human benefits need to cintinue to fully understand the true breadth of the environmental, social, and economic impacts and contributions of ES.

For more information on the ES pilot and other ES related work by ESRD please contact the author and go to:
http://environment.gov.ab.ca/info/listing.asp?txtsearch=ecosystem+services&searchtype=asset&audience=

Literature Cited

City of Calgary. 2006. Calgary wetland conservation plan. City of Calgary Parks. Calgary State of the Environment Report, 2006. Calgary, Alberta

Government of Alberta. 2010. Ecosystem services approach pilot on wetlands integrated assessment report January 2012. Available at http://environment.gov.ab.ca/info/posting.asp?assetid=8493&searchtype=asset&txtsearch=ecosystem services

Millennium Ecosystem Assessment (MA). 2005. Ecosystems and human well-being: current state and trends. Island Press, Washington, DC.

Ranganathan, J., Bennett, K., Raudsepp-Hearne, C., Lucas, N., Irwin, F., Zurek, F., Ash, N. and West, P. 2008. Ecosystem services: a guide for decision makers. World Resources Institute. Accessed online: http://www.wri.org/publication/ecosystem-services-a-guide-for-decision makers

TEEB (The Economics of Ecosystems and Biodiversity). 2010. The mainstreaming the economics of nature: a synthesis of the approach, conclusions and recommendations of TEEB. Available at website: www.teebweb.org_ publications.

Indian Oil and Gas Canada's Environmental Regulatory and Policy Changes

S. TAYLOR
Indian Oil and Gas Canada, Aboriginal Affairs and Northern Development Canada, Suite 100, 9911 Chiila Boulevard, Tsuu T'ina, Sarcee, Alberta T2W 6H6.

Expanded Abstract

Indian Oil and Gas Canada (IOGC) is the federal regulatory agency responsible for the management and administration of oil and gas resources located on designated Indian Reserve land across Canada, pursuant to the *Indian Act*, and *Indian Oil and Gas Act* (IOGA) and Regulations, 1995. IOGC issues surface leases, right-of-way permits and exploration licenses for oil and gas activity which triggers the *Canadian Environmental Assessment Act* (CEAA). As part of the Government's plan for Responsible Resource Development, which seeks to modernize the regulatory system for project reviews, CEAA (S.C. 1992, c. 37) was repealed when the *Canadian Environmental Assessment Act, 2012* (CEAA 2012) came into force on July 6, 2012. CEAA *2012* focuses federal environmental assessment efforts on major projects that have a greater potential to cause adverse environmental effects. Since the majority of projects proposed on reserve lands are less complex or lower risk in nature, they are therefore 'non-designated' and not subject to the formal federal environmental assessment under CEAA *2012*. However, this does not mean that these non-designated projects can proceed without any environmental review. CEAA *2012* requires that before a federal department can authorize a project on federal lands, including reserve lands, it must determine that the project is not likely to cause significant adverse environmental effects. IOGC has prepared an Environmental Review Form that will give more certainty to First Nations and industry while still allowing IOGC to fulfill their duty to ensure projects will not cause significant adverse environmental effects.

The Environmental Review Form is a checklist and includes the following sections: A) project identification, B) project description, C) standard versus non-standard application, D) First Nation and traditional knowledge, E) site-specific environmental information as well as several appendices. New with the Environmental Review Form is the requirement for pre-construction water well test results to be submitted at the time of application.

Results from both consultation and engagement with the First Nation and a field assessment conducted by a qualified assessor are required to complete the Environmental Review Form. In addition, the Environmental Review Form must be completed by a qualified independent environmental consultant and must be signed by a representative from the company making the application. The Environmental Review Form will be processed as standard or non-standard based on certain criteria where non-standard applications require the identification of non-standard mitigation measures and the submission of supplemental information. The form has also been designed to be used to apply for amendments, additional wells/ pipelines, change of use and to extend the environmental protection terms for projects not yet constructed.

Field assessments and any baseline studies should be completed in the growing season, to allow for the proper assessment of vegetation, wildlife and wildlife habitat, fish and fish habitat, water bodies and soils. If Species-at-Risk have been identified within the project area, Species-at-Risk surveys will be required. Projects located in native prairie will require rare plant surveys.

In addition to reviewing project proposals for surface leases, right-of-way agreements and exploratory licenses, the environment unit at IOGC is responsible for 1) providing assurance to First Nations that on-going oil and gas activity meets environmental standards through the management of the environmental audit framework, 2) building relationships with First Nations through on-going communication and conducting random and planned inspections of lease sites with First Nation representatives and 3) aiding in returning the land to the land base through the remediation, reclamation and surrender process.

The environmental audit framework requires that companies hire independent environmental consultants to conduct an environmental audit on a specified timeframe. Audits are required 1) One year after construction and every five years thereafter for well sites and other surface leases, 2) One year after construction and every three years thereafter for batteries and compressors, and 3) beginning in 2013, two years after installation and every ten years thereafter for pipeline rights-of-way (prior to 2013, pipeline audits were only required one year after installation). Audits are submitted to both the First Nation and IOGC's environment unit and are reviewed for compliance by the environment unit. Non-compliance issues are identified and companies are required to address the issues or face a Direction to Comply.

IOGC's environment unit conducts both random and planned environmental inspections with representatives of the First Nation. IOGC and the First Nation representative also conduct inspections with provincial authorities as required.

At the end-of-life of the project, IOGC has an abandonment, remediation, reclamation and surrender process. Once all appropriate documentation has been reviewed by IOGC's environment unit, a reclamation inspection is conducted in the growing season with representatives from the First Nation, the company and IOGC. If deficiencies are identified, the company must address them and coordinate another inspection within the year; otherwise, a new application will be required. IOGC's new Reclamation Cover sheet is available.

Finally, an amended *Indian Oil and Gas Act, 2009* received Royal Assent in May 2009 but has not yet come into force until new Regulations are developed. The purpose of the environmental regulations is to manage environmental responsibilities through regulation rather than policy. The regulations have been divided into the following environmental modules: environmental review process (as a result of CEAA 2012) and traditional knowledge, standard environmental protection terms, environmental audits, reclamation, release of substances and remediation. Consultation with First Nations is on-going and consultation with industry is expected shortly.

STEWARDSHIP CREDIT PROGRAM PILOT—A NEW GRASSBANKING TOOL FOR CANADA

DANA BLOUIN
Nature Conservancy of Canada, Alberta Region, 830-105 12th Avenue. SE, Calgary, Alberta T2G 1A1.
Phone: 877-262-1253, Website: www.natureconservancy.ca

Abstract: The Nature Conservancy of Canada's Stewardship Credit Program is being piloted on the Foothills Fescue grasslands of southern Alberta to maintain Natural Capital and create a new conservation tool for use on the agricultural landscapes of Alberta and Canada. Grassbanking is a recent approach to landscape-scale conservation whereby land is leased to livestock ranchers at a reduced rate in exchange for ranchers completing conservation projects on their private lands. The agreement enables ranchers to reduce their production costs, increase the quality of their beef with healthy forage and rest their private land to increase forage production in the long-term. This pilot project is being conducted on a 1,659 ha ranch in southern Alberta owned by the Nature Conservancy of Canada (NCC) and partners. Five neighbouring cattle ranchers have been involved in the development of the program and have access to graze the pilot property. In return, credits are assigned to them on an annual basis for maintaining the range and riparian health on their private property and implementing stewardship tools to further increase that health. Credits are assigned to the ranchers following a specific methodology on an annual basis for maintaining their Natural Capital (One credit =$1). Upon the completion of the pilot program the Nature Conservancy of Canada will positively influence 3,640 ha of Foothills Fescue grassland and provide the background to develop and implement a new conservation tool for Canada. A manual and lessons learned for the program will be available by December 2013.

Population Estimation for Rare Plants: How Much Sampling Effort is Enough?

SARAH H. LEE[1] and **CANDACE L. NEUFELD**[2]
Canadian Wildlife Service, Environment Canada, 11 Innovation Boulevard, Saskatoon, Saskatchewan S7N 3H5.
[1] Email: sarah.lee@ec.gc.ca; Phone: 306-975-5770
[2] Email: candace.neufeld@ec.gc.ca; Phone: 306-975-4101

Abstract: When conducting survey and monitoring work for rare plant species, obtaining a count of individuals within an occurrence or population is often desirable. However, it is often not feasible to count each plant, resulting in the need for estimation. Various methods and levels of effort are used to estimate population size of rare plants within an occurrence or population, but rarely are these estimates ever accompanied by a measure of error, or checked for accuracy or precision. Therefore, information such as population size and the natural range of variability, as well as the survey effort required to obtain these estimates is still unknown for many rare plants in the Prairie Provinces. Using Western Spiderwort (*Tradescantia occidentalis*) as the subject, this presentation will discuss the results of a project aimed at determining the sampling effort required to obtain population estimates within 10-20% of the mean and to detect change in population size over the long term. We will also discuss how estimates from extrapolation compare to true counts and the relationship between area of occupancy and population size.

SESSION 11: CITIZEN SCIENCE CONTRIBUTIONS TO ENDANGERED SPECIES

DEEP ROOTS – EXPLORING ALBERTA'S GRASSLANDS

T. KUPCHENKO

Rangeland Management Branch, Alberta Environment and Sustainable Resource Development, #106 Provincial Building, 346-3 St., SE, Medicine Hat, Alberta T1A 0G7, on behalf of the Prairie Conservation Forum's Education Committee.

Abstract: In 2011/2012, the Prairie Conservation Forum Education Committee developed an educational and interactive videoconference program titled 'Deep Roots – Exploring Alberta's Grasslands'. This presentation was designed for students in grades four to nine and links with both the Alberta Science and Social Science curriculums. The videoconference is intended to take its audience on a tour through the dynamic grassland ecosystem of Alberta without leaving the classroom, and is meant to assist teachers in educating the next generation about the values and importance of grasslands and its inhabitants. Participants in the program meet a rancher and First Nations' educator and hear their stories of how their history and lives are 'rooted' in the grassland. The program's main themes explore the incredible biodiversity of the grasslands, human impacts that have resulted in Species-at-Risk, and how human life is intimately linked to the health of the grasslands. Deep Roots is a tool which mirrors the 2013 Prairie Conservation and Endangered Species Conference theme because it directly engages people in appreciating, and thus conserving, this valuable landscape. This program fits into the socio-economic theme of the conference. Join Tracy Kupchenko as she demonstrates the effectiveness of this media-rich presentation and explains how you and your organization can make use of it in your outreach activities. "We will exploit what we only value, but we will protect what we love."-Wendell Berry.

ALBERTA PLANTWATCH: CITIZENS AS 'EYES OF SCIENCE' TRACK THE EFFECTS OF CLIMATE WARMING

ELISABETH BEAUBIEN
Renewable Resources Department, University of Alberta, Edmonton, Alberta T6G 2H1.

Abstract: Getting outside in spring to search for the first Prairie Crocus flowers (*Anemone patens*) is an enjoyable activity for anyone. Tracking spring phenology is highly suited to volunteers, and, with effective volunteer management, observers will stay loyal to a phenology program for many years. Over two decades beginning in 1987, Alberta PlantWatch volunteers reported 47,000 records, the majority contributed by observers who participated for more than nine years. This data combined with historical phenology records reveals considerable shifts to earlier blooming in response to increasing winter temperatures. In Alberta, observers can report on bloom and leafing times for up to 25 plant species (http://plantwatch.naturealberta.ca) and (www.plantwatch.ca). The plant species were selected based on criteria including wide distribution, ease of recognition by the public, short blooming period in spring, and a unique appearance (no similar looking subspecies or other species). Using simple protocols that focus on observations that cannot easily be mistaken, citizen scientists can reliably gather accurate data. Observers benefit by having fun while contributing to climate change research, and also learn about both native plant biodiversity and the sequence of spring events. Alberta PlantWatch observers receive regular newsletters summarizing the season's weather plus interesting comments from other observers. Data are reported electronically or on mailed data forms. Smartphone applications are in development and will offer the benefits of quick reporting including geographic locations and photos of observed plants.

How to Get Citizens to Work all Night for no Remuneration and Feel Good About it; Monitoring Black-footed Ferrets in Grasslands National Park.

ASHLEY WRUTH and **PAT FARGEY**,
Grasslands National Park, Parks Canada Agency, Box 150, Val Marie, Saskatchewan S0N 2T0.

Abstract: Black-footed Ferrets (*Mustela nigripes*), last seen in SW Saskatchewan in 1937, are a nocturnal specialist predators of prairie dogs (*Cynomys* spp). The West Block of Grasslands National Park (GNP), and immediate region, is the only place in Canada that Black-tailed Prairie Dogs (*Cynomys ludovicianus*) occur in the wild. Grasslands National Park, in collaboration with Government Agencies and Environmental Non-Government Organizations, began reintroducing Black-footed Ferrets to Canada in October 2009. Monitoring their population status requires 12-15 people walking tens of kilometers each night on prairie dog colonies using spot lights to detect eye shine. Having paid staff work with volunteers was the chosen approach because many people are needed within a short survey period and because a volunteer-based program contributes to Parks Canada Agency's Strategic Outcome of creating within Canadians a strong sense of connection, through meaningful experiences, to their national parks. We were able to recruit 139 volunteers over seven monitoring sessions for a total of 602 person nights of surveying. Volunteer management has been refined such that 100% of volunteers that responded (n = 34 of 82) in an after action review in the last two years of monitoring felt they positively contributed to BFF recovery and would recommend this experience. We have learned that a successful program requires that volunteers: know what to expect before arriving, be well trained in the tasks and equipment, be exposed to friendly and organized staff, feel safe on a remote landscape at night, work as part of a team, feel appreciated and, where possible, have their personal interests accommodated.

ENGAGING VOLUNTEERS WITHIN ALBERTA CONSERVATION ASSOCIATION WILDLIFE PROJECTS

KRIS KENDELL

Alberta Conservation Association, 101, 9 Chippewa Road, Sherwood Park, Alberta T8A 6J7.

Phone: 780.410.1978, Email: kris.kendell@ab-conservation.com; Website: www.ab-conservation.com

Abstract: Amateur citizen scientists contribute to the advancement of conservation through their volunteer activities. We believe the use of volunteers as part of Alberta Conservation Association (ACA) projects is mutually beneficial to both the volunteer and ACA. Our volunteers increase their knowledge of conservation issues and are able to network with wildlife professionals, while at the same time allowing us to increase our capacity to deliver our wildlife projects. Currently, our largest wildlife volunteer component is the Alberta Volunteer Amphibian Monitoring Program (AVAMP). AVAMP positively impacts conservation in Alberta through increased awareness of Alberta's herpetofauna and by providing baseline population data, including endangered species, to wildlife managers and researchers. We are also actively engaging conservation groups to help us answer targeted research questions. For example, ACA is partnering with Crowsnest Conservation Society (CCS), a volunteer-based conservation group, to achieve a better understanding of the distribution of the Boreal Toad (*Anaxyrus boreas*). Data collected by CCS volunteers can be used by wildlife managers to help incorporate setback distances around Boreal Toad breeding ponds into forestry harvest plans and to support an occupancy study for the species. AVAMP and CCS volunteers are trained in survey methods developed by ACA staff and are then able to collect data on their own without direct supervision from ACA. We have also been working with the Alberta Trappers' Association in a citizen science initiative to collect observations, photos and hair samples of Wolverine (*Gulo gulo*) in order to determine occurrence and gene flow of this data deficient species in the province. The involvement of ACA volunteers has been an important component and critical to the success of many of our projects.

LEADERSHIP, COMMUNICATION AND ADVOCACY

LORNE SCOTT
Box 995, Indian Head, Saskatchewan S0G 2K0. Email: lorne.scott@sasktel.net

Expanded Abstract

Key qualities to succeed in environmental leadership, communication and advocacy were identified in this presentation. Several personal experiences in non-government organizations and political situations were discussed. What actions and approaches worked and what led to failures? I described things that I learned that were necessary for success and took a brief look at some of today's leaders. Below are the notes from my presentation.

As conservationists, scientists and environmentalists, we are very good at research, documentation and preparing reports. We are not as successful in communicating with the public, industry and governments. One example is climate change. Despite overwhelming evidence, a large percentage of Canadians still deny climate change is happening, and that it has adverse effects. Despite proof that there are fewer than 100 Greater Sage Grouse (*Centrocercus urophasianus*) remaining in Canada, governments refuse to take action to protect critical habitat for Sage Grouse. Eco-Justice and four NGOs are in litigation trying to get the Federal Government to follow the Species-at-Risk legislation, in at least recognizing critical Sage Grouse habitat that is already documented. There are a number of challenges for us in garnering public support for our causes.

1. Our environment is free and taken for granted in many cases with no recognized or acknowledged monetary value. Wake up calls about contaminated drinking water and oil spills are soon forgotten once 'the problem is fixed.'
2. Conservation and environmental challenges are long-term initiatives, often taking years to achieve results. Most people are out of touch with our natural world and only look to the immediate future – pay cheque to pay cheque. In our hectic and technical world it is easy to be dismissive and say 'someone will look after the Sage Grouse and if they disappear, so what, I have never seen one and what good are they?'
3. For governments and politicians of every stripe, the world potentially ends every four years. They focus on what voters want in short-term gain before the next election. Long-term planning that may alter happy go lucky lifestyles are not vote getters and will result in crusading governments getting defeated.

Obviously our challenge in garnering public and political support for conservation and the environment is formidable. What are some qualities for successful leadership and communication?

- Honesty
- Transparency
- Credibility
- Simple messaging
- Factual
- Dedication
- Patience
- Partnerships
- Humbleness

Some of my experiences:

The Heritage Marsh Program

- The Province of Saskatchewan stopped wetland conservation projects (1980)
- Three groups joined forces for the first time
- The provincial government backed down

The *Wildlife Habitat Protection Act* (WHPA)

- In 1981, after ten years of not selling any public lands the NDP government changed their policy and put all public lands up for sale in a desperate bid to gain rural votes. The writing was on the wall.
- Conservative MLA support, membership resolution 83%.
- Work with Minister and partners/stakeholders.
- Ranchers didn't support us, but we kept talking.
- Leases continued: No break, drain or clear.
- 1984 *Wildlife Habitat Protection Act* legislation
- 1995 3.4 million acres of crown land protected from sale or development.
- 2010 Provincial government tried to open up WHPA to sell land.
- Major letter-writing campaign to Premier
- Lots of media coverage.
- Met with Premier to explain our concerns.
- Provincial government backed down.
- Environment Minister lost her job.
- 2012 Government again wants to sell some Crown lands with conservation easements…in negotiation.

When it comes to government policies and legislation, nothing is forever. Thirty years later we are still dealing with the same issue.

Rafferty-Alameda Dams & Old Man River Dam

- Local landowners asked for help
- Small town lawyer, Brandon University Economics Professor and me
- Issue was process and government following its own laws
- Government said 'We are doing this'
- Would not work with us
- Battle in Media
- Media tends to support the little guy as long as they are credible
- Personal attacks, death threats, monitoring
- Dozens of interviews. Kept the issue alive by sticking to the facts and being credible
- Government – no tree, picture of one. We countered with pictures of thousands of trees
- Senate Committee hearings in Ottawa
- On CBC, George Hill said Scott was an uneducated farmer, doesn't know anything. I stuck to the issue
- On CTV, Hill, myself and moderator – 19 versus 6. I came back for another interview
- CWF board lobbied one on one. Agreed to go to court
- Three court victories. Project still built.

- Won the battles, lost the War. The dams were built.
- Court rulings led to Federal Environmental Assessment laws that we have today, that are being eroded by our current Federal government

In 1990, I was recruited to run for the NDP in the upcoming provincial election.

- I asked a lot of people about whether or not I should get into politics
- Indian Head had never been won by the NDP or CCF before
- Sacrificial lamb
- Networked and campaigned
- Was in top 5 for membership sales among 60 constituencies
- Lady in Grenfell
- Lady in Glenavon
- Another house, “Hi, I’m Lorne Scott.” “Yes, I know you are.” Slam!
- Won again in 1995
- Appointed Minister of Environment
- Close parks, lobby ministers
- FSIN night hunting
- CE legislation – SSGA, SARM and NGOs in gallery
- Sidearms for COs. CO’s encounter more dangerous situations than do police officers
- Fifth Estate uranium mining

In 1999, I was defeated and there was an NDP minority government

- Government became arrogant and out of touch with voters
- We closed hospitals and said it would be good for the people. Couldn’t sell…surprise
- Ordered striking nurses back to work. Should pick your fights, nurses are sacred and respected

One more example of advocacy: **The Big Dig – Wascana Centre**

- Bury a Federal Migratory Bird Sanctuary in the middle of Regina, used extensively by nesting geese and other wildlife
- Big Dig was popular. Tried to negotiate with Wascana Centre Authority, City of Regina. NO!
- Minister in charge, NO!
- Told Premier ‘If not stopped, we go for court injunction’
- Premier – What do we tell the children who come out to see the turtles? Simple message, We can’t tell them that we buried the turtles under 50 feet of dirt, and we can’t lie to them.
- The Provincial and Federal Governments found another six million dollars to haul the excavated dirt out of the city
- Media would call us for comments and we played down the story as we would lose in the public arena
- The Premier mused later – “Looks like the turtles won.”

What have I learned? Long ago I thought if you had a good idea, everyone would agree. Today, your message must be simple. You need to ask who will not like the message. You need to recruit friends, organizations, as many supporters and partners as possible to advance your cause.

You MUST maintain your integrity and earn respect even from those who disagree with you. (Example - Maude Barlow says keep your messaging simple and transparent.) Always tell the truth so you don't have to remember what you said. Former Premier Romanow said 'when you are explaining, you are losing.'

Try to get people to like you by your personality by being humble, friendly, out-going, and down to earth (Premier Brad Wall).

Show determination. Don't give up in despair. You haven't lost until you give up or quit.

Communication: If you stop talking to those who oppose you, you are in trouble. Negotiate – ask your opposition what they want? Always better to win a little than lose it all. Court is the last resort since it is costly, time-consuming and a chance that you could lose everything.

Surprises: Nobody needs surprises. Do your homework. Being blind-sided by the media can end it all.

In closing, "The wildlife and its habitat cannot speak, so we must and we will." Roosevelt. We need not apologize for speaking up for conservation and the environment.

SESSION 12: PRAIRIE HUGGING FOR HERPTILES

SNAKES ON A PLAIN: COMPARATIVE ECOLOGY OF THREE SYMPATRIC SNAKE SPECIES IN SOUTHWESTERN SASKATCHEWAN

L. E. GARDINER[1,2], **R. G. POULIN**[2] and **C. M. SOMERS**[1]
[1] Department of Biology, University of Regina, Regina, Saskatchewan S4S 0A2.
[2] Biology and Environmental Studies, Royal Saskatchewan Museum, Regina, Saskatchewan S4P 4W7.

Abstract: The grasslands of southwestern Saskatchewan are home to a variety of snake species at their northern range limits in North America, including the (Threatened) Eastern Yellow-bellied Racer (*Coluber constrictor flaviventris*), the (Data Deficient) Bullsnake (*Pituophis catenifer sayi*), and Prairie Rattlesnake (*Crotalus viridis*), which is currently listed for conservation status assessment. Lack of data about their habitat use limits the ability of responsible jurisdictions to properly assess and develop comprehensive conservation plans for these species. We used radio-telemetry and GIS to compare habitat use by Racers (n = 33), Bullsnakes (n = 16), and Rattlesnakes (n = 23) in and around Grasslands National Park, Saskatchewan, Canada. Used and available macrohabitat sites were compared to quantify habitat use by these species. We found that although all species hibernate in communal den sites, during the active season they disperse into different macrohabitats across the landscape. As a result, home ranges were dumbbell-shaped with activity centres near hibernacula and in well-defined summer grounds and these centres of activity were connected by narrow corridors. Racers were found to strongly select for riparian areas, Bullsnakes tended to inhabit valley grassland habitats, and rattlesnakes tended to be associated with prairie dog colonies. Some Rattlesnakes travelled great distances (over 11 km) from the dens compared to the other species (Bullsnakes = 4 km; racers = 5 km), which may be a result of their selected macrohabitat being more patchily distributed in the landscape. Our findings will be useful in aiding designation of critical habitat for the Eastern Yellow-bellied Racer and contribute to assessment of Bullsnakes and Prairie Rattlesnakes in Canada.

SHORT-TERM OCCUPANCY DYNAMICS OF THREATENED POPULATIONS OF NORTHERN LEOPARD FROGS IN SOUTHERN ALBERTA

L.A. RANDALL[1], D.H.V. SMITH[1], B.L. JONES[1], **D.R.C. PRESCOTT[2]**, and **A. MOEHRENSCHLAGER[1]**
[1]Calgary Zoo Centre for Conservation Research, 1300 Zoo Rd., NE, Calgary, Alberta T2E 7V6.
[2]Alberta Fish and Wildlife Division, 4911-51 St., Red Deer, Alberta T4N 6V4.

Abstract: Dramatic decreases in Northern Leopard Frog (*Lithobates pipiens*) abundance and distribution were first reported in western Canada and the USA in the 1970s and 1980s. As a result of this decline, the western boreal/prairie populations of Northern Leopard Frog are designated as Special Concern by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and Threatened under Alberta's *Wildlife Act*. Recovery efforts have primarily focused on reintroducing Northern Leopard Frogs to historical portions of their former range. These efforts are hampered by the fact that little is known about the current population dynamics and distribution of Northern Leopard Frog in this region. To address this knowledge gap we conducted repeat visual surveys in spring and summer over four years at 68 sites spanning 90,000 km^2 of southern Alberta. Sites were selected based on historical observations of Northern Leopard Frog and those predicted to be suitable habitat. We used occupancy modeling to explore the short-term population dynamics of Northern Leopard Frogs in southern Alberta.

NORTHERN LEOPARD FROG REINTRODUCTION PROGRAM IN ALBERTA: 2006-2012

S. STEVENS[1], **K. KENDELL**[2], and **D. PRESCOTT** [1,3]

[1] Alberta Environment and Sustainable Resource Development, Suite 404, 4911-51 Street, Red Deer, Alberta T4N 6V4.

[2] Alberta Conservation Association, 101, 9 Chippewa Road, Sherwood Park, Alberta T8A 6J7.
Phone: 780-410-1978; Email: kris.kendell@ab-conservation.com; website: www.ab-conservation.com

[3] Corresponding author: Email: dave.prescott@gov.ab.ca

Abstract: In 2005, the Alberta Northern Leopard Frog Recovery Team listed reintroduction as a strategy for recovery of the species in Alberta, and as part of an action plan to meet recovery objectives. Goals included reintroduction of egg masses to at least ten unoccupied but suitable sites in two or more of the six major river basins in southern Alberta. Potential reintroduction sites were determined by using historical Northern Leopard Frog (*Lithobates pipiens*) occurrences and by using weir data provided by Alberta Environment. Overall, 37 potential sites were evaluated based on ownership, access, connectivity of habitat, and apparent overwintering suitability during the summers of 2006 and 2007. Sites described as 'Medium' or 'High' summer suitability (n=28) were tested for dissolved oxygen, a limiting factor for overwinter survival, in the winters of 2007-2009. Between 2007 and 2010, ten of the most highly suitable sites received 4-8 egg masses over two years from healthy populations in the core of the range. Overall, 80 egg masses were distributed among the ten reintroduction sites, resulting in the release of over 200,000 tadpoles. Soft releases occurred, where egg masses were kept in predator exclosures until hatch. Sites were monitored by visual surveillance in July and August, after young of year had emerged, and by song meters (SM2, Wildlife Acoustics™) during spring breeding. All sites produced young of the year from introduced egg masses. At six sites we were able to confirm overwinter survival. Subsequent reproduction by introduced Northern Leopard Frogs occurred at four of the ten sites. The presentation describes the techniques used during reintroductions and surveillance, evaluated the success of the reintroduction program, and discusses future directions for the conservation of Northern Leopard Frogs in Alberta.

RESOURCE SELECTION FUNCTION DEVELOPMENT

MULTISAR and RANGELAND CONSERVATION SERVICES LTD.
Alberta Conservation Association, #400, 817-4th Ave., South, Lethbridge, Alberta T1J 0P6.

Abstract: The Eastern Short-horned Lizard (*Phrynosoma douglassii brevirostra*) is the only lizard to occur in Alberta and is only found in the southeast corner of the province. It is found in badlands habitat and associated sparsely vegetated coulee slopes. It is legislated as Endangered in the province. Wildlife species select for very specific habitat features, which are not available in coarser datasets. The Resource Selection Function (RSF) model, using GVI, was better at predicting potential short-horned lizard habitat than the original Habitat Suitability Index (HSI) model. The GVI dataset allowed for an increased number of variables in the model and a finer spatial resolution. The RSF modeling approach improves the performance of models over the HSI approach and provides a better suite of tools for government and conservation organizations to help conserve Species-at-Risk.

BEAVERS AS ECOSYSTEM ENGINEERS IN POTHOLE WETLANDS: IMPLICATIONS FOR AMPHIBIANS

NILS L. ANDERSON[1], **CYNTHIA A. PASZKOWSKI**[1] and **GLYNNIS A. HOOD**[2]

[1] Department of Biological Sciences, University of Alberta, Edmonton, Alberta T6G 2E9

[2] Augustana Campus, Science Department, University of Alberta, 4901-46 Ave., Camrose, Alberta T4V 2R3.

Abstract: Beavers (*Castor canadensis*) are widely recognised as ecosystem engineers for their habit of damming streams to create wetlands. In this way, beavers create breeding habitat for many amphibian species, and are often referred to as a keystone species. However, the effects of such an ecosystem engineer can vary considerably between different environments, and streams are not the only aquatic ecosystems modified by beavers. Across the plains of North America, beavers occupy many pre-existing depressional wetlands. In these pothole wetlands, beavers do not build dams but commonly dig extensive networks of foraging canals towards nearby forest cover. In order to better understand how amphibians are affected by beavers in pothole wetlands, we examined the response of the Wood Frog (*Lithobates sylvaticus*), a common species throughout the Aspen Parkland. Although canals were not commonly used as breeding sites, they were used by larval wood frogs as an extension of the littoral zone of the pond. Canals provided moist movement corridors that were used by dispersing young-of-the year and migrating adults. Beaver canals may relieve density dependent effects of intraspecific competition in the larval stage as well as aiding the movements of adult frogs, facilitating linkages between aquatic and terrestrial environments. Incorporating native ecosystem engineers, such as beavers, is an increasingly popular approach to wetland restoration. Understanding how the effects of beavers can change based on their surroundings is crucial to predicting the outcome of such restoration efforts.

MAPPING OIL AND GAS INFRASTRUCTURE IN GREATER SAGE-GROUSE HABITAT: PRIORITIZING THE RECLAMATION OF INDUSTRIAL INFRASTRUCTURE AND THE PROPOSED RESEARCH TO DEVELOP THIS AS A MANAGEMENT TOOL

KAYLA L. BALDERSON, JOEL T. NICHOLSON and DALE H. ESLINGER,
Alberta Environment and Sustainable Resource Development, #106 Provincial Building, 346-3 St., SE, Medicine Hat, Alberta T1A 0G7.

Abstract: In Alberta, the distribution of Greater Sage-Grouse (*Centrocercus urophasianus*) has been reduced to approximately 4000 km^2 which represents roughly 10% of historical range. The current sage-grouse population in Alberta is 2.12% of the estimated population in 1968 and this decline has been correlated with periods of increased development in the late 1970s, early 1980s and in the 1990s. The construction of oil and gas wells and associated infrastructure results in the localized loss of habitat and contributes to anthropogenic edge which sage-grouse have been shown to avoid (Aldridge and Boyce 2007). Infrastructure can serve as predator perches, auditory emissions can cause habitat abandonment and associated vehicular traffic may increase the frequency of road kill. In concert with the Enhanced Approval Process, a Conservation and Development Zone tool has been developed with the intent to coordinate industrial development and sage-grouse conservation. In Alberta, there are approximately 1533 wells located in current sage-grouse range. Of these wells, 23.22% remain on the landscape as non-producing and 11.09% as non-operational (Source: ERCB). By spatially joining the well site layers, 3.2 km lek buffer and critical habitat layers, it was found that 33.67% of abandoned wells and 49.14% of suspended wells are in critical habitat, 30.74% of abandoned and suspended wells are within 3.2 km of a lek. Further research is proposed to model the response of sage-grouse to the reclamation of wells in critical habitat so that reclamation efforts can occur efficiently and strategically. This effort should result in more rapid habitat improvements for this critically imperiled species.

Introduction

The current sage-grouse population in Alberta is 2.12% of the estimated population in 1968 (Figure 1). Threats include agricultural activities, development in the energy sector, road and power line development, increasing predator populations and diseases including West Nile Virus. The population decline has been correlated with periods of increased oil and gas development in the late 1970s, early 1980s and in the 1990s.

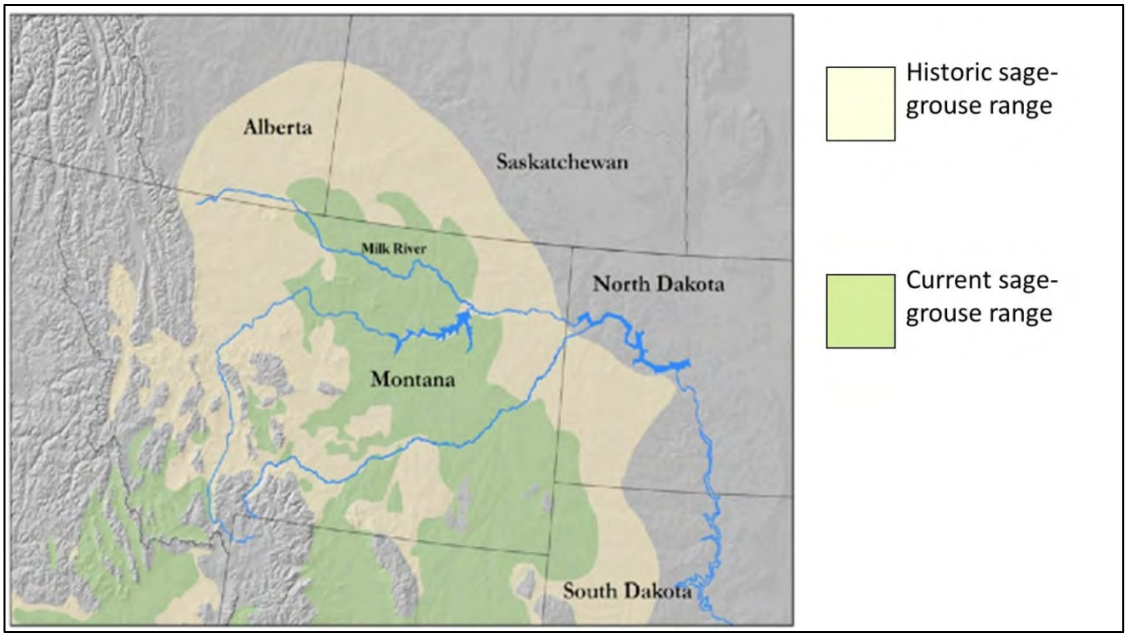


Figure 1. Current range of sage grouse in northern Great Plains compared to its historical range.

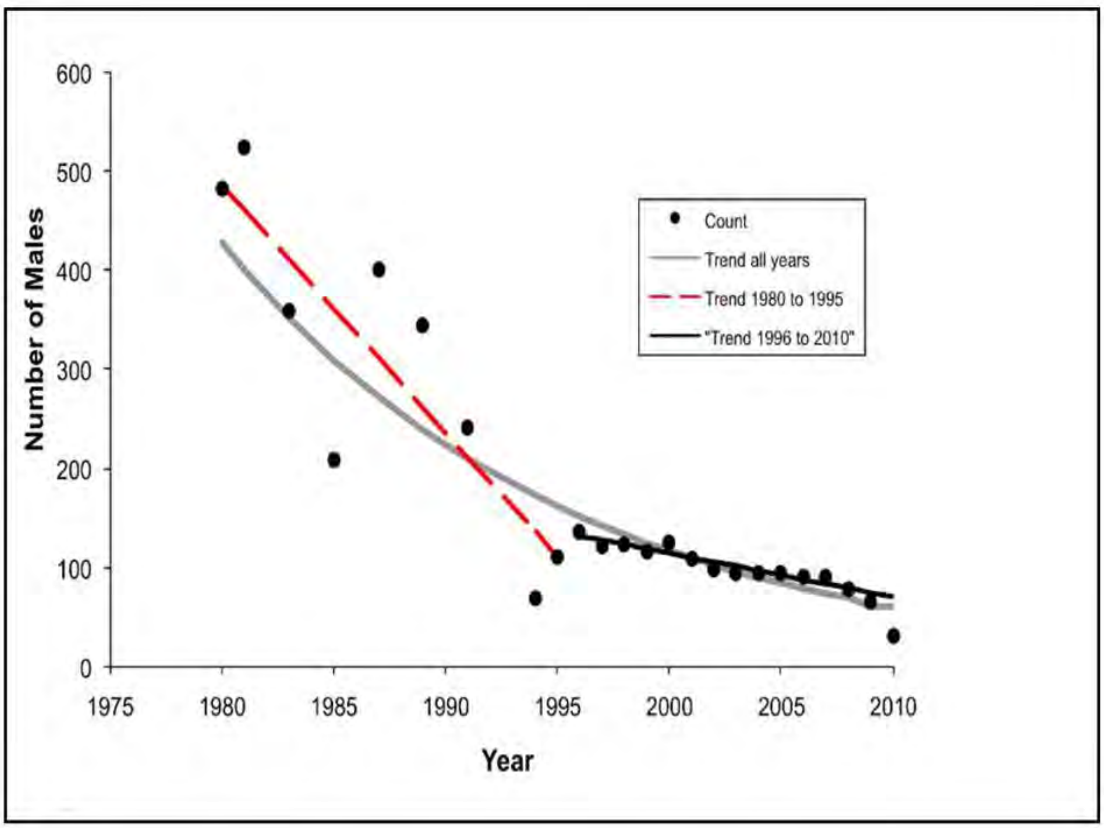


Figure 2. The sage-grouse population decline from the early 1980s to the mid 1990s was significantly more drastic than the decline from 1995 to 2010. Source: AccuMap and CAPP (2010).

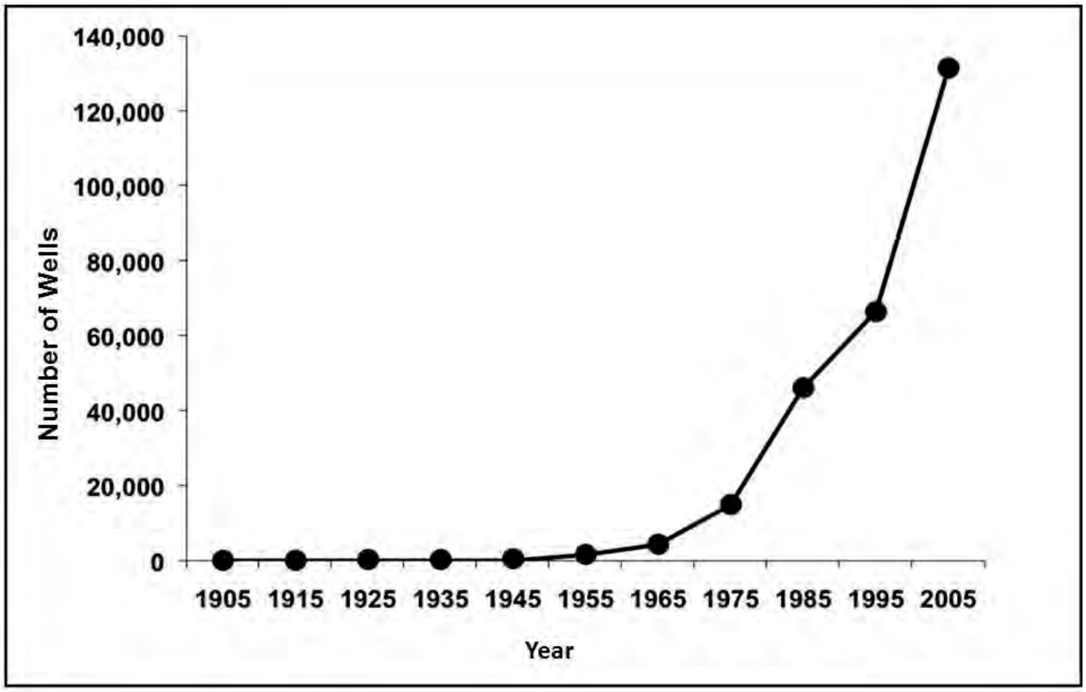


Figure 3. The population decline correlates with an increase in energy development in Alberta in the 1980s. Source: AccuMap and CAPP (2010).

Picture 1. Battery station in the Manyberries oilfield.

Picture 2. Storage tank in sagebrush habitat.

Picture 3. Abandoned well site in sagebrush habitat.

In Alberta, sage-grouse select patches of nesting habitat with low proportions of anthropogenic edge and brood-rearing habitat with lower densities of well sites (Aldridge and Boyce 2007). Avoidance of habitat may result in decreased survival or reproduction if sage-grouse are displaced to marginal habitats (Holloran 2005, Naugle et al. 2011).

Methods

The 'Conservation and Development Zones' (C&D Zones) were developed collaboratively with the University of Calgary, Miistakis Institute and Alberta Environment and Sustainable Resource Development (AESRD) to coordinate industrial development and sage-grouse conservation. The C&D Zones are a tool under the Enhanced Approval Process (EAP) in Alberta. All industrial development proposed to occur in sage-grouse habitat are 'non-standard' and require consultation with AESRD. The C&D Zones are then used to evaluate the potential impact of the proposed development on sage-grouse habitat. Industry has agreed to use the C&D Zones voluntarily and the approach can be modified as new information becomes available.

Conservation & Development Zones:
Zone 1: Large areas of contiguous habitat, no to very low development footprint
Zone 2: Secondary habitat, no to very low development, high biodiversity value, surrounded by Zone 1 areas
Zone 3: Habitat area with Land Use Intensity (LUI) exceeding threshold for sustaining sage grouse
Zone 4: Outside current distribution of sage grouse, with some habitat, high biodiversity value, low LUI
Zone 5: High LUI, mostly crop agriculture, some potential for habitat restoration

Land Use Intents:
Zone 1: Primary area for sage-grouse recovery, most restrictive land use, light impact activities allowed
Zone 2: Biodiversity conservation, maintain light footprint, minimum impact management
Zone 3: Long-term restoration, continued energy development, on-site and off-site mitigation
Zone 4: Biodiversity and natural features conservation, minimum impact management
Zone 5: Target area for conservation offsets where conditions support habitat restoration

The Compliance and Operations Management database (COM) was queried to obtain all wellsite data for townships 1-1 to 6-7 W4M (the extent of sage-grouse range in Alberta). This data was put into ArcMap and categorized by C&D Zone, 3.2 km lek buffers, and critical sage-grouse habitat.

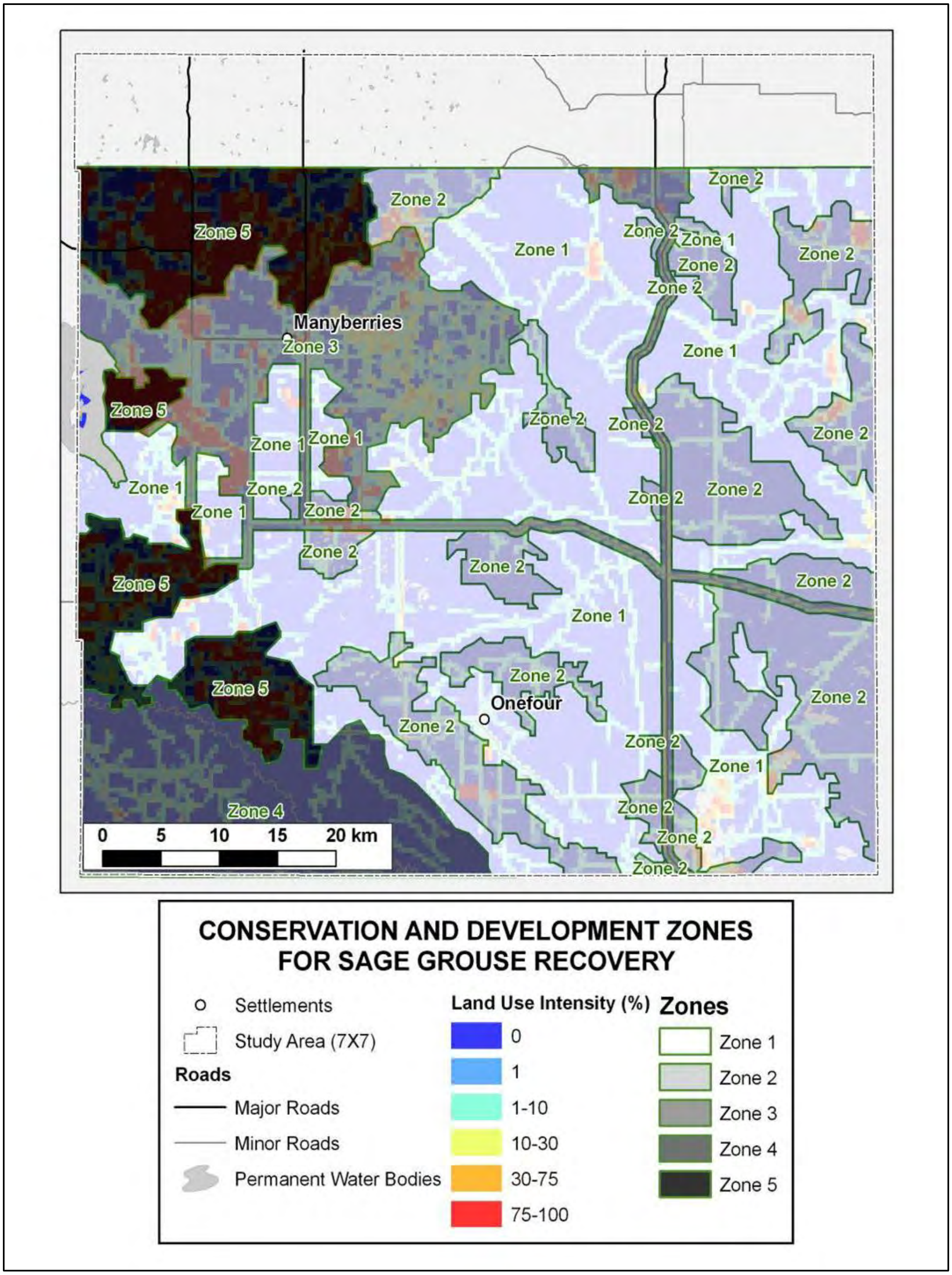


Figure 4 Conservation and development zones for Sage Grouse recovery in south-east Alberta.

Results

Table 1. Summary of abandoned, suspended and active wells in townships 1-1 to 6-7 W4M, as of 11/2012 (excluding water wells).

Well Site Status	Number of Well Sites	Percentage of Total Well Sites
Abandoned	170	11.1%
Reclamation Certified	617	40.3%
Reclamation Exempt	149	9.7%
Suspended	186	12.1%
Active	411	26.8%
TOTAL	1533	

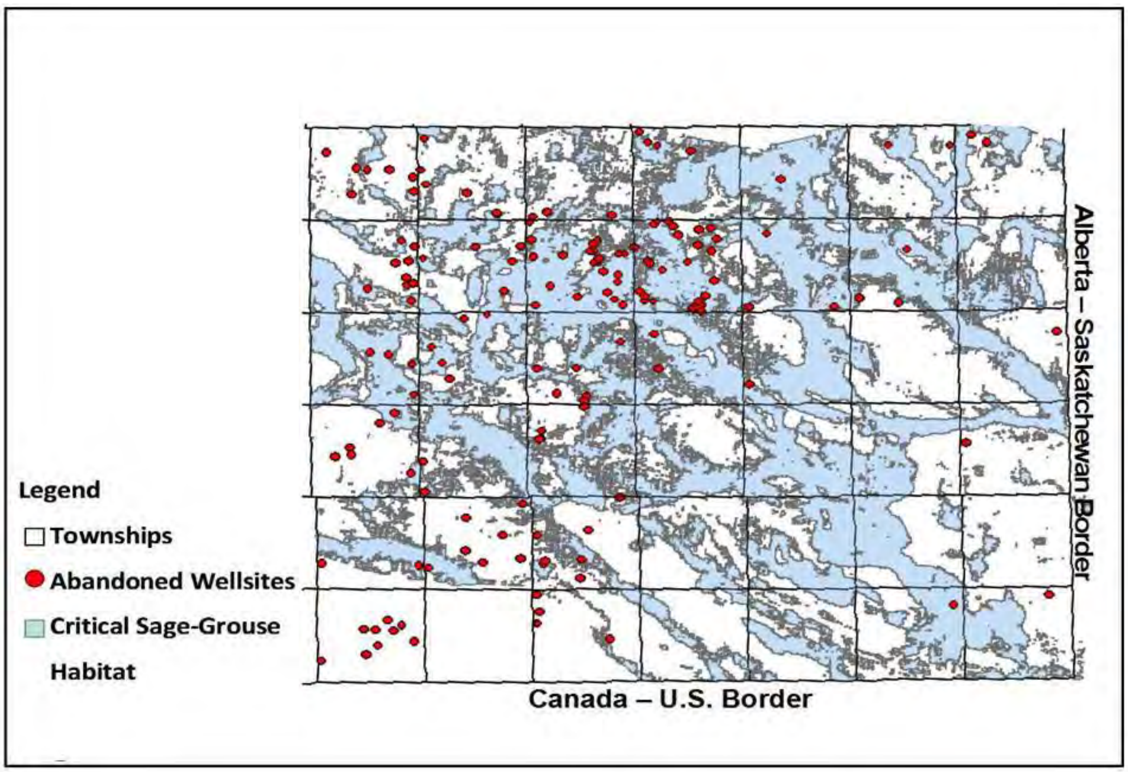


Figure 5. Abandoned wells in relation to critical habitat.

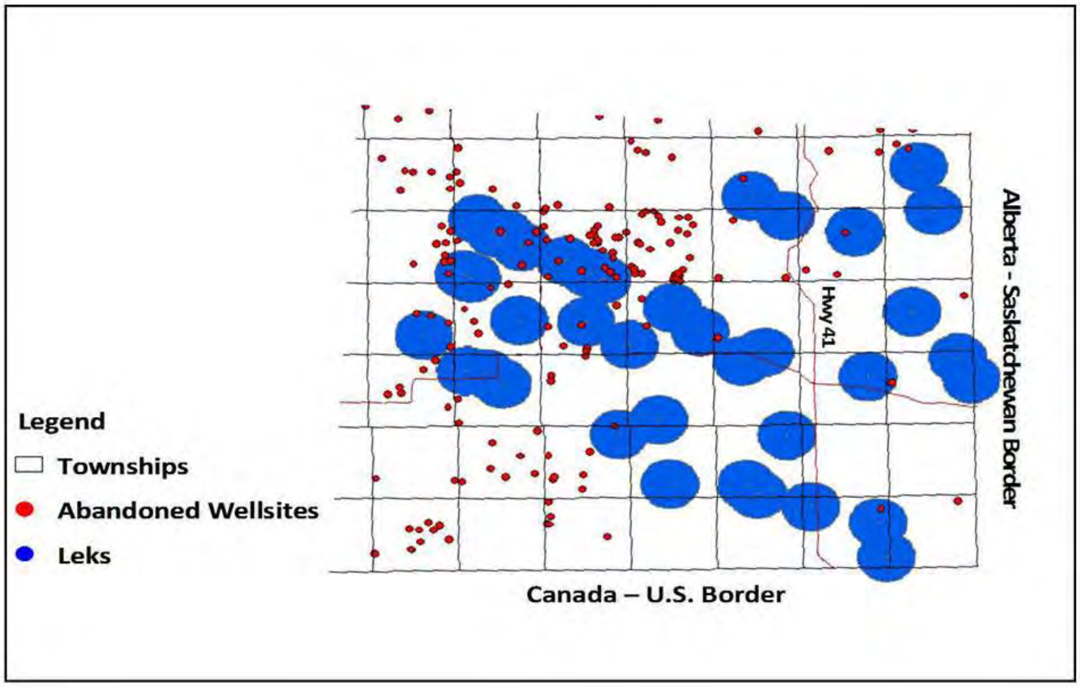


Figure 6: Proximity of lek buffers to wells where downhole abandonment has been done according to ERCB guidelines and where surface reclamation still needs to be done.

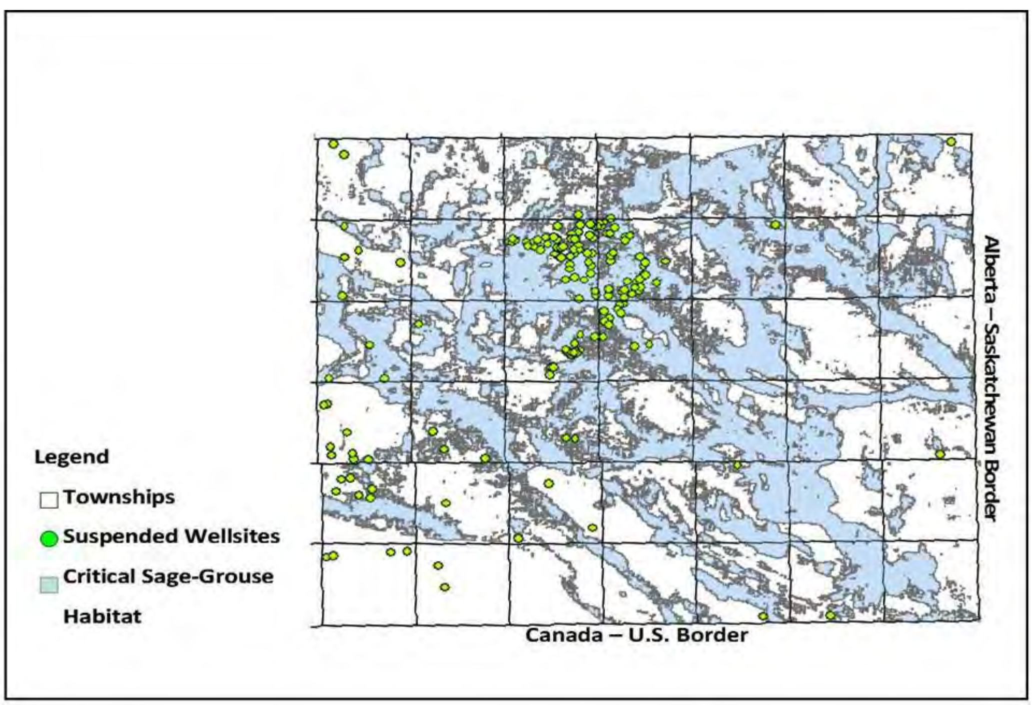


Figure 7. Suspended wells in relation to critical habitat.

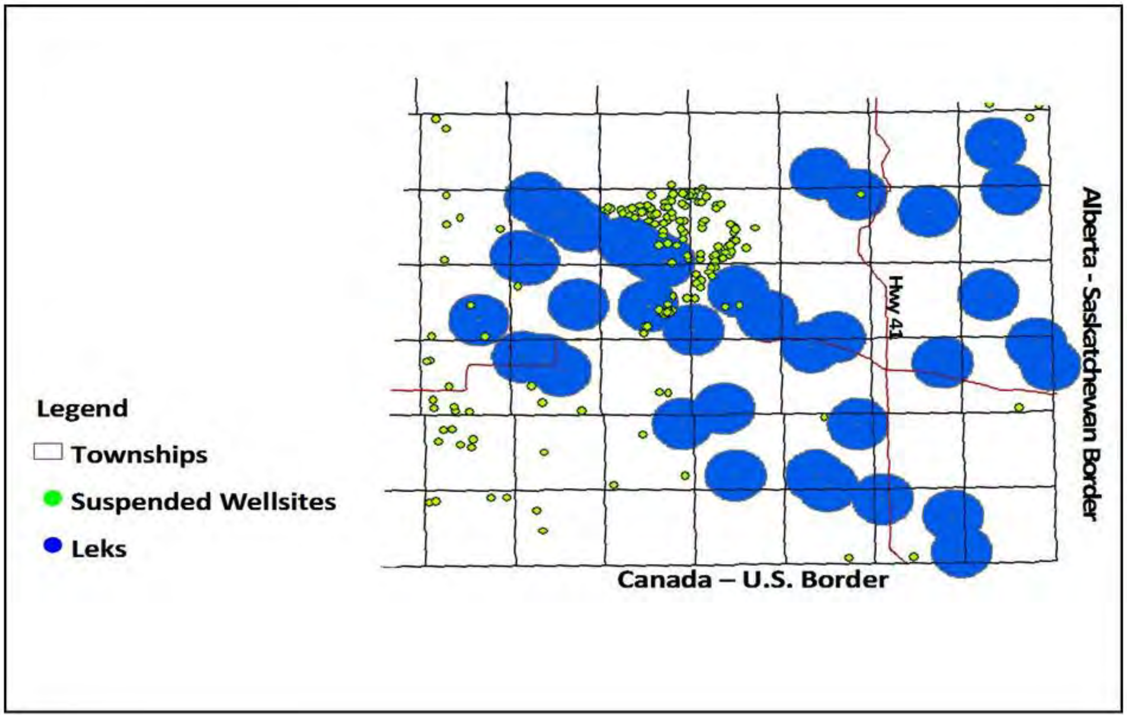


Figure 8: Proximity of lek buffers to wells that still have wellhead equipment present and are currently not in production due to economic or environmental reasons, but may produce in the future.

Discussion

In Alberta, there are approximately 1533 wells located in current sage-grouse range. Of these wells, 23.22% remain on the landscape as non-producing and 11.09% as non-operational. By spatially joining the well site layers, 3.2 km lek buffer and critical habitat layers, it was found that **33.67%** of abandoned wells and **49.14%** of suspended wells are in critical habitat, **30.74%** of abandoned and suspended wells are within 3.2 km of a lek.

Other anthropogenic features including abandoned buildings and nesting platforms will also be considered for removal and reclamation. Predator populations have increased on the prairies, likely a result of increased habitat fragmentation and the presence of anthropogenic features. Anthropogenic features can serve as perching points for hunting and nesting and have been linked to increased predator densities (Holloran and Anderson 2005, Coates et al. 2008).

Conclusion

We are proposing further research to model the response of sage-grouse to the reclamation of anthropogenic features on the landscape so that reclamation efforts can occur efficiently and strategically. This effort should result in rapid habitat improvements for this critically imperilled species by removing those features from the landscape that appear to most effectively limit habitat use by sage-grouse.

Picture 4. Artificial nesting platform for raptors in sage-grouse habitat.

Picture 5. Abandoned farmstead in sage-grouse habitat.

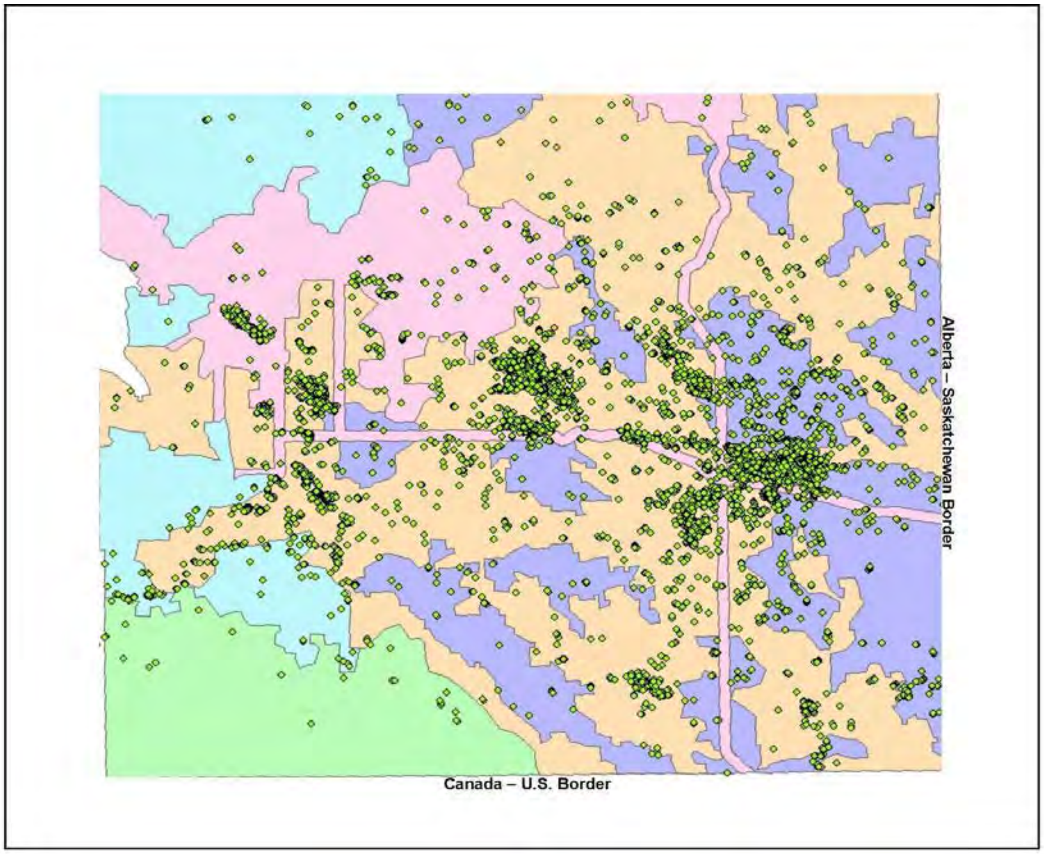


Figure 9. GPS points of the locations of trans-located sage-grouse from 2011 and 2012.

Acknowledgments

Thank you to Alberta Environment and Sustainable Resource Development, Alberta Species-at-Risk Program, Kevin Redden and City of Medicine Hat Petroleum and Natural Gas, Dr. D. Gummer of Parks Canada for developing the sage-grouse critical habitat model and Montana Fish, Wildlife & Parks. A special thank you to the Energy Resources and Conservation Board for access to the COM Database.

References

Aldridge, C. L. and M. S. Boyce. 2007. Linking occurrence and fitness to persistence: habitat-based approach for endangered greater sage-grouse. *Ecological Applications* 17: 508-526.

Coates, P.S. and D.J. Delehanty. 2010. Nest Predation of Greater Sage-Grouse in Relation to Microhabitat Factors and Predators. *The Journal of Wildlife Management* 74: 240–248.

ERCB (Energy Resources Conservation Board) Regulations and Directives. http://www.ercb.ca/regulations-and-directives/directives. Accessed on January 5, 2013.

Holloran M.J. and S.H. Anderson. 2005. Spatial distribution of Greater Sage-Grouse nests in relatively contiguous sagebrush habitats. *The Condor* 107: 742-752.

Naugle, D. E., K. E. Doherty, B. L. Walker, M. J. Holloran, and H. E. Copeland. 2011. Energy development and Greater Sage-Grouse in Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats S. T. Knick and J. W. Connelly (editors). *Studies in Avian Biology* (vol. 38), University of California Press, Berkeley, CA.

DEVELOPMENT OF MULTI-SPECIES-AT-RISK MANAGEMENT, RECOVERY AND RESEARCH ACTION PLANS FOR NATURE CONSERVANCY OF CANADA LANDS IN SOUTHEASTERN MANITOBA

CARY HAMEL
Nature Conservancy of Canada, 611 Corydon Avenue, Suite 200, Winnipeg, Manitoba R3L 0P3.

Abstract: Long-term maintenance of biodiversity in disturbance-driven ecosystems such as tall grass prairie requires conservation land managers to consider prescribing management techniques such as fire, haying and grazing. The application of these tools can be challenging in landscapes that support multiple Species-at-Risk and within a regulatory and recovery framework that prohibits individual harm and focuses on individual species. Management prescriptions directed at the recovery of one particular species may conflict with the recovery objectives of other species. Locally-appropriate data on sensitive time periods and management activities are often lacking. Here we present a practical conservation land management decision support tool that is in development for Nature Conservancy of Canada lands at the Manitoba Tall Grass Prairie Preserve. We also present multiple Species-at-Risk Management, Recovery and Research Action Plans that are based on the best available science and data, that recognize the recovery needs of all Species-at-Risk and their habitats, that recognize disturbance as a key ecological factor of Species-at-Risk habitat ecology, and that formalize the identification of key knowledge gaps and ongoing monitoring of the effectiveness of management actions and of species and their habitats.

SPECIES-AT-RISK: SUCCESSES, CHALLENGES AND LESSONS LEARNED FROM STAKEHOLDER CONSULTATIONS

CANDACE L. NEUFELD
Canadian Wildlife Service, Environment Canada, 115 Perimeter Road, Saskatoon, Saskatchewan S7N 0X4.
Phone: 306-975-4101; Email: candace.neufeld@ec.gc.ca

Abstract: For species that are listed as Threatened, Endangered, or Special Concern under the *Species at Risk Act* (SARA), recovery plans (recovery strategies, action plans, and management plans) must be created. In addition to preparing the recovery plans in cooperation with provincial/territorial governments, other federal departments, aboriginal groups, and wildlife management boards, the SARA sets out requirements for consultation with landowners and others seen as directly affected by the recovery plans (stakeholders). This consultation process can become more complex when critical habitat identification is included in a recovery strategy or action plan, particularly when it is identified on leased Crown or private land. Staff from Environment Canada (Prairie and Northern Region) have had the opportunity to participate in and/or lead a number of these consultations with stakeholders. Successes, challenges, and lessons learned from these consultations in the prairies over the last few years will be discussed.

GRASSLAND STEWARDSHIP CONSERVATION PROGRAMMING ON NATURAL GRASSLANDS USED FOR LIVESTOCK PRODUCTION

S. MICHALSKY[1]**, O. BALAS**[1]**, M. BURGESS**, [1] **K. GOOD**[2] and **R. HADDOCK**[2]
[1] Ranchers Stewardship Alliance Inc., P.O. Box 448, Eastend, Saskatchewan S0N 0T0.
[2] Miistakis Institute for the Rockies, University of Calgary, current address: Room U271, Mount Royal University, 4825 Mount Royal Gate, SW, Calgary, Alberta T3E 6K6.
Project website: www.rockies.ca/project_info2.php?id=56

Abstract: The Ranchers Stewardship Alliance Inc. (RSAI) is working in partnership with Nature Saskatchewan, Prairie Trust, the Miistakis Institute and other partners to:

- Evaluate market-based incentives from around the world including payments for ecosystem services (PES) programs and grassland stewardship certification programs for applicability to the Great Plains in Canada, and
- Research methods of placing economic values on the ecological goods and services provided by natural prairie grasslands grazed by livestock.

The evaluation of certification programs involved programs that involved livestock production and had a grassland conservation component. Very few existing programs met those criteria. The programs evaluated included The Southern Cone Alliance for the Grasslands – Grassland Beef, Country Natural Beef, Oregon, Natural Beef Program of Certification of Uruguay, and The Nature Conservancy - Conservation Beef. PES programs are much better developed and used more effectively around the world than certification programs for biodiversity conservation. About 15 programs met our initial criteria and five were shortlisted including ground nesting birds in the Netherlands, conservation performance payments for carnivores in Sweden, Golden Cheeked Warbler recovery credit system in Texas, rewarding farmers for vascular plant diversity in managed grasslands in Germany and PES from agricultural lands in the Northern Everglades of Florida. With the recommendations from these reviews and an assessment of the economic value of biodiversity and other ecological services provided by natural grasslands in the northern Great Plains, RSAI and our partners plan to design and pilot one or more results-based, regionally designed programs. Our goal is to design a program or programs that increases endemic grassland biodiversity, secures sequestered carbon and improves the economic viability of livestock producers participating in a program, thereby providing an effective use of public and private funds.

SESSION 14: TRANSBOUNDARY CONSERVATION INITIATIVES

Session Moderator: Geoff Holroyd

STRATEGIC OVERVIEW OF THE WORLD'S TEMPERATE GRASSLANDS

BOB PEART

World Temperate Grasslands Conservation Initiative, 11166 Willow Road, Sidney, British Columbia V8L 5K6. Phone: 250-655-0250; Email: bobpeart@shaw.ca

Abstract: The temperate grasslands biome is the most endangered, the most altered and yet the least protected biome on the planet. Only 3.4% of the world's indigenous temperate grasslands currently have any form of legal protection. This talk discussed where these grasslands were and the current efforts being made to conserve them in various regions throughout the world. The Great Plains of North America were put into the context of global efforts to protect this rich and diverse ecosystem. Website: www.iucn.org/wcpagrasslands.

NORTHERN SAGEBRUSH STEPPE INITIATIVE

DALE ESLINGER[1]**,** and **CORMACK C.GATES**[2]
[1] Alberta Environment and Sustainable Resource Development, #106 Provincial Building, 346-3 St., SE, Medicine Hat, Alberta T1A 0G7.
[2] Faculty of Environmental Design, University of Calgary, 2500 University Drive, NW, Calgary, Alberta T2N 1N4.

Abstract: As latitude increases north of the Missouri River in Montana, Big Sagebrush (*Artemesia tridentata*) ecosystems are gradually replaced by Silver Sagebrush (*A. cana*), which assumes dominance among shrub species in the dry mixed grasslands north of the Milk River. Remaining large contiguous native grassland areas provide habitat for numerous listed wildlife species, which in Alberta host 80% of provincial Species-at-Risk. This international transboundary region encompasses portions of three provincial or state jurisdictions, Alberta, Montana and Saskatchewan, and is the focus of an inter-jurisdictional agreement among mandated wildlife agencies. The Northern Sagebrush Steppe Initiative (NSSI) was formally established in 2007 under a five-year Memorandum of Understanding (M.O.U.) among the three jurisdictions. It was renewed for another five-year term in July 2012. The agreement is endorsed by the Western Association of Fish and Wildlife Agencies (WAFWA). The M.O.U. provides support for management coordination, information exchange and wildlife research in the region. The initial non-restrictive focus of the NSSI was on three species of mutual concern: Greater Sage-Grouse (*Centrocercus urophasianus*), Pronghorn (*Antilocapra Americana*), and Mule Deer (*Odocoileus hemionus*). These priority species were identified because of current conservation and management concerns. Annual meetings are convened for agency staff to foster coordination and communication. Research results and information about management activities for the three key species have been shared at annual meetings held since 2007. Other significant supporting work includes cooperation among GIS specialists to create common seamless spatial data bases. The shared vision of the agencies under the NSSI is to conserve ecologically functional landscapes and native biodiversity across international and provincial/state boundaries.

TAKING TRANSBOUNDARY WATERSHED MANAGEMENT TO THE NEXT LEVEL—LOCALLY: MILK RIVER WATERSHED CASE STUDY

S. RIEMERSMA
Milk River Watershed Council Canada, 113-1 Ave NW, Milk River, Alberta T0K 1M0.

Abstract: The Milk River watershed covers an area of about 59,857 km^2 in southern Alberta and Saskatchewan, Canada, and northern Montana, U.S.A. In Alberta, the watershed is unique, characterized by the flow-augmented Milk River, the badlands, and large, contiguous tracts of native grassland that supports the highest number of Species-at-Risk in the province. Land use is predominantly agricultural, consisting of farming and ranching, although the oil and gas industry is also present and is increasing production. Transboundary partnerships are necessary to ensure that resources are properly managed and maintained for future generations. To overcome transboundary watershed management issues in the Milk River watershed, good communication among government, organizations, landowners and residents is essential. This has proven true since 1909 when the Boundary Waters Treaty was written to solve water-sharing disputes between Alberta and Montana. More recently, the International Joint Commission established a Task Force to investigate the apportionment of flows between Alberta and Montana, and if not apportioned equally, to determine how the flows could better be apportioned. In 2006, the Task Force Report was filed with the IJC, but no resolution could be found. Alberta and Montana were then asked to collaborate through a Joint Initiative Team comprised of government officials and local citizens. Through these more informal routes, the Team could share information, ask questions, gain trust and work toward a solution. At the same time, the Milk River Watershed Council Canada focused on local ability and strived to unite jurisdictions toward common watershed goals that include limited surface water supply, water quality, shared groundwater resources (i.e., Milk River Sandstone Aquifer), streambank erosion, invasive species and biodiversity. With the understanding that shared information, knowledge and successes across boundaries are critical to achieving watershed goals, a transboundary Milk River State of the Watershed Report is currently underway.

RECOVERY & MANAGEMENT OF THE IMPERILLED POWESHIEK SKIPPER BUTTERFLY IN A MULTI-SPECIES-AT-RISK LANDSCAPE

C. HAMEL and **K. TENEYCKE**
Nature Conservancy of Canada, Winnipeg and Brandon, Manitoba.

Abstract: The Poweshiek Skipper (*Oarisma powesheik*) is a nationally listed (Canada and the USA) butterfly that in Canada is found only in the Tall Grass Prairie Natural Area in southeastern Manitoba. Most known Canadian sites for the species are on Nature Conservancy of Canada (NCC) owned and managed prairie lands. The species is declining in Canada, and across most of the rest of its range in the USA Midwest. Given the importance of NCC lands to the species survival, and a reported sensitivity to land management activities, NCC endeavors to implement conservation land management activities that assist in the recovery of the species, while also managing for several other Species-at-Risk present in the same habitat. Since 2010, the Nature Conservancy of Canada has taken a lead international role in the recovery of the species, through the coordination of surveys, studies of the species habitat and potential threats, and leading international workshops bringing species experts, regulators and conservation land managers together to work towards coordinated range-wide conservation actions. This presentation will summarize the species' current status, threats, research gaps, and NCC's ongoing multi-Species-at-Risk recovery actions.

Ecological Communities, Rare Plants and Biodiversity areas in Alberta's Prairies and Parkland

LORNA ALLEN
Alberta Parks, 2nd Floor, 9820-106 St., Edmonton, Alberta T5K 2J6.

The Alberta prairie is surprisingly diverse; changing in character and species from north to south and east to west. In this paper I will review the vegetation diversity of the Alberta prairies and parkland. Then discuss a number of new and recent international initiatives focused on plant conservation.

Alberta has been divided into seven Natural Regions which are further subdivided into a total of 21 Natural Subregions based on criteria such as geology, soils and ecosystems (Natural Regions Committee 2006, Figure 1). This stratification is a useful way of organizing a discussion on natural diversity. The area in Alberta often considered 'prairie' falls generally within the Grassland Natural Region, which is divided into the Mixedgrass, Dry Mixedgrass, Northern Fescue and Foothills Fescue Natural Subregions and also includes the southern two subregions of the Parkland Natural Region. A third Parkland Subregion is recognized - the Peace River Parkland, but it is outside the area generally considered Great Plains prairie and parkland. A review of the main characteristics for each of the prairie and parkland subregions follows, based on 'Natural Regions of Alberta' (Natural Regions Committee 2006).

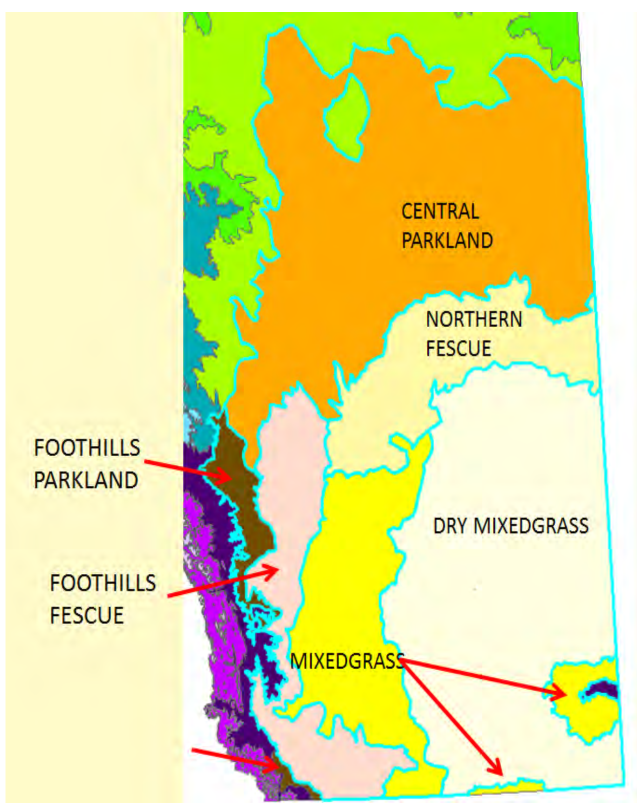


Figure 1. Natural Subregions that make up the Alberta Prairies.

The Central Parkland is essentially a wide transition area - from the boreal forest to the north and the grasslands to the south. Native vegetation is characterized by a 'parkland' structure consisting of groves of Aspen (*Populus tremuloides*) intermixed with Plains Rough Fescue (*Festuca hallii*) dominated grasslands. Characteristic woodlands consist of Aspen clones with rose (*Rosa* spp.), snowberry (*Symphoricarpos albus*), Saskatoon (*Amelanchier alnifolia*), or Beaked Hazelnut (*Corylus cornuta*) dominated shrub understories (Figure 2). Balsam Poplar (*Populus balsamifera*) is common adjacent to wetlands and in moist locations in the landscape. Grasslands are dominated by Plains Rough Fescue, but other common graminoids include June Grass (*Koeleria macrantha*), Western Porcupine Grass (*Stipa curtiseta*), Northern Wheat Grass (*Elymus lanceolatus*) and Hooker's Oat Grass (*Helictotrichon hookeri*). White Spruce (*Picea glauca*) stands do occur in this landscape and are generally found in mesic locations protected from fire; often north-facing coulee slopes. Wetlands are common and are typically Cattail (*Typha latifolia*), sedge (*Carex* spp.) or Great Bulrush (*Schoenoplectus acutus* var. *acutus*) marshes. Soils are predominantly Black Chernozems under the grasslands and Dark Grey Chernozems under Aspen stands. There is also a significant band of Solonetzic soils in the eastern part of the subregion that makes up about 15% of the area.

Figure 2. A common woodland type typical of the Central Parkland Natural Subregion. Photo by L. Allen

The area of native vegetation is now reduced to an estimated 5% of the subregion due to urbanization and extensive cultivation (Natural Regions Committee 2006). Three of the major cities, Edmonton, Calgary and Red Deer, are wholly or partially within the Central Parkland Subregion and this is the most densely populated region of Alberta. Remnant areas of native vegetation tend to be those that are too sandy, too wet or too hilly to cultivate. Parts of the Solonetzic zone are also unsuitable for cultivation.

The Central Parkland Subregion grades into the Northern Fescue Subregion, which is the most northern of the Grassland subregions. It is typically an undulating to hummocky landscape dominated by Plains Rough Fescue grasslands on moister sites and Plains Rough Fescue / Western Porcupine Grass on warmer and drier sites such as south-facing slopes. Buckbrush-dominated (*Symphoricarpos occidentalis*) shrublands are common, often with a significant component of common Wild Rose (*Rosa woodsii*). Wetlands are dominated by sedges, Great Bulrush or Cattails. Soils are predominantly Dark Brown Chernozems and Dark Brown Solonetzic soils. Solonetzic areas make up approximately 25% of the subregion (Figure 3).

Figure 3. Solonetzic areas are common in the Northern Fescue Subregion, and provide habitat for some rare species. Photo by L. Allen

Similar to the Central Parkland, the Foothills Parkland is a transition zone – but the transition is from the Rocky Mountain Natural Region in the west to the fescue grasslands in the east. Topography is rougher than in other parkland subregions but the vegetation has a similar physiognomy, with distinct copses of parkland Aspen forest interspersed with grasslands. The dominant species of the grasslands however has changed. Plains Rough Fescue is the dominant fescue in the Central Parkland, Mountain Rough Fescue (*Festuca campestris*) is dominant in the Foothills Parkland.

Aspen forests and groves with under stories of Snowberry and Saskatoon are common. A distinct area of willow parkland occurs in the northern portion of the subregion, with characteristic dense, tall shrublands dominated by Beaked Willow (*Salix bebbiana*) with a diverse understory. Grassland communities most commonly occur on southern exposures. Mountain Rough Fescue is often dominant, but other species such as Parry Oatgrass (*Danthonia parryi*), Idaho Fescue (*Festuca idahoensis*) and wheatgrasses are also common.

Balsam Poplar stands are found on moist sites and along river terraces. Shrub and forb layers include many species that are common in the adjacent Montane Subregion but that are not typical of other parkland or grassland subregions.

The Foothills Fescue Subregion is a grassland subregion located along the flanks of the Rocky Mountains, with elevations much higher than found in the other grassland subregions (Achuff 1994). Summer aridity and frequent winter chinook winds limit the persistence of woody species (Adams *et al*. 2003). Mountain Rough Fescue - Parry Oatgrass grasslands occur on the moistest of the upland loamy sites. Mountain Rough Fescue - Idaho Fescue tends to occur in more southerly parts of the subregion. Moving east, Western Wheatgrass (*Pascopyrum smithii*) signals the transition to the mixedgrass prairie. Wetlands and sub-irrigated sites often have shrublands dominated by Beaked Willow (Figure 4). Black Chernozemic soils are characteristic.

Figure 4. Rare Beaked Willow communities of Foothills Fescue Subregion. Photo by L. Allen

The Mixedgrass Subregion is a zone of transition between the Dry Mixedgrass Subregion and the fescue grasslands of the Foothills Fescue and Foothills Parkland Natural Subregions. It is found primarily along the western edge of the Dry Mixedgrass Subregion but also is found on the flanks of two isolated highlands; the Cypress Hills and the Sweetgrass Upland. The grasslands show a mixedgrass character; made up of grasses of medium height such as Needle-and-thread (*Stipa comata*), Porcupine Grass, Northern and Western Wheatgrass. Blue Grama (*Bouteloua gracilis*), a grass of shorter stature, is common on poorer soils or heavily grazed sites.

There is some variability among the two highland areas, with Plains Rough Fescue prominent on the flanks of the Cypress Hills, probably due to the cooler, moister environment. Idaho Fescue is a prominent component of the Milk River Ridge area, reflecting an affinity to ecosystems to the west and south, into Montana. Buckbrush-dominated shrublands are common. Soils are predominantly Dark Brown Chernozems. Fertile soils, a longer growing season than the adjacent Foothills Fescue Subregion and more favourable moisture conditions than in the Dry Mixedgrass Subregion mean that this subregion is a significant agricultural area, with approximately 70% no longer in native prairie (Adams et al. 2013).

The Dry Mixedgrass has a hummocky to nearly level topography dominated by dry Blue Grama and Needle-and-thread grasslands on Brown Chernozemic soils (Figure 5). Solonetzic soils are common, making up about 25% of the subregion and there are also significant sand areas, making up approximately 10% of the subregion (Natural Regions Committee 2006). Sandy sites are dominated by Needle-and-thread, Sand Grass (*Calamovilfa longifolia*) and June Grass. Solonetzic sites may have unvegetated areas, termed blowouts, interspersed with Western Wheatgrass and Sandberg Bluegrass (*Poa sandbergii*). Extensive areas of low shrubs occur, including Silver Sagebrush (*Artemisia cana*), Silverberry (*Elaeagnus commutata*), Western Snowberry and Prickly Rose (*Rosa acicularis*). Sites that are strongly Solonetzic or sodic may have a shrub layer of Greasewood (*Sarcobatus vermiculatus*).

Figure 5. Grasslands of the Dry Mixedgrass Subregion. Photo by L. Allen

The Dry Mixedgrass has the largest number of Effective Growing Degree Days and the lowest annual precipitation of the grassland subregions (McNeil 2004). The different dominant grasses reflect conditions that are drier and warmer in summer compared with bordering Natural Subregions.

The natural regions classification provides the big-picture view of the diversity of the Alberta prairies. An analysis of the rare element information accessed from the Alberta Conservation Information Management System (ACIMS 2013) shows details on the fine-scale diversity. Table 1 summarizes, by Subregion: the number of rare plant-related elements (ecological communities, mosses, lichens and vascular plants); the number of individual element locations that are mapped and the number of elements not found in any of the other grassland or parkland subregions under discussion. Figure 6 provides a visual of the numbers presented in Table 1, and Figure 7 illustrates the comparative of size of each of the subregions.

Table 1. Summary of Rare Elements* by Subregion.

Natural Subregion	Number of rare elements	Number of occurrences**	Number of unique rare elements***
Total	407	2939	242
Central Parkland	143	542	83
Foothills Parkland	120	260	56
Northern Fescue	51	99	14
Foothills Fescue	95	313	19
Mixedgrass	85	265	9
Dry Mixedgrass	165	1521	61

* Rare element groups included in this count are lichens, non-vascular and vascular plants and ecological communities.

** This is the number of mapped locations of rare elements in the Subregion.

*** This is the number of rare elements found only in the Subregion, as compared to the other prairie and parkland Subregions. They are unique to the prairie area under discussion, but some may also be found outside the prairie area.

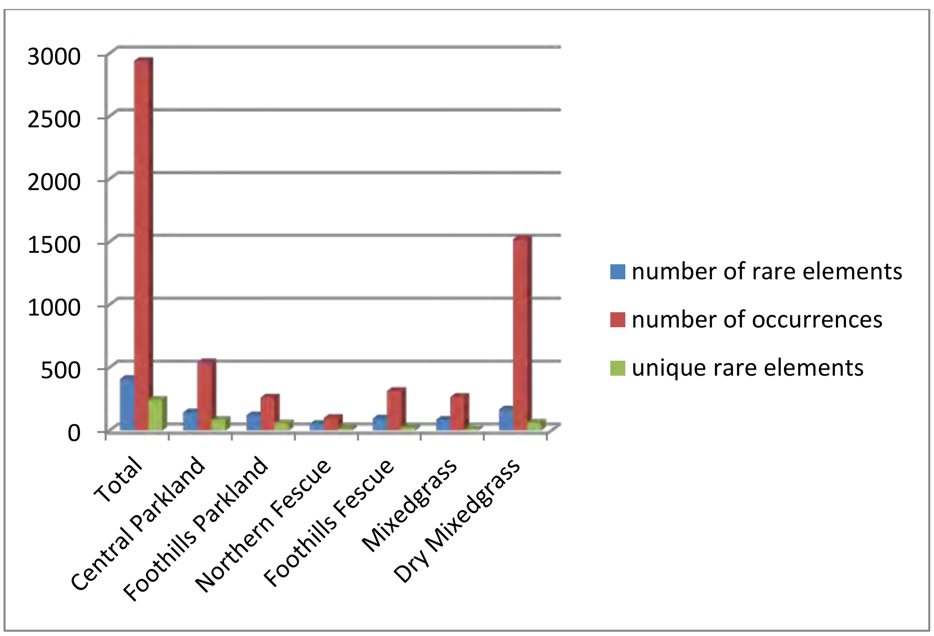


Figure 6. Summary of Rare Elements by Subregion.

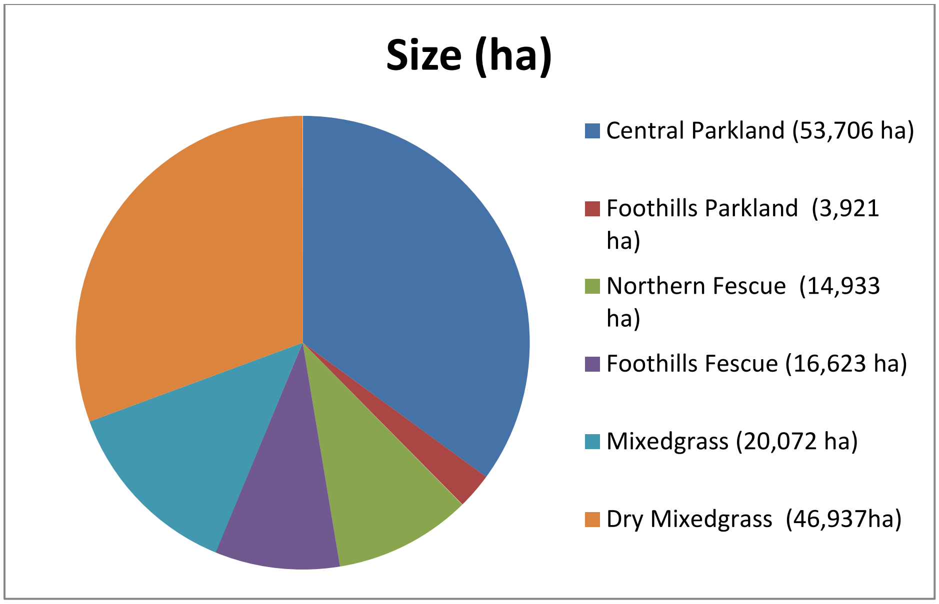


Figure 7. Comparative Sizes of the Parkland and Prairie Subregions.

Ten of fifteen SARA listed plant species that occur in Alberta are found only within the prairie subregions (Table 2). Of these, seven are found only in the Dry Mixedgrass. The Dry Mixedgrass also has both the highest number of rare elements and the most mapped locations for rare elements. The Central Parkland has the highest number of elements that are unique to the subregion, as compared to other of the prairie subregions. The two parkland subregions have a high number of unique elements, probably in part because they include species and ecological communities that are from the adjacent mountain or boreal subregions, not found in the other prairie subregions.

Table 2. SARA listed species in the Alberta Prairies

Natural Subregion	Common Name	Scientific Name	SARA Designation
Dry Mixedgrass	Dwarf Woollyheads	*Psilocarphus brevissimus var. brevissimus*	Special Concern
Dry Mixedgrass	Tiny Cryptanthe	*Cryptantha minima*	Endangered
Dry Mixedgrass	Slender Mouse-Ear-Cress	*Halimolobos virgata*	Threatened
Dry Mixedgrass	Smooth Narrow-leaved Goosefoot	*Chenopodium subglabrum*	Threatened
Dry Mixedgrass	Sand Verbena	*Tripterocalyx micranthus*	Endangered
Dry Mixedgrass	Soapweed	*Yucca glauca*	Threatened
Dry Mixedgrass	Western Spiderwort	*Tradescantia occidentalis*	Threatened
Mixedgrass; Foothills Fescue; Foothills Parkland	Western Blue Flag	*Iris missouriensis*	Special Concern
Foothills Fescue	Hare-footed Locoweed	*Oxytropis lagopus*	Special Concern

A comparison of the rare elements in ACIMS (2013) among the prairie natural subregions shows that each subregion has numerous documented locations for rare plant species or ecological communities, and each has some unique plant or community elements. So, we have the framework for understanding the variation of 'prairies' across Alberta, from the dominant species, to the soils, to the rare species and ecological communities found in each. There are a number of recent initiatives that are designed to accomplish the conservation of the diversity of vegetation and plant species.

The Global Strategy for Plant Conservation, an initiative under the Convention on Biological Diversity (CBD) was adopted in 2002. As a signatory to the CBD, Canada also adopted the plant conservation strategy. Sixteen global targets were initially developed, grouped under five main objectives: understanding and documenting plant diversity; conserving plant diversity; using plant diversity sustainably; promoting education and awareness about plant diversity; and building capacity for the conservation of plant diversity (Anderson 2002). Revisions to targets and an updated strategy for the period 2011-2020 were adopted by CBD Parties in 2010. The main target around conserving plant diversity, Target 5, states: "At least 75 per cent of the most important areas for plant diversity of each ecological region should be protected with effective management in place for conserving plants and their genetic diversity". This is revised upward from the 2002 target of protection for 50 per cent of the important areas for plant diversity.

To address Target 5, the Important Plant Areas concept has been adopted by many countries, particularly in Europe. An Important Plant Area (IPA) is defined as, "a natural or semi-natural site exhibiting exceptional Botanical richness and/or supporting an outstanding assemblage of rare, threatened and/or endemic plant species and/or vegetation of high Botanic value" (Plantlife International 2004).

There is a detailed manual developed to assist with site selection of IPAs in Europe (Anderson 2002). Global criteria for identifying IPAs were published in 2004 (Plantlife International 2004). To qualify as an Important Plant Area, a site needs to satisfy one or more of the criteria. **Criterion A:** The site holds significant populations of one or more species that are of global or regional conservation concern. **Criterion B:** The site has an exceptionally rich flora in a regional context in relation to its biogeographic zone. **Criterion C:** The site is an outstanding example of a habitat or vegetation type of global or regional plant conservation and Botanical importance. Criterion C is meant to include threatened habitats.

Patterned after the Important Bird Areas (IBA) and piloted initially in seven countries, there are now more than 66 countries with IPA programmes (Plantlife International 2010), but North America is only now starting to get involved. Montana has one IPA – Logan Pass (Hanna 2012). Dr. D. A. Galbraith (2011) proposed four specific initiatives for a Canadian response to the global strategy for plant conservation, including the need to develop an Important Plant Areas network in Canada. As a signatory to the Global Strategy for Plant Conservation Canada will need to find some mechanism to meet Target 5, the conservation of at least 75 per cent of the most important areas for plant diversity.

In a project to develop standardized methodology for identifying threatened habitats, in 2008 the International Union for Conservation of Nature (IUCN) began the process to establish a Red List of Ecosystems (RLE). An IUCN working group spent two years developing quantitative criteria for categorizing ecosystems according to their risk of range-wide collapse, using a process analogous to the IUCN Red List of Threatened Species. Results were published in 2011 (Rodríguez et. al 2012). For ecosystems, collapse is defined as disappearance or transformation into another ecosystem. Work on refining the criteria is ongoing. The IUCN goal is to further refine the criteria and, by 2025, provide an initial assessment of conservation status of the world's terrestrial, freshwater, marine, and subterranean ecosystems (www.iucnredlistofecosystem/)

In 2013 a project was initiated called ‘Alaska to Patagonia: IUCN Red List of the Continental Ecosystems of the Americas’. In addition to public awareness and policy objectives, there is a scientific objective to “assess fully the conservation status of the continental ecosystems of the Americas” (Rodríguez et. al 2012). Ecosystems types will be classified, the continental distribution of each type mapped, and levels and drivers of change assessed. This will allow the types to be quantitatively assessed, using the red-list criteria to identify ecosystems that: are restricted total extent, show historical and recent losses in extent, and show trends in ecological degradation. Each factor is measured to indicate whether an ecosystem is vulnerable, endangered, or critically endangered.

While Alberta types have not yet been classified or assessed, it is likely that some will come out as being of high conservation concern. The species Plains Rough Fescue, for example, is essentially restricted to the Canadian Prairie Provinces (Alberta, Saskatchewan and Manitoba), with some outliers (Barkworth et al. 2007). Ecosystems dominated by Plains Rough Fescue must also then be limited in extent; they have shown both historical and recent losses and they are vulnerable to transformation into other ecosystems if subjected to continuous heavy grazing pressure (Kupsch et al. 2012).

So, we have the framework for understanding the variation of our ‘prairies’ across Alberta, from the dominant species, to the soils, to the rare species and ecological communities found in each. Each subregion has numerous documented locations for rare plant species or ecological communities, and each has some unique plant or community elements. The importance of plant conservation is hi-lighted in a number of global initiatives. Any conservation strategy to maintain the biodiversity of the prairies must include examples from each of the prairie subregions.

Literature Cited

Achuff, P.L. 1994. Natural Regions, Subregions and Natural History Themes of Alberta: A Classification for Protected Areas Management. Prepared for Parks Services, Alberta Environmental Protection. Edmonton, Alberta.

ACIMS. 2013. Alberta Tourism Parks and Recreation, Edmonton, Alberta. http://www.albertaparks.ca/albertaparksca/management-land-use/alberta-conservation-information-management-system-(acims).aspx. Accessed February 2013.

Adams, B.W., R. Ehlert, D. Moisey and R.L. McNeil. 2003. Rangeland Plant communities and Range Health Assessment Guidelines for the Foothills Fescue Natural Subregion of Alberta. Rangeland Management Branch, Public Lands Division, Alberta Sustainable Resource Development, Lethbridge Alberta. Pub. No. T/038. 64 pages.

Adams, B.W., J. Richman, L. Poulin-Klein, K. France, D. Moisey and R.L. McNeil. 2013. Rangeland Plant Communities for the Mixedgrass Natural Subregion of Alberta. Second Approximation. Rangeland Management Branch, Policy Division, Alberta Environment and Sustainable Resource Development, Lethbridge Alberta. Pub. No. T/03940. 103 pages.

Anderson, S. 2002. Identifying Important Plant Areas. Plantlife International, Salisbury, UK.

Barkworth, M.E., L.K. Anerton, K.M. Capels, S.Long and M.B. Piep (Eds.). 2007. Manual of grasses for North America north of Mexico. Utah State University Press. 627 pages.

Galbraith, D.A. 2011. A National Response to the Global Strategy for Plant Conservation for Canada. Royal Botanical Gardens, Hamilton, Ontario.

Hanna, D. 2012. Important Plant Areas: Has the time come for BC? *Menziesia* Winter 2012.

Kupsch, T., K. France J. Richman and R. McNeil. 2012. Range Plant Communities and Range Health Assessment Guidelines for the Northern Fescue Natural Subregion of Alberta. Rangeland Management Branch, Lands Division, Alberta Environment and Sustainable Resource Development, Red Deer Alberta. Publication Number. T/265. 77 pages.

McNeil, R. 2004. Physiography, climate and soils in Subregions of the Grassland and Parkland Natural Regions. Interim Report prepared by Landwise Inc. for Public Lands and Forests Division, Alberta Sustainable Resource Development, Lethbridge, Alberta.

Natural Regions Committee. 2006. Natural Regions and Subregions of Alberta. Compiled by D.J. Downing and W.W. Pettapiece. Government of Alberta, Publication. No. 1/005.

Plantlife International. 2004. Identifying and Protecting the World's Most Important Plant Areas. Plantlife International, Salisbury, UK.

Plantlife International. 2010. Important plant areas around the World: Target 5 of the CBD Global Strategy for Plant Conservation. Plantlife International, Salisbury, UK.

Rodríguez, J. P., K. M. Rodríguez-Clarka, D. A. Keith, E. G. Barrow, P. Comera and M. A. Oliveira-Miranda. 2012. From Alaska to Patagonia: the IUCN Red List of the continental ecosystems of the Americas. *Oryx* 46: 170-171.

RARE PLANTS AND RANCHERS: STEWARDSHIP SOLUTIONS TO SPECIES-AT-RISK CONSERVATION

CANDACE R. NEUFELD
Native Plant Society of Saskatchewan (NPSS), Box 21099, Saskatoon, Saskatchewan S7H 5N9.
Email: info@npss.sk.ca

Abstract: Rare Plants and Ranchers is a program aimed at working with stewards to develop site-specific beneficial management plans using an ecosystem-based approach to address threats such as invasive species and habitat loss/degradation for federally-listed plant Species-at-Risk (SAR) and their habitats in Saskatchewan. To do this, the Native Plant Society of Saskatchewan has partnered with Nature Saskatchewan to draw participants from their existing stewardship program, Rare Plant Rescue. Participating landowners would be interviewed to gather information about SAR and SAR habitat on the land and a site assessment would also be conducted. From this, a site specific management plan would be produced containing all information collected as well as recommendations to benefit SAR. Ongoing support (logistical and financial) and monitoring would ensure plan implementation. The benefits to this program are an increase in landowner knowledge of SAR, increased SAR stewardship, more effective SAR management and reduction of threats to SAR. 2012 was the first year of the program and has already produced many positive results. Five landowners with 558 acres were recruited to the program. Two plant SAR were addressed: Hairy Prairie Clover (*Dalea villosa*) and Buffalograss (*Bouteloua dactyloides*). New populations of Buffalograss were found, and known populations were mapped. New threats were also found, such as previously unknown occurrences of Leafy Spurge (*Euphorbia esula*) within close proximity to Buffalograss populations. Overall, the program has been well received by the stewards and the NPSS will continue to work with them by providing logistical and financial support to help implement recommendations from the management plan.

Shifting Population Dynamics of the Grassland Bird Community at the Manitoba Tall Grass Prairie Preserve as a Result of Habitat Changes

C. L. BORKOWSKY
Critical Wildlife Habitat Program, Manitoba Tall Grass Prairie Preserve, Box 24, 200 Saulteaux Crescent, Winnipeg, Manitoba R3J 3W3.

Abstract: Over the past 17 years, there have been changes in the relative abundance of several grassland passerines species at the Manitoba Tall Grass Prairie Preserve. The Monitoring Avian Productivity and Survivorship (MAPS) Program was established in 1996 in the northern block of the Manitoba Tall Grass Prairie Preserve to assess and monitor the population dynamics of prairie passerines. The Preserve's MAPS station follows the constant-effort mist netting protocol established by the Institute for Bird Populations (IBP) and is part of a network of stations located across North America. During the 14 seasons of operation over 1,500 birds have been captured and more than 1,200 individuals were banded among nearly 60 species. Over this 17-year period, the species assemblage has shifted with a decrease in the number of captures of Savannah Sparrow (*Passerculus sandwichensis*) and an increase in Clay-colored Sparrow (*Spizella pallida*) and Common Yellowthroat (*Geothlypis trichas*). A change in the habitat structure has also been recorded during this time, with a decrease in dry upland prairie and an increase in sedge meadow and greater encroachment by Trembling Aspen (*Populus tremuloides*). Presently, the Preserve and greater southeastern region of Manitoba are experiencing a drying period which may cause another shift in the vegetation and avian communities.

THE CHALLENGES OF EMPLOYING A NON-LEGISLATED CONSERVATION TOOL ON A HIGHLY LEGISLATED LANDSCAPE: THE IMPORTANT BIRD AREAS PROGRAM IN THE PRAIRIE PROVINCES

C. ARTUSO[1], **M. MICO**[2], **P. ROWELL**[3] and **D. TROWSDALE-MUTAFOV**[4]

[1] Bird Studies Canada, P.O. Box 160, Port Rowan, Ontario N0E 1M0. Email: cartuso@bsc-eoc.org

[2] Nature Manitoba, 401-63 Alberta St., Winnipeg, Manitoba R3B 1G4.

[3] Nature Alberta, 11759 Groat Rd., Edmonton, Alberta T5M 3K6.

[4] Nature Saskatchewan, Room 206, 1380 Lorne St., Regina, Saskatchewan S4P 2L7.
Email: info@naturesask.ca

Abstract: All three Prairie Provinces are trying to manage the cumulative impacts of growth and development on biodiversity and ecosystems including bird populations and their habitat. One tool for conserving bird habitat is the Important Bird Areas (IBA) program. This program is internationally recognized with strict criteria; however, it does not have any legislative status. As such, while there is no disputing when a site numerically qualifies as globally or internationally significant, there is no way to enshrine this value under legislative protection. Additionally, IBAs must compete with many other values that may be developed under legislated tools such as municipal planning or resource development dispositions. To be successful, the IBA program must not only support a strong network of local champions (i.e., landowners and managers, be they public or private), it must also engage a broader suite of stakeholder values. As a profession, conservationists and biologists tend to focus on a species' habitat requirements without considering what makes that habitat valuable to landowners. IBAs are important for local birds and migratory populations – but bird conservation attracts only a small segment of society. Fortunately, IBA sites are also areas of relatively good ecosystem function and most probably provide a host of other ecological goods and services (such as water filtration, groundwater recharge, etc.) to society. They might also provide good benchmarks in an otherwise rapidly changing landscape. We need to understand and quantify these different values so we can participate equally in broader socio-economic and environmental trade-off discussions, regardless of whether or not we have legislative standing. So, perhaps the first step in engaging people in conservation is to engage them in conversation!

REBUILDING NATIVE ECOSYSTEMS IN URBAN AREAS: EDMONTON'S STORM WATER MANAGEMENT FACILITY ROUGH FESCUE PRAIRIE PLANT AND SOIL ESTABLISHMENT

M. RAWSON CLARK[1], **A. AMINI**[2], **D. MACKENZIE**[2] and **C. PASZKOWSKI**[3]
[1] Clark Ecoscience and Sustainability, Edmonton, Alberta. Email: cec@clarkecoscience.com
[2] Department of Renewable Resources, University of Alberta, Edmonton, Alberta T6G 2H1.
[3] Department of Biological Sciences, University of Alberta, Edmonton, Alberta T6G 2E9.

Abstract: The 8,800 m^2 Larch Park storm water management facility is the first native ecosystem storm water management facility in an Edmonton urban development. Both wetland (1200 m^2) and terrestrial (6600 m^2) areas were rebuilt with salvaged soils and native plants to emulate Rough-Fescue Prairie in the Aspen Parkland, and the natural urban wetlands nearby. A five-year research project including plant ecology and soil science is based at the site. We are determining:

(1) how the different reproductive strategies of the rhizomatous and non-rhizomatous plants used in native ecosystem rebuilding affect ecosystem function of the rebuilt grassland compared to natural Rough Fescue Prairie, and

(2) how soils are recovering from storm water management facility construction. In 2011, the rhizomatous plant community had 40% more belowground production compared to the non-rhizomatous plant community.

However, the non-rhizomatous plant community had 60% fewer non-native species compared to the rhizomatous community. Below ground, the soil inorganic N was 16 times higher at the storm water management facility than in a Rough Fescue Prairie. The soil microbial carbon was two times higher in native grasslands, while the soil microbial nitrogen was equivalent. Soil microbial communities in the SWMF were typical of early, post-disturbance assemblages and were dominated by actinomycetes. Underneath Rough Fescue (*Festuca hallii*) at Larch Park the important microbial groups doubled compared to other locations, and were dominated by actinomycetes and arbuscular mycorrhizal fungii. Our result suggests that one year after grassland construction, plants that focus growth on aboveground biomass (non-rhizomatous) are outcompeting 'weeds' more successfully than rhizomatous plants. Native species are having positive impacts on stabilizing soils, thus the Larch Park storm water management facility native plant and soils communities are headed in a positive direction.

A Comparison of Revegetation Strategies for Grassland Communities in the Central Parkland and Northern Fescue Natural Subregions of Alberta

J. LANCASTER[1], **M. NEVILLE**[2] and **B. ADAMS**[3]
[1] Kestrel Research Inc., 11 Cochrane Lake Place, Cochrane, Alberta T4C 2A8.
[2] Gramineae Services Ltd., Box 95, Lundbreck, Alberta T0K 1H0.
[3] Rangeland Management Branch, Environment and Sustainable Resource Development, 200-5 Ave South, Lethbridge, Alberta T1J 4L1.

Expanded Abstract

Several revegetation trials were established in the Central Parkland and Northern Fescue Natural Subregions during construction of the Express Pipeline in 1996-7. Revegetation strategy trials included:

- seeding with native cultivars and wild-harvested seed;
- natural recovery;
- sod salvage of a Northern Fescue plant community.

The Express Pipeline Long-term Revegetation Monitoring Project conducted 14 years later in 2010 assessed the long term recovery of plant communities from soil disturbance using time series data collected one, two, three, five and fourteen years post-construction. Measurements included cover and species composition on the disturbance and on an adjacent undisturbed control site. In year 14, range health was also measured both on the disturbance and the associated controls. The health of the range before disturbance and during recovery affects the ability of a disturbed area to respond and can affect the outcome of restoration. The study provides data on the long term performance of the native cultivars and wild-harvested seed and the recovery over time of seeded, natural recovery and sod salvage trials.

Seeded Cultivars: Slender Wheatgrass (*Elymus trachycaulus*) and Northern Wheatgrass (*Elymus lanceolatus*) behaved as transition species, establishing in the early years and providing initial cover to stabilize soils, build litter and shelter other seedlings. Both species are diminishing with time to near natural cover levels. However, persistent cultivars which after 14 years are still expanding or maintaining relative cover beyond levels on the controls are influencing the trajectory of plant community succession.

Wild Harvested Seed: Establishment of wild harvested rough fescue from two sources (Plains Rough Fescue (*Festuca hallii*) from Roes, Hand Hills and Foothills Rough Fescue (*Festuca campestris*) from Petherbridge, Milk River Ridge) was very slow initially. On the two Central Parkland sites where grazing pressure is high, it has not established well. On a lightly grazed Northern Fescue site, rough fescue has re-established to pre-disturbance cover levels.

Natural Recovery: Over 14 years, native plant communities have re-established on natural recovery sites on relatively level sandy terrain in the Hemaruka Dunes, near the southern boundary of the Northern Fescue Natural Subregion. Cultivars are absent from the reclaiming plant communities. Composition and cover are very similar between disturbed and undisturbed soils with the exception of two grazing increaser species. Blunt Sedge (*Carex tribuloides*) is dominant on the controls and Kentucky Bluegrass (*Poa pratensis*), an introduced rhizomatous species, is dominant on the disturbed soils.

Plains Rough Fescue Sod Salvage Trials: Plains rough fescue plants can survive a transplant procedure in the long term where sod of sufficient depth and quality is used. Range health plays an important role in transplant success over the long term. Shallow-rooted, rhizomatous, non-native grasses such as Kentucky

Bluegrass or Smooth Brome (*Bromus inermis*) can colonize the sod transplant areas from outside sources, competing with the recovering Plains Rough Fescue and associated native bunch grasses. The presence of invasive non-native grasses in the stand prior to disturbance severely limits the success of the sod salvage procedure.

There is very little information available on the long term efficacy of various native grassland reclamation techniques in the Central Parkland and Northern Fescue Natural Subregions of Alberta. The number of replicates for each trial is limited. More long term monitoring is needed to contribute to our understanding of whether restoration of native vegetation communities is possible, and if so, in what situations and over what timeframe.

Rough Fescue Seeding Following Disturbance, in Central Alberta

P. A. DESSERUD[1] and **M. A. NAETH**[2]
[1] Department of Geography, University of Calgary, 2500 University Dr. NW, Calgary, Alberta T2N 1N4.
Email: desserud@ualberta.ca
[2] Department of Renewable Resources, University of Alberta, Edmonton, Alberta T6G 2H1.
Email: anne.naeth@ualberta.ca

Abstract: Plains Rough Fescue (*Festuca hallii*) once dominant in rough fescue grasslands of central Canada, recovers poorly if disturbed by cattle grazing or oil and gas soil handling techniques. This long-lived bunchgrass requires three to five years to become established, during which time it may be exposed to competition from faster-growing species. Our first research objective was to assess the recovery of rough fescue by comparing a monoculture seeding to a mixed seeding of six native grass species including: Plains Rough Fescue, June Grass *(Koeleria macrantha)*, Slender Wheatgrass (*Elymus trachycaulus)*, Western Wheatgrass (*Pascopyrum smithii)*, Green Needle Grass *(Nassella viridula)*, Needle-and-thread Grass *(Hesperostipa comate)*, and Blue Grama Grass *(Bouteloua gracilis)*. Our second objective was to evaluate plant community development of both seeding mixes. We established seeding experiments on three field sites in central Alberta, Canada. When seeded as a monoculture, the rough fescue plant community that resulted included native species re-established from the seed bank or seed rain, such as Intermediate Oat grass *(Danthonia intermedia)*, Northern Wheatgrass (*Elymus lanceolatus)*, Short Bristle Needle and Thread (*Hesperostipa curtiseta)* and numerous forbs. In the native species seed mix, wheatgrasses dominated in the first three years with low rough fescue cover. In our results we recommend seeding rough fescue with little or no aggressive species, such as wheatgrasses, in the seed mix.

Introduction

Plains Rough Fescue recovers poorly if disturbed by cattle grazing or oil and gas soil handling techniques. Rough Fescue is a long-lived bunch grass that grows slowly, requiring three to five years to mature. It seldom produces seed, having at least two to ten years between seeding events (Johnston and MacDonald 1967; Toynbee 1987; Romo 1996). Few attempts to restore rough fescue plant communities have been successful. Research has shown almost no recovery of Foothill Rough Fescue (*Festuca campestris*) on pipelines after seven to 20 years, despite having been seeded with rough fescue (Desserud et al. 2010). Mae Elsinger studied 35 well sites and ten pipelines in the Rumsey Natural Area in central Alberta and also found little Plains Rough Fescue recovery following seeding (Elsinger 2009). Despite its poor recovery in the field, rough fescue readily germinates and grows in greenhouse conditions. Obviously, other factors come into play when it is seeded during disturbance reclamation.

Study

In 2006, Plains Rough Fescue experienced a mass flowering event, producing seed for the first time in over ten years, and flowering all across central Alberta. We harvested seed in the Rumsey Natural Area in July 2006. Seed production was so dense, that we were able to harvest it with a small nursery combine. Seed collected from this harvest had over 95% germination under greenhouse conditions.

We set up three field sites in 2007 in central Alberta, Canada: one in the Central Parkland natural region at Ellerslie, in south Edmonton, and two in the Northern Fescue sub-region of the Grassland natural region, east of Drumheller and near Byemoor. Native grassland vegetation in both regions is dominated by rough fescue in conjunction with Short Bristle Needle and Thread in the Central Parkland, and Blue Grama Grass in the Northern Fescue sub-region. Field sites were seeded in July 2007, with a Brillion® seeder and packer. Two seed mixes were applied in randomized strips (6 -7m by 70 -90m) with four replications (Figure 1).

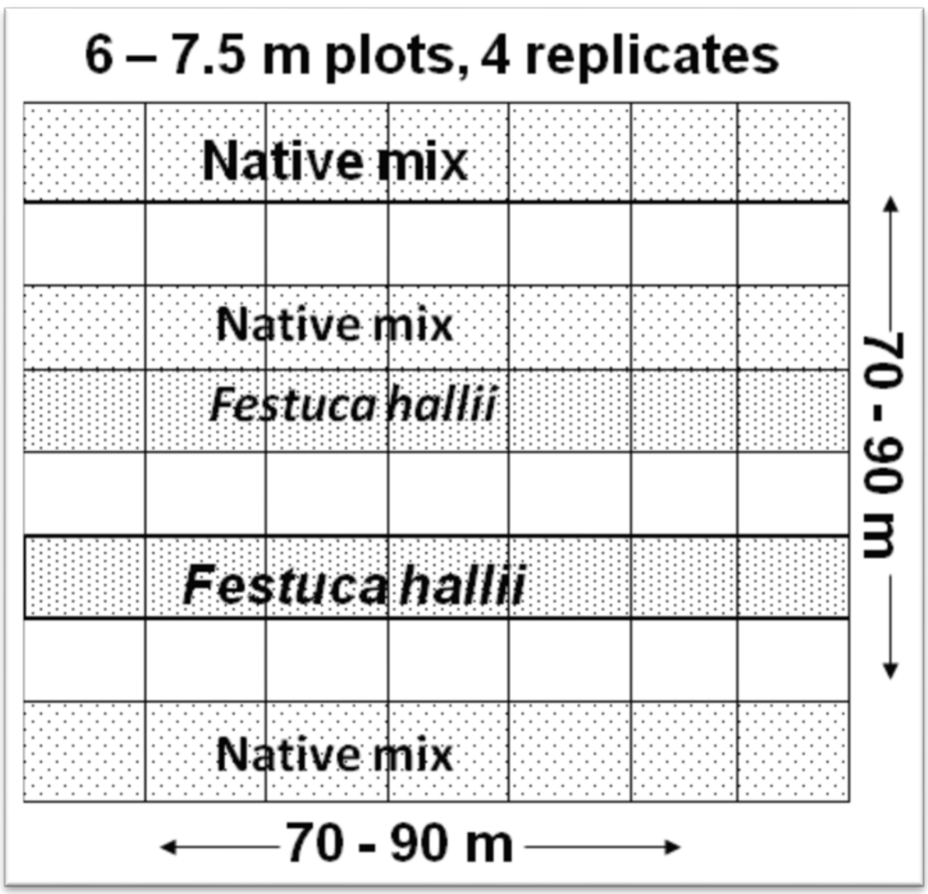


Figure 1. Schematic of experimental design showing portion of a wellsite with 70 to 90 m seeded strips, divided into 6 to 7.5 m^2 sampling sub-plots.

The seed mixes were a monoculture of rough fescue and a native mix similar to reclamation seed mixes; although the native mix had only five percent wheatgrasses (Table 1).

Table 1. Seed mixes of rough fescue and native mixes showing percentage of total mix and kg/ha.

Seed Mixes

(15 kg/ha)

Central Parkland	**%**	**Northern Fescue**	**%**
Rough fescue	99	**Rough fescue**	99
Other	1	Other	1
Native Mix		**Native Mix**	
Rough fescue	20	Rough fescue	20
June grass	35	June grass	20
Green needle grass	40	Needle and Thread	25
Slender wheat grass	3	Blue grama	30
Western wheat grass	2	Slender wheat grass	3
		Western wheat grass	2

When seeded as a monoculture, the rough fescue plant community that resulted included native species re-established from the seed bank or seed rain, such as: Intermediate Oat Grass, native bluegrasses, Northern Wheatgrass, Tickle Grass (*Agrostis scabra)*, Short Bristle Needle and Thread and numerous forbs (Figure 2).

Figure 2. Sample subplot seeded with rough fescue monoculture, showing rough fescue dominance. Other species in the plot were: Prairie Wild Rose (*Rosa arkansana*), June Grass, Blue Grama Grass, Sandberg Bluegrass (*Poa secunda*), Tickle Grass, Pasture Sage (*Artemisia frigida*) and White Prairie Aster (*Symphyotrichum falcatum*).

In the native species seed mix, wheatgrasses dominated in the first three years with low rough fescue cover, despite having been 20% of the seed mix (Figure 3).

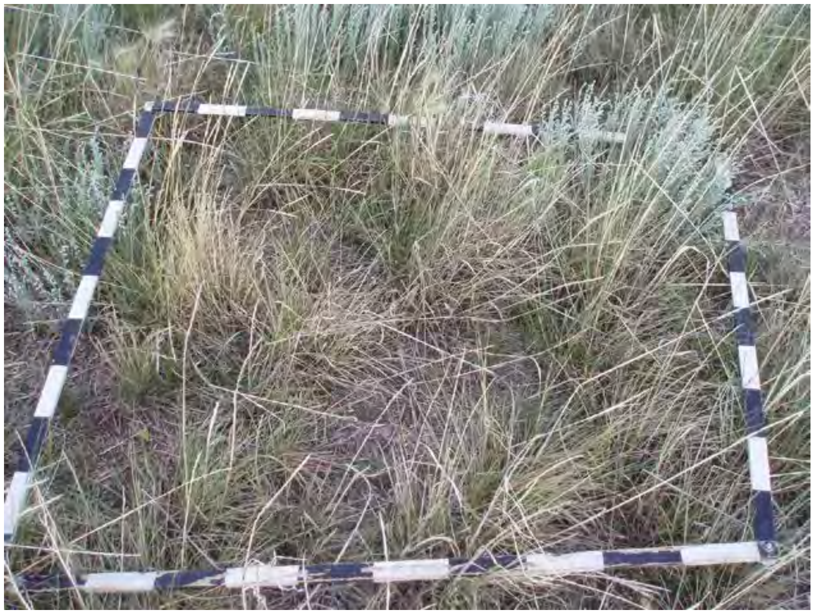


Figure 3. Sample subplot seeded with the native mix, showing Slender Wheatgrass dominance. Other species were June Grass, Blue Grama Grass, Western Wheatgrass, and Prairie Sage.

We conducted a nearest neighbour analysis, measuring the distance from rough fescue plants of the closest species, within a 30 cm radius (Figure 4). Rough fescue plants growing close to other rough fescue plants or forbs, had the longest leaf length. Those growing closest to wheatgrasses had the shortest leaf length.

Although Slender Wheatgrass dominated for the first three years, it all but disappeared by the fifth year. Nevertheless, its early dominance impeded the establishment of rough fescue, and once it disappeared, it was too late for slow-growing rough fescue.

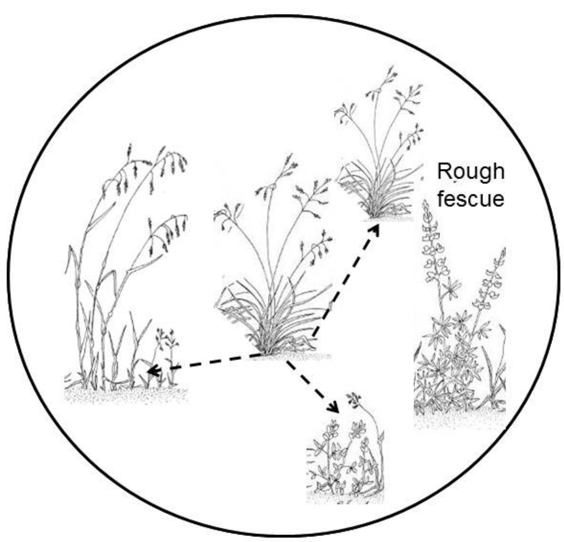


Figure 4 Schematic of nearest neighbour measurements.

Conclusion

Our study demonstrated that Plains Rough Fescue can be successfully seeded. The seeding success of rough fescue with little competition underscores the importance of reducing the amount and number of aggressive species in rough fescue grassland when reclamation seeding. Seeding rates should be no more than 15 kg/ha as bare patches will allow infill from adjacent species. While monoculture seeding of rough fescue is not practical due to low seed availability and high cost, seed mixes should include few or no wheat grasses, and instead a mix of other native grasses common in the area.

These results are published in the Native Plants Journal as follows:

Desserud, P. and Naeth, M.A. 2013. Promising results with rough fescue (*Festuca hallii*) seeding following disturbance, in Central Alberta. *Native Plants Journal* 14:25-31.

Complete results of this research may be found in PAD's PhD dissertation:

Desserud, P.A. 2011. Rough fescue ecology and restoration in the Central Parkland and Northern Fescue regions of central Alberta. Dissertation. University of Alberta, Edmonton, Alberta. 216 pages. https://era.library.ualberta.ca/public/view/item/uuid:bd436164-eaca-47fa-a196-02c4abd64038

Literature Cited

Desserud, P., Gates, C.C., Adams, B. and Revel, R.D. 2010. Restoration of Foothills rough fescue grassland following pipeline disturbance in southwestern Alberta. *Journal of Environmental Management* 91: 2763-2770.

Elsinger, M. 2009. Reclamation status of plains rough fescue grasslands at Rumsey Block in Central Alberta after oil and gas well site and pipeline disturbance. Thesis. University of Alberta, Edmonton, Alberta. 247 pages.

Johnston, A. and MacDonald, M.D. 1967. Floral initiation and seed production in *Festuca Scabrella* Torr. *Canadian Journal of Plant Science* 47: 577-583.

Romo, J.T. 1996. Seed age-germination relationships in plains rough fescue, *Festuca altaica* subspecies *hallii*. *Canadian field Naturalist* 110: 294-297.

Toynbee, K. 1987. Prolific flowering year for plains rough fescue at the Kernen Prairie. *Blue Jay* 45: 142-143.

Rough Fescue Plant Community Response to Disturbance within the Central Parkland and Northern Fescue Subregions

ANGELA BURKINSHAW
Environment and Sustainable Resource Development, 10th floor, 9915-108 Street, Edmonton, Alberta T5K 2G8.

Abstract: The reference plant community within the Central Parkland and Northern Fescue Subregions is Plains Rough Fescue (*Festuca hallii)* + Western Porcupine Grass (*Stipa curtiseta*). Within these subregions there are different soil correlation areas, and through the development of the range health assessment and plant community guides we have found differences in this reference plant community and how it responds to disturbance. Through the ordination of vegetation inventories conducted throughout these subregions on grazing dispositions and Rangeland Reference Areas we have successfully identified the main plant communities and furthermore we have been able to determine the successional pathways these rough fescue plant communities follow when they are disturbed as well as when they are not grazed.

SESSION 17: RESTORATION: GOING BEYOND GRASSES

USING NATIVE FORBS TO IMPROVE PLANT COMMUNITY DIVERSITY ON DISTURBED PRAIRIE SITES

A.W. FEDKENHEUER
ALCLA Native Plant Restoration Inc., 3208 Bearspaw Dr NW, Calgary, Alberta T2L 1T2.

Abstract: Much of the emphasis for reclaiming or restoring disturbed prairie sites has been on the use and establishment of native grasses with little thought to re-establishing prairie forbs and shrubs. This has been due to requirements from a regulatory perspective and what is perceived to be difficulties in establishing native forbs. These difficulties have been partially economic and partially a perception of availability. This paper challenges this thinking. It proposes some changes to the typical approach and identifies the values this change of thinking has associated with it, such as improved habitat for insects, birds and animals, more leaf area ground cover and a 'can do' approach if the desire is there. Some strategies, as examples, are simply a question of using seeds or plants, how to ensure supply, timing, accessing expertise, and bridging the gap between user and supplier. The presentation will be oriented toward how to achieve the desired end results of increased plant diversity and will be presented based on the author's experience with growing and out-planting native forbs as well as long term land reclamation history.

Forage and Nutritional Benefits of Grazing Purple Prairie Clover and White Prairie Clover on Western Canadian Grasslands

A.D. IWAASA[1], Y. LI[1], Y. WANG[2], J.D. SCIANNA[3] and G. HAN[4]
[1] Semiarid Prairie Agricultural Research Centre, Agriculture and Agri-Food Canada, P.O. Box 1030, Swift Current, Saskatchewan S9H 3X2.
[2] Lethbridge Research Centre, Agriculture and Agri-Food Canada, 5403-1 St., Lethbridge, Alberta T1J 4B1.
[3]NRCS Plant Materials Program, USA Department of Agriculture, 98 South River Rd., Bridger, Montana 59014-9718, USA.
[4] College of Ecology and Environment Science, Inner Mongolia Agricultural University, Huhhot, China

Abstract: Currently, a number of native prairie plant germplasm or ecological varieties have been released and are available in Canada and the United States for land reclamation and pasture/forage seeding. Purple (*Dalea purpurea* Vent.) and White Prairie Clovers (*Dalea candida* Michx.ex Willd; PPC and WPC) are widely distributed throughout the south and central Prairies and Parklands in Canada and act as warm-season forbs, with much of their growth occurring during July and August. The clovers are tap-rooted, drought-resistant, fix nitrogen and grow to a height of 30-55 cm. Swift Current and Lethbridge AAFC researchers have been evaluating the forage qualities and animal health benefits of PPC and WPC since 2009. Mean digestibility and crude protein values for PPC and WPC (whole plant) were similar or higher compared to tame sainfoin. In addition, fibre content of PPC and WPC were lower or similar to tame sainfoin. Both PPC and WPC contained high concentrations of condense tannins which improve protein utilization and reduce *E. coli* 0157:H7 activity in cattle. Thus, these clovers would be excellent additions to a pasture to improve the forage nutritional profile, extend the grazing season, environmental benefits and increase animal and human health. The inclusion of PPC and WPC in pastures is not a blanket solution, nevertheless these native species have potential multiple benefits to the health and reclamation of prairie pastures in Canada and the United States.

Introduction

There has been growing interest in the potential use of native legumes (Fabaceae) Purple Prairie Clover (*Dalea purpurea* Vent; formerly *Petalostemon purpurea*; PPC) and White Prairie Clover (*Dalea candida* Michx.ex Willd; formerly *Petalostemon candida*; WPC) for restoration and improving rangelands on the Canadian Prairies, as well as, their potential forage and animal health benefits (Scheaffer et al. 2009; Liu, et al. 2013). A number of native prairie clover germplasm or ecological varieties have been released [e.g., AC-Lamour (PPC) and Antelope (WPC)] and are available in Canada and the United States for land reclamation and pasture/forage seeding. Both Purple and White Prairie Clovers are widely distributed throughout the south and central Prairies and Parklands in Canada. Purple and White Prairie Clovers are tap-rooted, drought-resistant, fix nitrogen, produce palatable and nutritious forage, grow to a height of 30-55 cm and act as warm-season forbs, with much of their growth occurring during July and August. Since 2009, Agriculture and Agri-Food Canada (AAFC) researchers at Swift Current and Lethbridge have been evaluating the forage, grazing and animal nutritional and ecological benefits of PPC and WPC (Fig. 1 and 2.)

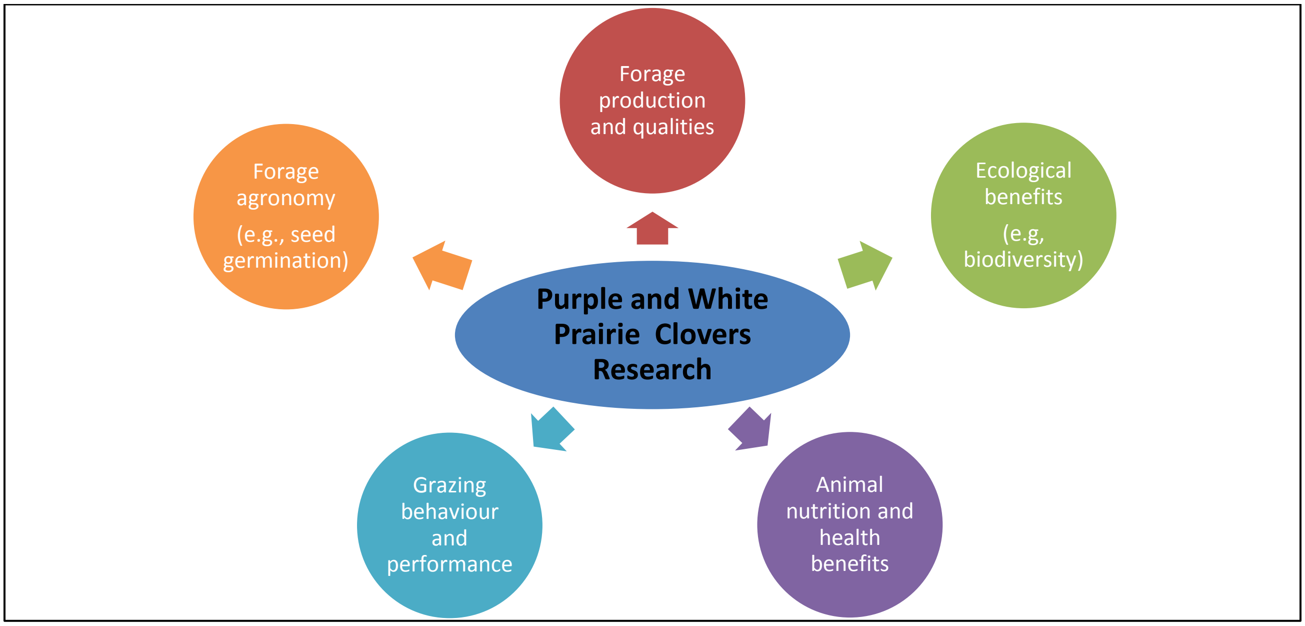


Figure 1. Ongoing research areas that are being evaluated for purple and white prairie clovers at AAFC Swift Current and Lethbridge.

Figure 2. AAFC-SPARC Yearling steers grazing re-established native pasture containing Purple Prairie Clover during the summer of 2012.

Materials and Methods

Forage species and growing conditions: A total of four legume species were examined in this study. They were Sainfoin (SF; *Onobrychis viciifoliav* Scop.), PPC, WPC and Canadian Milkvetch (CMV; *Astragalus Canadensis* L.). The study was conducted at Semiarid Prairie Agricultural Research Centre-AAFC, near Swift Current (50°12'N, 107°24'W, 825m elevation), Canada. All forages were established under dryland conditions and in small trial plots, (1.2 × 7.0 m) completely randomized, with four replications. Both SF (var. Nova) and CMV (var. Great Plains) were seeded in 2008 and the PPC (var. AC-Lamour) and WPC (var. Antelope) were seeded in 2010, respectively. All forages were seeded at a rate of 100 pure live seeds per meter row using a seeder with double disk openers and fertilizer (27 kg of 12-51-0 per ha) was added during seeding only. All forages were grown in the same Swinton Silt Loam soil (Orthic Brown Chernozem).

Sample preparations: Whole plant samples were collected over two consecutive growing seasons (2011 and 2012) at three different phenological stages: vegetative, flowering and seed maturity. For each species at each phenological stage, a total of 56 whole plants (14/plot) were randomly selected, harvested individually at about 5 cm above ground level with a pair of scissors, placed in plastic bags and transported on ice. No plant material was harvested from WPC in 2011 at the vegetative stage due to insufficient plant material available. All plant materials prepared above were freeze-dried (FreeZone 2.5 liter freeze dry systems, LABCONCO), weighed, ground to pass through a 1-mm screen using a Willey mill (Model no. 4; Arthur H. Thomas Co., Philadelphia, PA) and stored in sealed containers in a dark room at 20°C prior to analysis.

Mean phenological stage of development for each species was estimated using the classification system of morphological characteristics (Giorgio et al. 2003). Briefly, all species contained no visible buds except for SF which contained a few flower buds (≤ 2%) at vegetative stage whilst there were more than 50% of the unfolded buds at the flowering stage. The seed maturity stage was when the majority of flowering had fallen off and more than two nodes had green seedpods or ripe seedpods (brown and dry) present.

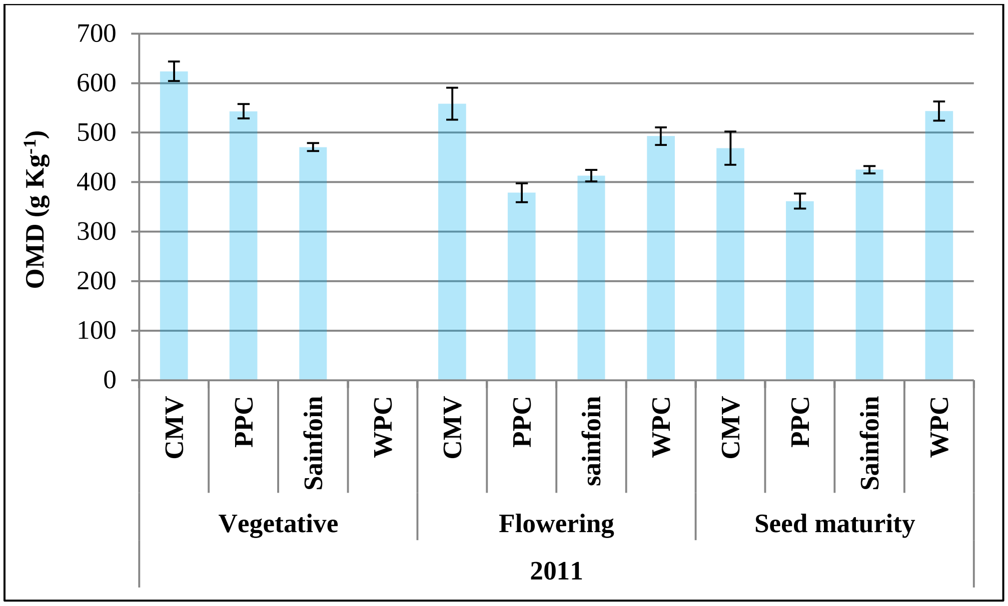
Extractable Condensed Tannins: Samples of whole plant were analyzed for extractable condensed tannins (ECTs) in the 2011 and 2012 growing season using the procedure described by Terrill et al. (1992). Extractable CT purified from whole plant of SF was used as a reference standard for all plant species examined. All analyses were completed within two months after harvesting.

Forage chemical analyses: Whole plant samples collected in 2011 and 2012 were evaluated for the following forage chemical analyses (Goering and Van Soest 1970): organic matter digestibility (OMD), crude protein (CP) and neutral detergent fibre (NDF).

Statistical analysis: Data were statistically analyzed by analysis of variance using mixed procedure of SAS (Version 9.1.3, SAS Institute, Inc., Cary, NC). Differences among treatments were tested using LSMEANS with the PDIFF option and multiple comprised with a Tukey's test in SAS (2009) with significance declared at $P < 0.05$.

Results and Discussion

Organic matter digestibility: In Figure 3, the different percent OMD observed for each of the different species harvested at different plant maturities are shown. Consistently over the two years both CMV and WPC generally had the higher OMD percentages among the three phenological stages compared to the other forage species. White prairie clover consistently had higher OMD compared to PPC at any phenological stage. At flowering, averaged over years, the OMD percent values (±SE) for PPC and WPC were 40.6 ± 2.3% and 51.3 ± 2.2%, respectively. Both PPC and WPC can complement and improve the forage nutritional profile for grazing livestock during spring to fall grazing periods.



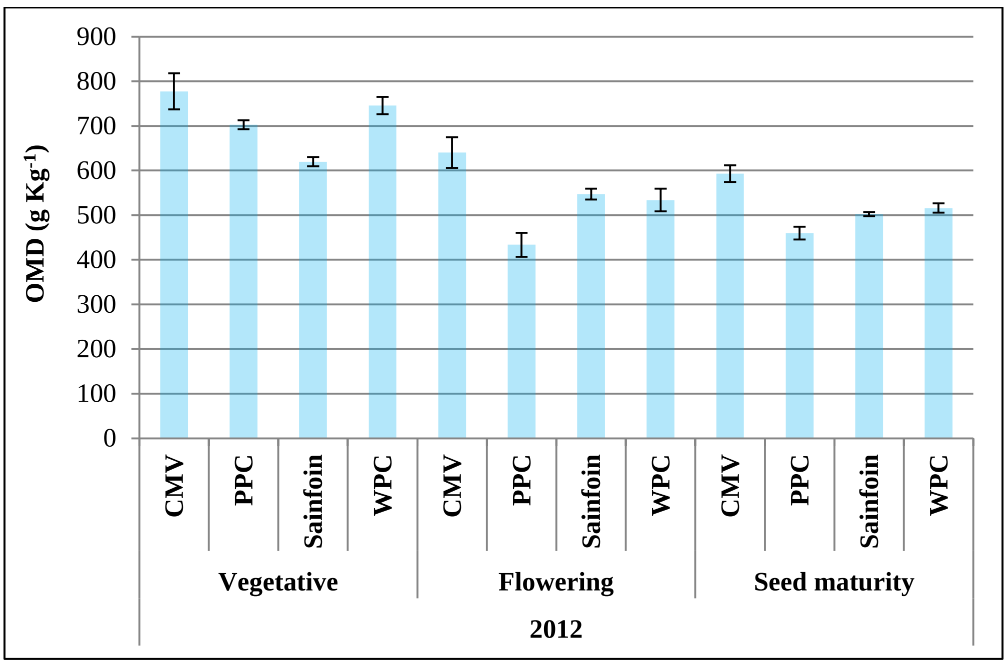


Figure 3. Percent organic matter digestibility (OMD) of the whole plant for Canadian Milkvetch (CMV), Sainfoin, Purple Prairie Clover (PPC) and White Prairie Clover (WPC) harvested at three different stages of maturity in 2011 and 2012.

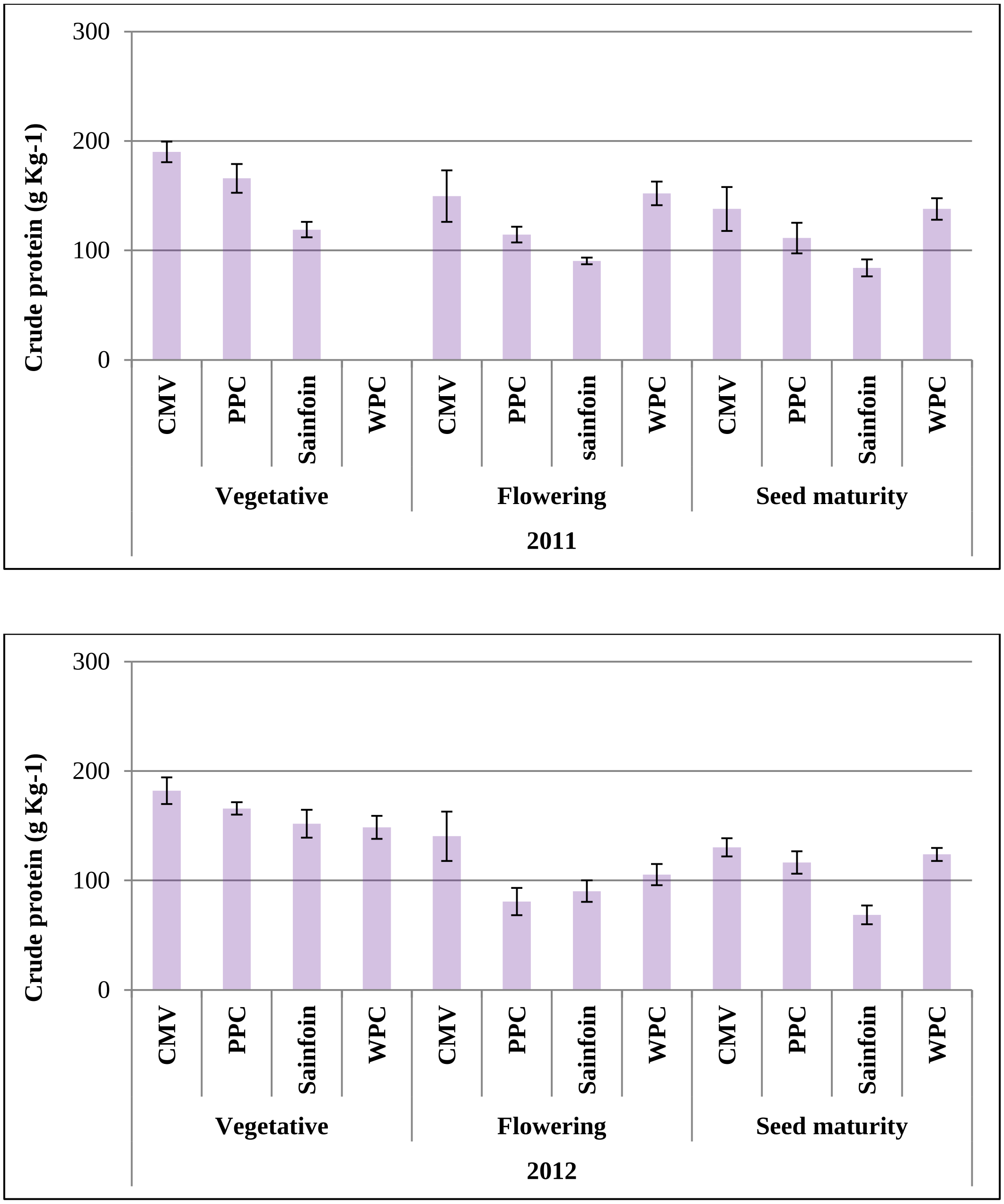
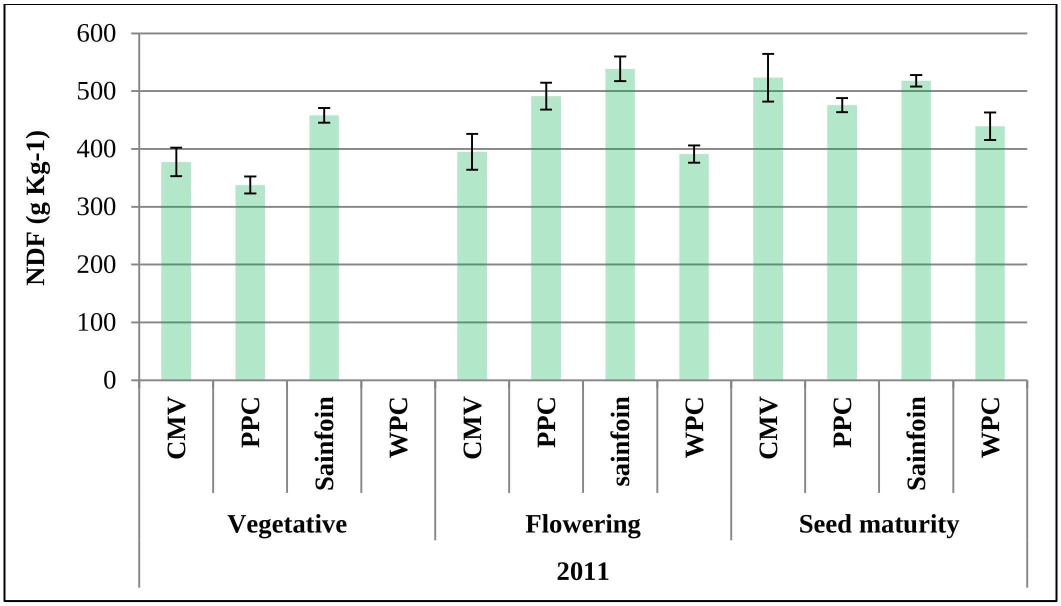


Figure 4. Percent crude protein of the whole plant for Canadian Milkvetch (CMV), Sainfoin, Purple Prairie Clover (PPC) and White Prairie Clover (WPC) harvested at three different stages of maturity in 2011 and 2012.



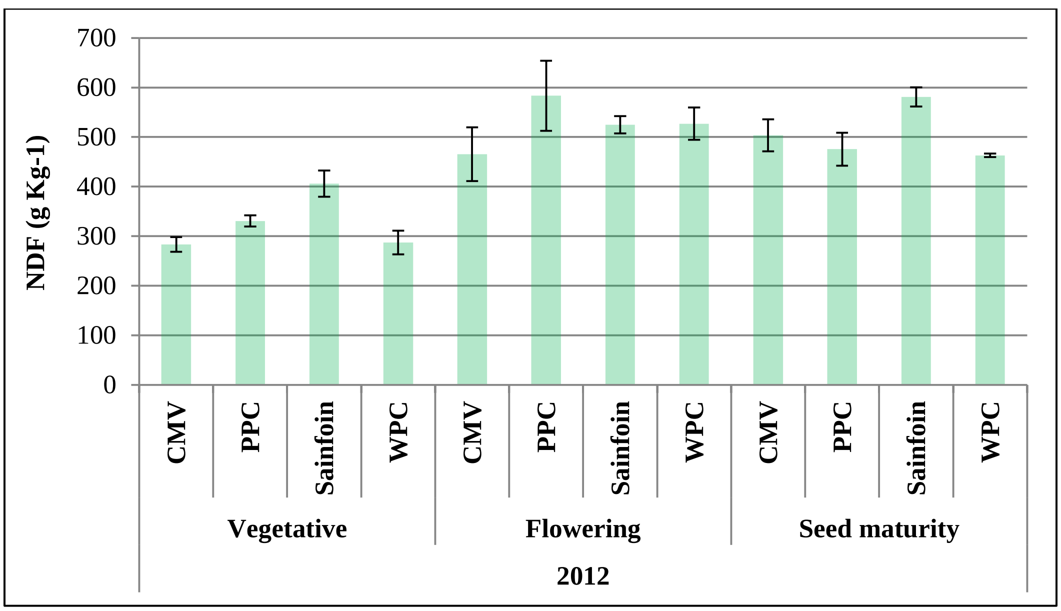


Figure 5. Percent neutral detergent fibre (NDF) of the whole plant for Canadian Milkvetch (CMV), Sainfoin, Purple Prairie Clover (PPC) and White Prairie Clover (WPC) harvested at three different stages of maturity in 2011 and 2012.

Crude protein: In Figure 4, the different percent CP found for each of the different plant maturities and species are shown. Generally higher or similar CP values for CMV, PPC and WPC compared to sainfoin at all maturity stages. At flowering, averaged over years, the CP percent values (±SE) for PPC and WPC were 9.8 ± 1.0% and 12.9 ± 1.0%, respectively. At seed maturity, the good CP levels (> 10%) for PPC and WPC is a major benefit during fall grazing period and can complement other pasture species to meet the nutritional requirements of beef cattle in the fall.

Neutral detergent fibre: Figure 5 shows the different percent NDF found for each of the different plant maturities and species. WPC had lower NDF values at most phonological stages of maturity. During flowering, averaged over years, the NDF percent values (±SE) for PPC and WPC were 53.7 ± 4.7% and 45.9 ± 2.4%, respectively. Observed lower fibre percentages associated with WPC have potential benefit in maintaining good forage digestibility and intake later in the grazing season.

Condensed Tannins: Figure 6 shows the ECTs associated from the different plant species and maturity stages. Trace amounts of ECTs were found for CMV at flowering and seed maturity (0.5 to 1.4 g kg^{-1}). Both PPC and WPC had the highest ECTs at flowering and seed maturity. The presence of ECTs in forages can result in better protein utilization and feed efficiency in cattle. In addition, the ECTs in PPC and WPC may be an effective method to inhibit the shedding of Escherichia coli 0157:H7 from cattle grazing PPC and WPC (Li et al. 2012; Liu et al. 2013).

Conclusions

Comparing PPC and WPC chemical compositions to Sainfoin harvested at the same phenological stages generally observed higher CP and lower NDF values. Digestibility value rankings were for WPC > sainfoin > PPC. Research has shown that both PPC and WPC contained some of the highest concentration of condense tannins which improve protein utilization and reduce E. coli 0157:H7 activity in cattle which is a major human health concern. Increasing plant species diversity can improve plant community stability, increase dry matter yield and extend the grazing season. Is addition, the prairie clovers attract a rich and diverse number of native pollinators which are important in prairie restorations. Thus, these clovers would be excellent additions to a pasture to improve the forage nutritional profile, extend the grazing season, environmental and prairie restoration benefits and increase animal and human health. The inclusions of PPC and WPC in prairie pastures offers the potential for multiple benefits to some of the challenges faced in current pasture land management.

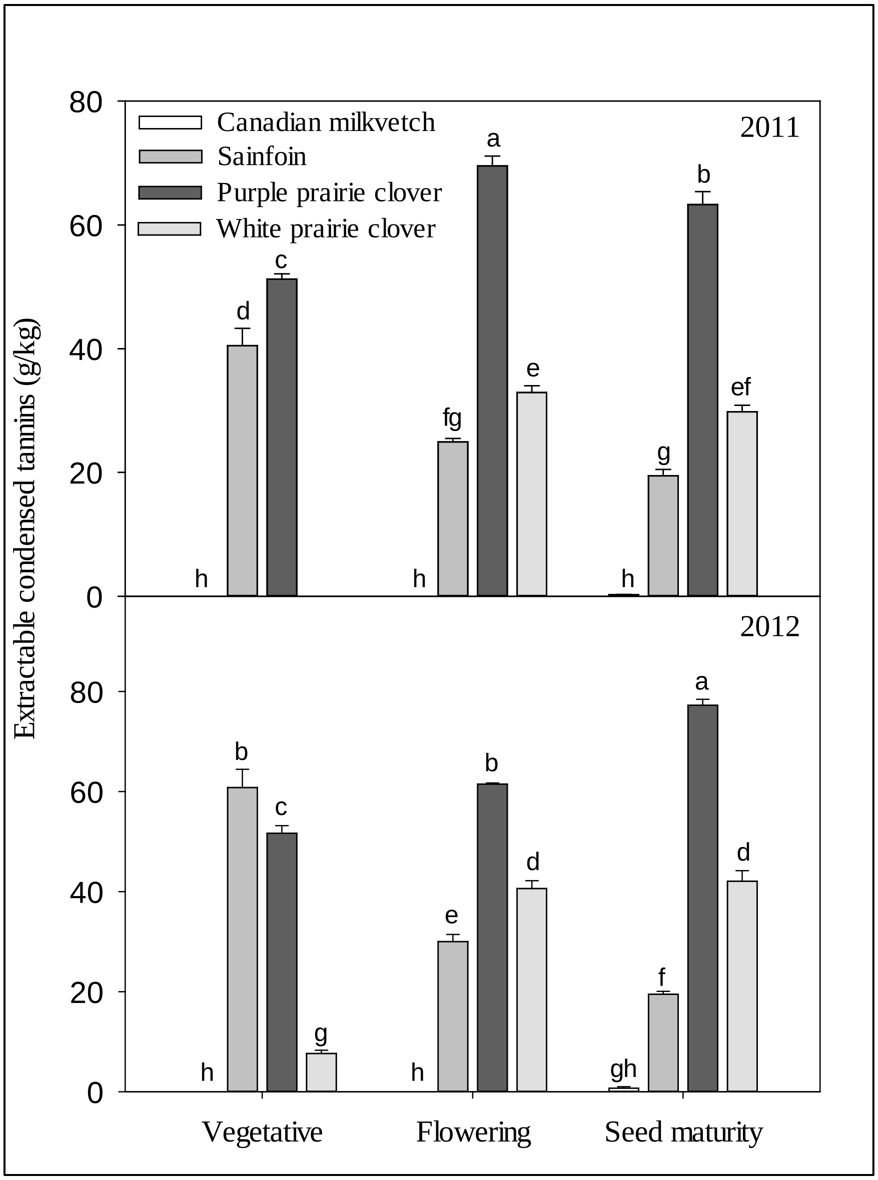


Figure 6. Extractable condensed tannins (g kg^{-1}) of the whole plant for Canadian Milkvetch, Sainfoin, Purple Prairie Clover and White Prairie Clover harvested at three different stages of maturity in 2011 and 2012.

Acknowledgements

The authors are grateful for the technical assistance of E. Birkedal, R. Muri, D. Sandau, and L. Haubrich at the Semiarid Prairie Agricultural Research Centre (SPARC) of Agriculture and Agri-Food Canada (AAFC) for plot establishment, sample collection, data collection and field measurement. The work was financially supported by AAFC, Southwest Forage Association, Horn Cattle Purchasing Fund, GF1 & 2 Beef Cluster and China Scholarship Council that provided a scholarship to Y. Li.

Literature Cited

Giorgio, B., G.P. Pier and T. Ernesto. 2003. Evolution of yield and quality of sainfoin (*Onobrychis viciifolia* Scop.) in the spring growth cycle. *Agronomie* 23: 193-201.

Goering, H.K. and P.J. Van Soest. 1970. Forage fibre analysis. USDA Agric. Handbook No. 379: 1-20.

Li, Y., A.D. Iwaasa, Y. Wang, L. Jin and G. Han. 2012. Condensed tannins concentrations of prairie legume forages at different phenological stages. ADSA-AMPA-ASAS-CSAS-WSASAS JAM Phoenix Conference, 15-19 July 2012, Phoenix, Arizona.

Liu, X.L., Y.Q. Hao, L. Jin, Z.J. Xu, T.A. McAllister and W. Yuxi. 2013. Anti-*Escherichia coli O157:H7* properties of purple prairie clover and sainfoin condensed tannins. *Molecules* 18: 2183-2199.

Sheaffer, C.C., D.L. Wyse and N.J. Ehike. 2009. Palatability and nutritive value of native legumes. Native Plants J. 10: 224-231.

Terrill, T.H., A.M. Rowan, G.B. Douglas and T.N. Barry. 1992. Determination of extractable and bound condensed tannin concentrations in forage plants, protein concentrate meals and cereal grains. Journal of the Science of Food and Agriculture 58: 321-329.

Propagation Techniques to Establish Difficult to Grow Native Plant Species

S.C. TANNAS
Tannas Conservation Services Ltd., Eastern Slopes Rangeland Seeds Ltd., Box 31, Cremona, Alberta T0M 0R0.

Abstract: Over the past 30 years Eastern Slopes Rangeland Seeds has established hundreds of species of native plants on projects all over western Canada. From our experiences we have hands on experience on what techniques work and do not work in establishing native plants. We have been involved in relocation and propagation of endangered plant species for the purpose of conservation as well as establishing entire plant communities. From soils to climate, all variables must be taken into account in restoring a plant community. In this discussion I will endeavor to explain how to move from a simple reclamation project to a restoration of an ecosystem through establishing many difficult to grow species successfully. I will cover techniques necessary in establishing native plants from source material selection, choosing the appropriate establishment technique, preparing the plant materials to establishing and monitoring the plant community.

MECHANISMS **R**ESPONSIBLE FOR **E**NHANCING THE **R**ESTORATION OF ***F**ESTUCA CAMPESTRIS* INTO A ***P**HLEUM PRATENSE* **D**OMINATED **P**LANT **C**OMMUNITY ON A **P**IPELINE **R**IGHT OF **W**AY

S.C. TANNAS
Tannas Conservation Services Ltd., Eastern Slopes Rangeland Seeds Ltd., Box 31, Cremona, Alberta T0M 0R0.

Abstract: The fescue grasslands of the southern foothills are diverse ecologically sensitive areas important for agriculture, recreation, wildlife and industry. Recent pressures from industry, urban expansion and recreation have increasingly exacerbated the effects of agriculture, culminating in destabilization of many plant communities. Timothy (*Phleum pratense*) invasion has become a widespread problem in these grasslands with or without industrial activity, but on industrial sites establishment of foothills Rough Fescue (*Festuca campestris*) has been plagued with failures. In 2008, ten sites were selected along a reclaimed pipeline that had high timothy cover and presite assessments were conducted. In the spring of 2009, 1,000 greenhouse grown Rough Fescue plugs were planted at 1 plug/m^2 at each site. Monitoring of 600 of these plants occurred under six randomly selected sets of plugs (10 plugs) across each site. In spring 2010, 600 more plugs were planted on the opposite side of each marker. Annual timothy control was initiated in 2009 through wick application (glyphosate), mowing and a combination of the two techniques on five sites, with two sets of fescue in each treatment. Another five organic sites received mowing treatments (presence/absence) with the fescue divided between the treatments. Survival of Rough Fescue was compared to cover, biomass species composition and historical grazing patterns. Results suggest Rough Fescue survival was highly correlated with bare ground and low vegetation biomass associated with the pretreatment conditions and grazing patterns. Mortality of fescue appeared to be associated with competition (plant biomass) and herbivory by mice.

RESTORATION OF PREVIOUSLY CULTIVATED LAND IN THE DRY MIXEDGRASS NATURAL SUBREGION OF ALBERTA.

RICHMAN, J.D[1], **B.A. DOWNEY**[2], **P.F. JONES**[2], **B.L. DOWNEY**[1], **F.BLOUIN**[3], **J.NICHOLSON**[2], **K.A FRANCE**[1],

[1] Alberta Environment and Sustainable Resource Development, 200-5 Ave., South, Lethbridge, Alberta T1J 4L1.

[2] Alberta Conservation Association, #400, 817-4th Ave., South, Lethbridge, Alberta T1J 0P6.

[3] Prairie Conservation Forum, c/o Alberta Environment, 2nd Floor, Provincial Building, 200-5 Ave., South, Lethbridge, Alberta T1J 4L1.

Abstract: MULTISAR is a multiple species conservation strategy that aims to conserve multiple species of wildlife, including Species-at-Risk, at the landscape level, through a process that integrates range management with fish and wildlife management principles. In the early 1900s a significant amount of native dry Mixedgrass range was ploughed to make way for intensive agriculture. Currently, only 43% of the dry Mixedgrass natural subregion remains native and continues to be fragmented by human development. In 2008, the MULTISAR program partnered with a landowner to convert 57ha of marginal cropland back to native grassland. A seed mix for the site was determined by assessing the ecological characteristics of the native grasslands immediately adjacent and identifying the composition of the plant community. Seed was broadcast at 10kg/ha followed by a light harrow in the spring of 2008. In the spring of 2009 the site was sprayed with a broadleaf herbicide to combat weeds and 150 silver sagebrush plugs were planted in low lying areas. In 2010 after the third growing season, species composition equalled 13.4% Blue Grama (*Boutelua gracilis*), 13% Northern Wheatgrass (*Agropyron dasystachyum*), 10.9% June Grass (*Koeleria macrantha*), 6.7% Western Wheatgrass (*Agropyron smithii*), and 4.7% Needle and Thread Grass (*Stipa comata*). Wildlife present on the site shifted from a community dominated by Horned Larks (*Eremophila alpestris*) in 2007, to thirteen species identified in 2010 including Species-at-Risk like Sprague's Pipit (*Anthus spragueii)* and Chestnut-collared Longspur (*Calcarius ornatus*). Further research is needed to determine their nesting and rearing success on reseeded native grasslands.

Forage and Grazing Evaluations of Purple Prairie Clover and White Prairie Clover at AAFC-Semiarid Prairie Agricultural Research Centre

ALAN IWAASA[1], **MIKE SCHELLENBERG**[1], **RUSS MURI**[1], **B. BILIGETU**[1], **YUANHENG LI**[2], and **YUXI WANG**[3]

[1] Semiarid Prairie Agricultural Research Centre, Agriculture and Agri-Food Canada, P.O. Box 1030, Swift Current, Saskatchewan S9H 3X2.

[2] College of Ecology and Environment Science, Inner Mongolia Agricultural University, Huhhot, China

[3] Lethbridge Research Centre, Agriculture and Agri-Food Canada, 5403-1 St., Lethbridge, Alberta T1J 4B1.

Abstract: Purple Prairie Clover (PPC) (*Dalea purpurea* Vent.) and White Prairie Clover (WPC) (*Dalea candida* Michx. Ex Willd.) adaptation and distribution range in Western Canada is associated with the Mixed and Short Grass Prairie Ecoregion. Both PPC and WPC are members of the Pea family (*Fabaceae* spp.), fix nitrogen, produce palatable and nutritious forage and play an important ecological role in native grasslands. Research at AAFC-SPARC on PPC was first initiated in 1993, while the interest in WPC started in 2000. The prairie clovers are warm-season forbs, with much of their growth occurring during July and August. At that time many of our cool-season grasses are in that mid-summer nutritional slump (i.e., forage quality is declining as the plant matures). This makes PPC and WPC excellent additions to a pasture, as it can improve the nutritional profile and help to extend the grazing season. Both PPC and WPC have hard seed coat characteristics of 78.8% $\pm$ 5.8 and 22.7% $\pm$ 4.4, respectively. Results have revealed that PPC and WPC floral/seed portions contain some of the highest condensed tannin concentrations (11.2 to 16.2% and 8.6 to 15.1% DM basis). In comparison the highest condensed tannin concentrations for Sainfoin (*Onobrychis viciifolia*) is in the leaves (7.5 to 8.9% DM basis). SPARC and Lethbridge researchers have found the PPC contains unique condensed tannins which can improve protein utilization by cattle but also inhibit the growth of E. coli. Research is ongoing at both SPARC and Lethbridge evaluating these two remarkable plants and their potential forage nutritional and grazing benefits for Western Canada.

EXPERIMENTAL TREE REMOVAL IN GRASSLAND: VARIABLE FLORAL AND FAUNAL RESPONSES ALONG A GRADIENT OF ENCROACHMENT

A. L. ALFORD[1], **E. C. HELLGREN**[2]**, R. F. LIMB**[3] and **D. M. ENGLE**[4]
[1] Department of Biology, Ambrose University College, 150 Ambrose Circle SW, Calgary, Alberta T3H 0L5.
Email: AAlford@ambrose.edu
[2] Cooperative Wildlife Research Laboratory, Southern Illinois University, Carbondale, USA
[3] Department of Rangeland Ecology and Management, Oregon State University, USA
[4]Department of Natural Resource Ecology and Management, Oklahoma State University, USA

Abstract: Changing land use and management within the past two centuries has facilitated increases in woody plant cover in many ecoregions of North America. In the southern Great Plains, encroachment by Eastern Red Cedar (*Juniperus virginiana*) can convert grasslands to closed-canopy woodlands in <50 years, changing floral and faunal composition and decreasing species diversity. Increases in red cedar cover also may shift key abiotic factors that, over the course of encroachment, create feedbacks that limit grassland restoration. We used a Before–After, Control–Impact (BACI) design to examine eight pairs of grassland sites undergoing various levels of red cedar encroachment to determine whether responses of flora and fauna to experimental red cedar removal differed according to the level of pretreatment red cedar cover. We monitored changes in herbaceous plant and small-mammal assemblages on grassland sites for two years following red cedar removal. In general, tree removal increased herbaceous plant and small-mammal diversity, with sites having the highest levels of pretreatment red cedar cover exhibiting the greatest responses to tree removal. Tree removal also shifted small-mammal species composition toward a more grassland-associated assemblage. Our results demonstrated that tree removal increased important grassland community metrics over a relatively short time frame, with responses to removal being influenced by the stage of initial encroachment. However, given the high cost of treatment and the imperiled status of many grassland-associated species, early detection and management of encroachment will be necessary for successful grassland conservation. Woody encroachment is an ecological concern in grassland ecosystems, and appears in a number of biological, historical, and cultural contexts in Canada. Encroachment has implications for many provincial and federal priorities (i.e., Species-at-Risk programs), influences rangeland productivity, and is strongly affected by land use practices and management. Understanding the dynamics of woody encroachment, studying its effects in different ecosystems, and disseminating information about effective management strategies to stakeholders will be a necessary part of future grassland conservation efforts.

SESSION 18: RESTORATION: PRAIRIE RECOVERY AFTER FIRE

CHARACTERIZATION OF A WILDFIRE EVENT IN THE TALL GRASS PRAIRIE REGION OF MANITOBA

JORDAN BECKER[1], **CARY HAMEL**[1], **JULIE PELC**[1], **TIM TEETAERT**[1], **JON EERKES**[2] and **RUSSELL REISZ**[2],
[1] The Nature Conservancy of Canada, Suite 200, 611 Corydon Ave., Winnipeg, Manitoba R3L 0P3.
[2] The Nature Conservancy, P.O. Box 139, Karlstad, Minnesota 56732, USA.

Abstract: Characterization of wildfires, including mapping their extent and monitoring their effects on plant communities, is an important aspect of the decision making process required for management of fire-adapted ecosystems. In response to a 10,539 ha wildfire in the Tall Grass Prairie Region of south-eastern Manitoba in autumn 2011, a plan was developed to measure the fire's impact on plant communities and assess its effects on infrastructure, Species-at-Risk habitat, and woody species encroachment. The precise boundary of the fire, as well as the unburned areas within this boundary, were mapped at a fine scale. Effects on the soil litter layer and woody species were also recorded. Fire effects were not consistent; data suggests that the fire behaved differently depending on the moisture regime, community type, and vegetation of the site. The collection of fire effects data represents the first step towards the development of a more extensive, long-term fire monitoring database that will aid in understanding how fire behavior differs amongst plant communities and between seasons. Combined with ongoing measures of Species-at-Risk occurrence patterns and abundance, natural area management staff can utilize this knowledge to more effectively direct prescribed fire planning and management of conservation lands.

Fire Severity and its Role in Native Grassland Recovery

K. FRANCE
Environment and Sustainable Resource Development, 200-5 Ave., South, Lethbridge, Alberta T1J 4L1.

Abstract: Alberta's grasslands have evolved with fire; in fact most of our Fescue grasslands are a product of bison grazing and fire. Fire is considered essential for regenerating fire-dependent species, controlling plant pathogens, and preventing tree and shrub encroachment. Fire was a constant presence in the last nine thousand years, and has fluctuated with regional climate change, post-glacial forest to grassland succession, and cultural change. Whether it was natural, lightning strikes, or First Nation burning, these systems burnt regularly. However, the timing of fire, fire intensity and severity can produce different results and challenges. The severity of each fire will depends on fuel loads, fuel moisture, fire temperature and duration. Generally, grassland fires are relatively low intensity, short duration events and rarely will these fires burn into the soil. Fires with high fine fuel loads, such as abundant grass production that is dormant (fall and winter), can lead to severe fires. These fires usually lead to distressing results such as forage loss for livestock and wildlife, infrastructure loss, soil erosion and the potential for weed invasion. We will examine the effects of three fires in Southern Alberta with different levels of severity and how they influenced grassland recovery.

USING PRESCRIBED FIRE AND GLYPHOSATE TO MANAGE THE INVASION OF NATIVE PRAIRIE BY TREES AND SHRUBS, AND THE EXOTIC INVASIVE GRASS, SMOOTH BROME IN SASKATCHEWAN.

R. A. WRIGHT, G. LONGPRE, J. R. SMITH, K. KELLY, and **J. KARST**.
Saskatchewan Parks Service, 3211 Alberta St., Regina, Saskatchewan S4S 5W6.

Expanded Abstract: A long-term study to develop a best management practice (BMP) for controlling the invasion of indigenous trees and shrubs, and the exotic invasive Smooth Brome (*Bromus inermis*) in three provincial park grasslands was initiated in the 1990s. Several prescribed fires were undertaken between 1994 and 2012. A wicked application of glyphosate to Smooth Brome was incorporated into the experiment in 2008. Prescribed fires are successfully controlling native tree and shrub invasion and the combination of burning and glyphosate wicking is more effective for Smooth Brome control than either fire or glyphosate alone. Height differentials between the Smooth Brome and native plants is essential for effective, low-risk wicking but sufficient differentials may only occur early in the first summer following spring prescribed burning. Specific results include:

1. Combined burning and wicking treatments diminished the cover and reproductive potential of Smooth Brome,
2. Smooth Brome affected the resource partitioning among species but did not diminish native species richness,
3. the native grass Big Bluestem (*Andropogon gerardii*) appears to be dominant over Smooth Brome and has promise as a bio-control agent for Smooth Brome, and
4. three prescribed burns, over 15 years, were required to nearly eliminate invasive tree growth and restore the dominance of grasses and forbs.

The next step in developing the BMP is to begin an operational-level wicking trial of glyphosate in 2014. Some consideration is being given to combining a graminicide (e.g., Poast^{TM}) with glyphosate to improve the lethality to Smooth Brome. The trial will begin with work in one park, to minimize risk to biodiversity across the system. If the operational application proves successful in very significantly decreasing the importance of Smooth Brome in this one grassland, then the logistics of ramping the program up to a system-wide application will be developed. Is Smooth Brome destined to be an unavoidable part of the naturalized flora in protected areas on the Canadian Prairies? Operational trials combining herbicide wicking and prescribed burning in Saskatchewan provincial park native grasslands will help to determine the extent of our powers to effectively limit the spread of exotic, competitive grass species. If trials prove unsuccessful, then it may be necessary to re-visit our characterization of Smooth Brome as an undesirable exotic and begin the transition to acceptance of the species as a naturalized part of the flora.

SESSION 19: MULTI SPECIES CONSERVATION PLANNING: SOUTH OF THE DIVIDE

SOUTH OF THE DIVIDE INITIATIVE: STEWARDSHIP IN ACTION

Y.T. HWANG[1], M. WAYLAND[2], and P. FARGEY[3]

[1]Fish and Wildlife Branch, Saskatchewan Ministry of Environment, 3211 Albert St, Regina, Saskatchewan S4S 5W6.

[2]Canadian Wildlife Service, Environment Canada, 115 Perimeter Rd, Saskatoon, Saskatchewan S7N 0X4.

[3]Grassland National Park, Parks Canada, PO Box 150, Val Marie, Saskatchewan S0N 2T0.

Expanded Abstract: South of the Divide (SoD): Stewardship in Action is a joint initiative of the governments of Canada and Saskatchewan to conserve Species-at-Risk in the Milk River Watershed in southwestern Saskatchewan. The goal of the project is to conserve Species-at-Risk and their supporting habitats by collaborating with land owners and land users to identify and promote cost-effective land stewardship practices that respect cultural, traditional and economic values of this working landscape.

The SoD project area spans 14,909 km² or about 1.5 million ha. Over half of the area is native mixed-grass prairie (15% of the remaining native grassland in Saskatchewan). It is one of the few large, contiguous areas of native grassland remaining in the Canadian prairies, making it of provincial, national and continental significance because of the rarity of this habitat type. There are at least 21 Species-at-Risk known to occur in the SoD area. Threats that degrade or destroy native habitat are the most common reasons for species to become Threatened or Endangered so protecting this habitat for Species-at-Risk is the key to their conservation.

In 2008, the Canada-Saskatchewan Species-at-Risk Coordinating Committee (formed under the Canada-Saskatchewan Bilateral Agreement on Species-at-Risk) recognized the importance of the SoD area for Species-at-Risk and tasked its members to incorporate the development of an ecosystem based/multi-species approach into their annual work plan. The premise for recommending such an approach was that planning for conservation of several Species-at-Risk at the same time would be more practical and efficient than single-species planning, more successful at engaging local stakeholders, and would lead to the development of a recovery implementation platform. As a general example, because species occur in the same region, there is substantial overlap in threats: 81% of threats typically affect more than one SAR; 74% of threats are of concern in more than one habitat type; 64% of threats affect SAR habitat, much of which may be shared by several species; and at least 70% of threats require stewardship actions and/or community outreach. Threat mitigation measures therefore are best approached on an ecosystem, multi-species basis. A SoD Steering Committee and Task Groups composed of key partners including Environment Canada (co-lead), Agriculture and Agri-Food Canada and Parks Canada Agency; provincial ministries of the Environment (co-lead), Agriculture, Economy and Saskatchewan Water Security Agency, were formed to lead this initiative.

A key output of the project will be the *South of the Divide Multi-Species-at-Risk Action Plan*: a federal document that is compliant with the *Species at Risk Act* (SARA), meets Saskatchewan's species-at-risk legislative obligations, and is supported by landowners and stakeholders. The SoD Action Plan will complement but not include Grasslands National Park, which is developing its own SARA Action Plan to address the unique concerns that exist within a protected area and that distinguish it from the 'working' landscape that exists elsewhere in this watershed.

The SoD Action Plan will outline detailed approaches for implementing pre-existing SARA recovery strategies and management plans for 13 Species-at-Risk in the SoD area. Once national recovery strategies are prepared for other Species-at-Risk in the area, they may be added in future amendments to the SoD Action Plan.

The following nine focal species are included in the SoD Action Plan: Black-footed Ferret (*Mustela nigripes*; Extirpated), Burrowing Owl (*Athene cunicularia*; Endangered—EN), Eastern Yellow-bellied Racer (*Coluber constrictor flaviventris*; Threatened—TH), Greater Sage-Grouse (*Centrocercus urophasianus;* EN), Loggerhead Shrike (*Lanius ludovicianus; prairie population* - EN), Mormon Metalmark *(Apodemia mormo*; TH), Mountain Plover (*Charadrius montanus;* EN), Sprague's Pipit (*Anthus spragueii;* TH), and Swift Fox (*Vulpes velox*; TH). The plan will address population and distribution objectives that are identified in the Recovery Strategies for each of the nine species, but only to the extent to which those objectives can be realized within the SoD area. The plan will also include management considerations for the following four species of Special Concern: Black-tailed Prairie Dog (*Cynomys ludovicianus*), Long-billed Curlew (*Numenius americanus*), McCown's Longspur (*Rhynchophanes mccownii*), and Northern Leopard Frog (*Lithobates pipiens*; boreal/prairie populations).

While some SoD species have common needs, there are also differences that require unique approaches, especially when species' habitat needs are conflicting. For example, Burrowing Owls prefer nesting habitat consisting of short grass with good visibility for predator detection; Sprague's Pipits need taller grass. Loggerhead Shrikes prefer a matrix of grassland interspersed with shrubs while other SoD species might actually benefit from prescribed fire to maintain the prairie and remove shrubs. Thus, the development of a multi-species Action Plan requires different approaches depending upon which species are present, what their habitat needs are, and also how the land is actually being used.

Information Gathering

Information on land cover, land use and land tenure was compiled beginning in March 2008 and has been recently updated (Oct 2013). Threats to species were identified and compiled from the individual Recovery Strategies and Management Plans. Ground work and analysis to identify critical habitat also began for focal species and was completed in 2012.

Action Plan Development

Action Plan development with stakeholders, First Nations, and Métis engagement began in January 2012. Success in implementing this Action Plan will depend to a great extent on the interest and cooperation of key stakeholders whose activities have the potential to shape habitat and affect wildlife. Therefore, key stakeholders and Aboriginal peoples have been engaged in the planning process from an early stage. A stakeholder advisory committee (SHAC) was created with representatives from several livestock associations, irrigation districts, crop growers, the petroleum industry, energy, non-government environmental organizations, municipal governments, and others. Through the SHAC, stakeholders have had an opportunity to inform development of the Action Plan and more broadly to provide a voice for local and other stakeholder concerns. They have also collaborated specifically on the development of recovery measures, and advised the SoD committee on the best approaches to a broader consultation process that will need to be done in the future.

Action Plan Results to Date

Land Cover & Use: Ranching is the main activity in the project area but crop production is also important. Over 53% of the SoD land cover is native mixed-grass prairie; 13% is tame pasture and hay land cover; and 24% is annual cropland. Some cropland and hay land is irrigated due to the dry climate of the region. The petroleum industry is active in parts of the project area. A small percentage of the land base consists of protected natural areas. Human features cover less than 1% of the area; there are few major roads and little urbanization. There are approximately 2,500-3,000 residents in the project area. Land owned by four First Nations accounts for <1% of the total land area.

Proposed Critical Habitat: One of the purposes of identifying critical habitat is to ensure that it is protected. In developing and implementing the SoD Action Plan, partners will work together to ensure that steps are taken to protect the critical habitat from being destroyed. In the SoD Action Plan, proposed critical habitat will be identified for seven species. This is in addition to critical habitat already identified in recovery strategies for Black-footed Ferret, Burrowing Owl, Eastern Yellow-bellied Racer and Greater Sage-Grouse. Two wide-ranging species, Swift Fox and Sprague's Pipit, will likely require extensive critical habitat in order to provide for their survival and recovery. For example, about 38% of the SoD area may be proposed as critical habitat for pipits.

Land Cover & Critical Habitat: Native grassland areas are key to the survival and recovery of many of the SoD SAR. There is extensive overlap between areas of native grassland and proposed critical habitat.

Land Tenure & Critical Habitat: Candidate critical habitat will be proposed for identification on private land, provincial Crown land, and federal land that is not in federal protected areas. In the project area, 44% of the land is privately owned, 40% is provincial agriculture Crown land (with much of the latter leased to livestock growers), and 14% is federal land (nearly 94% of which is owned or managed by Agriculture and Agri-Food Canada (AAFC), 6% First Nation land, and <1% National Wildlife Area). AAFC has announced its intent to divest most of its community pastures to the provinces beginning in 2013. This decision will apply to its federal community pastures in the SoD.

A Socio-economic Evaluation of Costs and Benefits of the Action Plan is also being done. Preliminary results indicate that costs of implementing this Action Plan will arise mainly from promoting cost-effective stewardship activities to protect habitat. Substantial long-term benefits, consistent with the value that the Saskatchewan public places on Species-at-Risk conservation will be derived from the implementation of this plan.

Broad public consultation will occur before the Action Plan is finalized. A consultation plan is under development.

Implementation

Once the Action Plan is completed, the implementation of recovery actions, including stewardship and voluntary measures by stakeholders in collaboration with government agencies, will be vital to the success of the *South of the Divide Multi-Species-at-Risk Action Plan*.

A multi-stakeholder implementation committee with government, industry, agriculture, and conservation-organization representation is being formed to guide the implementation of the SoD Action Plan.

DOES A WORKING PRAIRIE LANDSCAPE WORK FOR WILDLIFE?: LINKING BIRD ABUNDANCE AND RANGE HEALTH IN SASKATCHEWAN, CANADA

ALLISON HENDERSON[1] and **STEPHEN K., DAVIS**[2]
[1] University of Saskatchewan, Saskatoon, Saskatchewan S7N 5C8.
[2] Canadian Wildlife Service, 2365 Albert Street, Regina, Saskatchewan S4P 4K1.

Abstract: North American temperate grasslands and the wildlife species they support are increasingly imperiled, largely due to habitat loss. The majority of remaining prairie is privately managed and supports livestock production. In Canada, voluntary stewardship is the preferred approach for protecting Species-at-Risk on private lands under the federal *Species at Risk Act* (SARA). However, attitudes of private land managers towards Species-at-Risk and their willingness to engage in stewardship are poorly understood. With data from interviews with 42 livestock producers in Saskatchewan, Canada, we describe producer characteristics, attitudes and awareness of Species-at-Risk and evaluate how these factors influence willingness to protect Species-at-Risk. Younger producers with increased formal education, awareness and positive attitudes were more willing to support Species-at-Risk conservation. Voluntary stewardship under the SARA may be enhanced by rewarding producers for sound habitat management and improving trust between producers and government agencies.

PARKS CANADA AGENCY'S PERSPECTIVES ON MULTI-SPECIES SITE-BASED ACTION PLANS

PAT FARGEY
Grassland National Park, Parks Canada Agency, Box 150, Val Marie, Saskatchewan S0N 2T0.

Abstract: Species listed as Extirpated, Endangered, and Threatened under the federal *Species at Risk Act* require a recovery strategy that identifies the population and distribution objectives as well as broad approaches to recovery. The act then requires that one or more action plans be prepared. The purpose of an action plans is to articulate the specific conservation actions that are required to achieve the population and distribution objectives. An action plan can be limited to a particular geographic area and can address multiple Species-at-Risk. Parks Canada Agency is developing multi-species actions plans for National Parks, National Marine Conservation Areas and National Historic Sites with significant numbers of Species-at-Risk. In this paper I explain the Parks Canada approach and discuss its strengths and challenges.

MOVING FORWARD WITH GRASSLAND CONSERVATION: EMPLOYING ECONOMIC INSTRUMENTS TO ACHIEVE CONSERVATION GOALS

ALICIA ENTEM
Department of Resource Economics and Environmental Sociology, University of Alberta, Edmonton, Alberta T6G 2H1. Email: aentem@ualberta.ca

Extended Abstract

Once conservation planning has progressed beyond (1) the definition of conservation goals and objectives, (2) selection of conservation actions/activities, and (3) delineation of the desired locations for the conservation implementation, the next step is (4) to design the policy mechanisms – or incentives – that will be used to promote the implementation of conservation actions. Policy mechanisms can be used either to promote changes that provide conservation gains or to discourage changes that result in conservation losses; these are common known as positive and negative incentives, respectively (Pannell 2008).

Several different policy mechanisms, either individually or collectively, can be used to promote conservation implementation and the achievement of conservation goals. However, the choice between mechanisms can be difficult. Education and stewardship are common non-regulatory options employed to varying success. Economic instruments, in comparison, can deliver flexibility and the incentives required to achieve conservation goals. Economic instruments can include the more familiar regulatory approaches (i.e., taxes, subsidies, grants, quotas) as well as less familiar market based approaches (i.e., offsets, payments for ecosystem services, transferable quotas). Market-based instruments, by definition, encourage behaviour through market signals rather than through explicit directives (Stavins 2003).

The multiple Species-at-Risk (Multi-SAR) project within Saskatchewan's Milk River Watershed was used to illustrate six primary points. (1) Extension – as method for achieving conservation – is limited by conflicting public and private goals. (2) The definition of property rights influences the choice of policy mechanisms. (3) The legitimization of ecosystem service values will contribute to the creation of viable environmental benefits markets. (4) Market-based instruments are complex and should be designed with multi-disciplinary input. (5) Market-based instruments, in conjunction with regulation and extension, can offer valuable conservation rewards. (6) Success of conservation initiatives will be aided by favourable policies and political climates.

References

Pannell, D. 2008. Public benefits, private benefits, and policy mechanism choice for land-use change for environmental benefits. *Land Economics* 84: 225-240.

Stavins, R.N. 2003. Experience with market-based environmental policy instruments. In: K.G. Mgiler and J.R. Vincent (eds.), Elsevier Science, Handbook of Environmental Economics 1: 354-435.

SESSION 20: ENGAGING RANCHERS IN CONSERVATION

ROLES OF RANCHERS AND URBAN CONSUMERS IN A SUSTAINABLE PRAIRIE LANDSCAPE. WHAT DOES A SOCIOECONOMIC-ECOLOGICAL WIN-WIN LOOK LIKE?

M.E. ERICKSON, and **K.J. GRISLEY**
Operation Grassland Community, Alberta Fish and Game Association, 6924 – 104 St, Alberta T6H 2L7.
Email: office@afga.org

Abstract: With over 95% of Alberta's Grassland Natural Region under human resource use and extraction, protection of wildlife can occur only with full consideration of this region's socio-economic reality. If we are to maintain and increase native grasslands, halt and reverse declines of Species-at-Risk, and prevent other species from becoming at risk, we must apply sustainable land management on a broad scale. For over two decades, Operation Grassland Community (OGC) has worked at the grassroots level—collaborating with its more than 300 ranching and farming members and other organizations toward realization of our common goals: economic stability, vital communities, and a healthy environment with sustainable wildlife populations. In more recent years, there has been a rapid and significant rise in consumer demand for 'sustainable' production. However, from over 20 years of building relationships of trust and mutual respect with our farming and ranching membership, our experience has been that consumers don't have an adequate understanding of the day-to-day challenges our producers face. If consumers desire stewardship of wildlife and their habitats, then the socio-economic realities of this stewardship must be properly communicated and consumers must come to understand their role in supporting this stewardship on a broad scale. Effective stewardship actions arise from mutual understanding. Operation Grassland Community is responding to these rapid changes through an innovative outreach/education initiative that highlights sustainable production through video and film. We believe that through accurate sharing of current ranching and farming realities, OGC can act as a catalyst for positive change throughout Alberta's agricultural regions.

MILK RIVER STATE OF THE WATERSHED REPORTING AND CONSERVATION PLANNING

S. RIEMERSMA
Milk River Watershed Council Canada, 113-1 Ave NW, Milk River, Alberta T0K 1M0.

Abstract: Effective watershed management must consider all aspects of the watershed, even when the watershed boundary crosses multiple planning jurisdictions (i.e., municipal, provincial or international boundaries). The Milk River watershed spans an area that includes Alberta and Saskatchewan, Canada, and a large area within Montana, U.S.A. The Milk River Watershed Council Canada (MRWCC) recognizes the importance of inter-provincial and international partnerships to develop a common understanding of ecological, social and economic watershed functions. The MRWCC has partnered with the Milk River Watershed Alliance, Montana, and together they are working to develop a Transboundary State of the Watershed Report. This report will address the health and function of the Milk River's water and land resources, as well as social and economic condition across provincial and international borders. The SOW Report will cover topics such as water supply and quality, riparian health, biodiversity, land use and stewardship. In addition to the Transboundary State of the Watershed Report, stakeholder input and the results of local, scientific studies are being used to inform management recommendations in the Milk River Integrated Watershed Management Plan. This plan addresses water supply and quality, land use (e.g., agriculture, oil and gas, recreation/tourism), biodiversity and stewardship. The management plan will be used as a guidance document and planning tool for decision-making authorities, natural resource managers and residents in the Milk River watershed, Alberta. Some recommendations in the plan are bound by historical Treaties and Orders that did not fully consider the environment at the time of writing. By developing a Transboundary State of the Watershed Report, and by recommending staged, practical and feasible management strategies for the watershed, shared knowledge and collaboration will improve management of watershed resources in the future. It is clear that our two countries are intricately connected by water, as well as by shared values and goals for watershed management and planning.

CONSERVATION AND THE RANCHING COMMUNITY

F. JACKSON
Environmental Affairs, Canadian Cattlemen's Association, #180, 6815-8 St NE, Calgary, Alberta T2E 7H7.

Abstract: The ranching community plays a key role in maintaining Canada's grassland biodiversity. Ranchers are managers of over 50 million acres of land in Canada, 13.6 million acres is in tame pasture and 36.3 million acres is in native grass. However it is not only the amount of land that they manage that makes them a key contributor to conservation efforts it is the best management practices (BMPs) that they employ. The presentation 'Conservation and the Ranching Community' will cover the successes of past conservation efforts on agricultural land and obstacles that limit uptake of BMPs on cattle operations across Canada. The presentation will then discuss the demands of the ever-changing consumer and agriculture's new need for a social license to operate. Finally the presentation will give insight into the future direction of the cattle industry in regards to sustainability and some of the strategic initiatives the industry is currently working on.

A CONVERSATION ABOUT CONSERVATION – A RANCHERS' PERSPECTIVE

T. KUPCHENKO
Environment and Sustainable Resource Development, #106 Provincial Building, 346-3 St., SE, Medicine Hat, Alberta T1A 0G7.

Abstract: This presentation will be a candid conversation with a couple of ranchers on how their day-to-day activities qualify as conserving the native grasslands. These ranchers make a living on native prairie and call the native prairie home. As part of the 'Agricultural Perspective' theme of the Prairie Conservation and Endangered Species conference, this presentation is a means of shedding light on the reality of raising cattle on the prairie, more specifically on Crown Land Grazing Leases. There will be a discussion of the definition of 'conservation' and what it means to them. This presentation is an opportunity to give credit where credit is due. To the everyday ranchers who work to maintain their living, and working landscapes and whom are a valuable part of this ecosystem.

MULTISAR: SUCCESS STORIES

JULIE P. LANDRY-DEBOER[1], **DARRYL J. JARINA**[2], and **KRISTEN S. RUMBOLT MILLER**[2]
[1] Alberta Conservation Association, #400, 817-4th Avenue South, Lethbridge, Alberta T1J 0P3.
[2] Prairie Conservation Forum, c/o Alberta Environment, 2 Floor, Provincial Building, 200-5 Ave S., Lethbridge, Alberta T1J 4L1.

Abstract: The MULTISAR program has implemented 55 habitat enhancements within the Milk River Watershed over the last ten years. These enhancements range from implementing native grass restoration projects to erecting artificial structures for Ferruginous Hawks (*Buteo regalis*). On the ground habitat enhancements are a result of local landowners voluntarily collaborating with MULTISAR to look at ways that they can not only benefit wildlife habitat but also improve their own cattle operation. Three enhancements that we will present are the installation of 1) Ferruginous Hawk poles after landowners noticed that native hawk nests had collapsed, 2) an upland watering site that reduced cattle pressure on the Milk River by attracting cattle out of riparian zones, and 3) wildlife friendly fencing for Pronghorn (*Antilocapra Americana*) and Greater Sage-Grouse (*Centrocercus urophasianus*). All habitat enhancements were made possible by the direct involvement and collaboration of landowners, the financial assistance of strong funding partners like Environment Canada and Canadian Natural Resource Limited, and in-kind support from AltaLink.

SUSTAINING RANCHERS AND GRASSLANDS: PARTNERSHIPS AND BENEFICIAL PRACTICES FOR SUSTAINABLE LIVESTOCK MANAGEMENT

SARAH A. HEIBERG[1] and **SUE J. MICHALSKY**[2]
[1] Commission for Environmental Cooperation, Suite 200, 393 St-Jacques St., W, Montreal, Quebec H2Y 1N9.
[2] Ranchers Stewardship Alliance Inc., P.O. Box 448, Eastend, Saskatchewan S0N 0T0.

Abstract: The central grasslands of Canada, Mexico and the United States form a region of significant economic importance that is both the most threatened, and only continentally-shared, terrestrial ecoregion in North America. The North American Grasslands: Management Initiatives and Partnerships to Enhance Ecosystem and Community Resilience project supported by the tri-national Commission for Environmental Cooperation (CEC), is working with government and non-government partners to establish a North American Grassland Alliance. One of the goals of the Alliance is to support ranchers who want to pilot beneficial management practices that promote sustainable ranching and biodiversity conservation and have them share their experience with a wider, continental audience.

The North American Grassland Alliance will work to:

- Compile, synthesize and disseminate beneficial practices for sustainable livestock production,
- Research the economic, green and low-carbon benefits of adopting sustainable rangeland practices, and
- Monitor grassland birds as indicators of overall rangeland health and success of range health improvement measures.

In parallel, beneficial management practices have been collected from ranchers, governments, non-governmental organizations and academic institutions at multiple scales across North America. These practices are being organized in a web-based digital repository of beneficial management practices, including the glossary of terms, a synthesis of common practices and a number of regionally-specific case studies. The beneficial practices collected by the CEC address ecosystem management, water resources, invasive/exotic species, Species-at-Risk/Endangered species, grass management, clean technology, education/awareness, livestock management, and socio-economic issues.

SESSION 21: THE FUTURE OF COMMUNITY PASTURES

SAVING GRASS: PANEL DISCUSSION(S) ON WHAT CAN BE DONE TO SAVE SASKATCHEWAN'S PFRA PASTURES

Session Moderator: TREVOR HERRIOT will be the facilitator of a panel session to discuss what many believe to be the single biggest threat to grassland conservation in Saskatchewan in decades: the impending privatization of the 1.6 million acres of Federal PFRA/CPP pastures, which the Saskatchewan Government says it will either sell or lease to patron ‘owner-operator’ groups. This panel will outline the problem, the opportunity and policy solutions especially with regard to how the pastures will be managed.

COMMUNITY PASTURES COOPERATIVE: FIRST NATIONS SUSTAINABLE LAND MANAGEMENT JOINT VENTURE INITIATIVE PROPOSES A THIRD PARTY MANAGEMENT OPTION THAT ALLOWS FOR AN INCLUSIVE AND VIABLE BUSINESS MODEL THAT WILL ACHIEVE BOTH PUBLIC AND PRIVATE SECTOR INTERESTS.

CARL NEGGERS
SM Solutions Inc., P.O.Box 926, Lumsden, Saskatchewan S0G 3C0, representing a multi-lateral sustainable land management proposal sponsored by several Saskatchewan First Nations. Phone: 306-731-3885, Email: carl@sustainablemanagement.ca

Abstract : The First Nations Sustainable Land Management Joint Venture Initiative proposes a third party management approach, enabled through a sound and inclusive business model, for a community pasture management initiative that should appeal to the various and diverse stakeholders and still achieve important public policy goals. History has proven that these lands are managed more appropriately and viably from both a business and ecological perspective as contiguous blocks.

Introduction

The purpose and mandate of this joint venture is to provide sustainable and inclusive management services for the Community Pastures' finite resources, with an eye on the planning and operations that maximize and measure business success and profitability, using triple bottom line metrics– *economically viable, environmentally sustainable and socially responsible.*

Though this initiative will benefit numerous stakeholders and First Nations groups, the specific bands sponsoring and steering this effort include *Piapot*, *Moosomin, Neekaneet, Muskowekan* and *Ochapawace* First Nations. Representatives have been selected and the initial coordinating meeting was conducted on September 6, 2012, in Regina. Former Federation of Saskatchewan Indian Nations (FSIN) Chief Rowland Crowe is serving as the Chair of this committee and SM Solutions is serving as the recording secretary and project manager. The steering group will guide the development of the Governance and Strategic Management Framework(s) and early stage consultations with key stakeholders. Once a Board comprised of various interest groups has been recruited, the steering committee will enable it towards achieving key project goals and serve as the Boards annual planning and reporting authority. Details of the Joint Venture proposal are presented below.

Purpose

Our purpose for meeting with you at this conference is to discuss in general terms emerging considerations that could demonstrate how provincial prosperity can be achieved using an approach that does not pit our economic growth against environmental integrity. SM Solutions is a network of professionals that believes that using metrics and measures that sponsor achievement of a 'triple bottom line' – economic prosperity, environmental integrity and social responsibility are essential for trading and competing in our current and ever emerging markets.

Background

According to the most recent Federal Budget (March, 2012; website: www.budget.gc.ca/2012/home-accueil-eng.html), the Prairie Farm Rehabilitation Administration (PFRA) will be dismantled over a course of six years. Specifically, the Community Pasture Program (CPP) administered by PFRA will be discontinued over time with initially five community pastures being devolved to the province of Saskatchewan after this year's grazing season is complete (2013). Currently the federal government operates 62 pastures throughout the province of Saskatchewan, covering approximately 710,000 hectares of land. These pastures support various interests including grazing of cattle, resource extraction, preservation of biodiversity/Species-at-Risk and protection of marginal lands from erosion, while providing essential habitat for wildlife.

To date, the Saskatchewan Government has introduced an advisory group populated with cattle and stock growers towards facilitating this transitional process, suggesting it will be conducted on a pasture by pasture basis. The province also recently announced (August 17, 2012) that it would negotiate the sale of these lands to current patrons on a pasture by pasture basis. They have given no regard to other stakeholders, including First Nations.

Key Economic, Environmental and Social Considerations:

- The pastures have proved over the past 80 years that keeping them unified and managing them in a portfolio manner has advantages for the various stakeholders, including all stock growers and various environmental and biodiversity groups. Aggregated, these lands are more economically and environmentally viable.
- Given the growing challenges on the prairies with drought and variable climatic conditions, important pasture reserves such as those afforded by the Community Pastures, will prove to be strategically important to all stock growers now and in the future.
- Dividing these sensitive lands up and selling them to a select few cattle producers will likely result in push back by many stakeholders that are not being considered such as bison producers, stock growers who currently do not have access to the pastures, environmental groups, wildlife associations and First Nations. Historically, the community pastures were open to all stock growers and ecologically sensitive interests (ecological reserves, Species-at-Risk, sensitive for flora and fauna communities) for the purpose of preserving ecological interests and residual grazing.
- Over the past 80 years the people of Canada have invested millions in capital and restorative efforts towards aggregating and leveraging these sensitive lands. To simply go back to dividing them amongst a handful of producers undermines these historical investments.
- Given the importance of these large tracts of land to various stakeholders and several key agreements (SARA), from a public policy perspective, more inclusive consultations need to be encouraged towards developing a more considerate and complete solution.
- Consideration should be given to sustainable alternatives that would maximize the economic and environmental potential of the pastures where the land rests in the public domain - as an ongoing societal asset - but without direct pasture management becoming the responsibility of the province.

Proposed Collaborative Action Plan:

As many of the disenfranchised stakeholders are varied in size and specific interests, it is easy for the two levels of government to excuse them by pitting one interest against another. By unifying under a common strategic initiative this divisive tactic becomes more difficult. As well, as a unified team it is possible to develop stronger efforts towards maximizing abilities and focusing communications; like the Community Pastures, the group will be *stronger together*.

First Nations Sustainable Land Management Joint Venture – '*Stronger Together* '

Project Intent:

To secure a partnership with the province of Saskatchewan and various other stakeholders that facilitate the sound transition of federally managed community pastures, while preserving and protecting the multiple of interests of various stakeholders in an inclusive, collaborative and considerate manner.

Key Objectives:

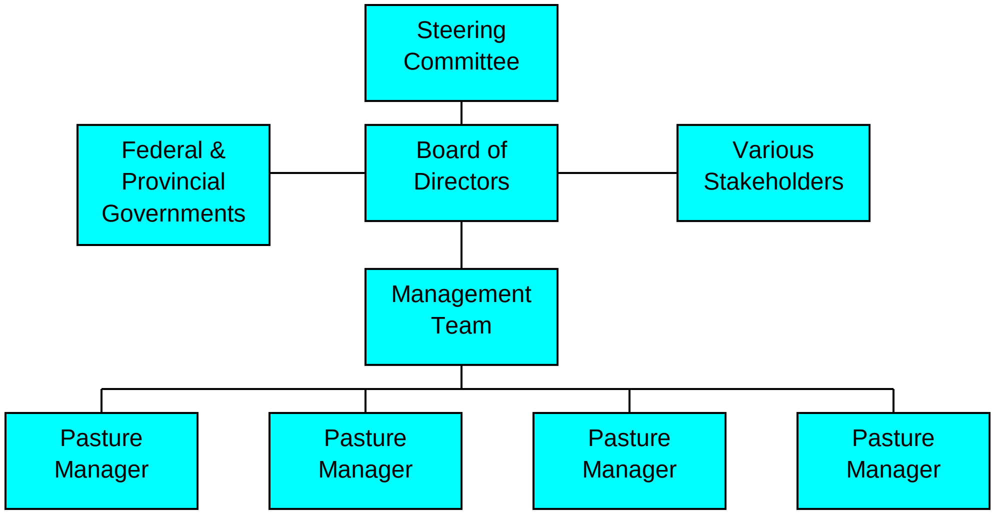
- Develop an inclusive transitional approach that allows for the involvement of all interests and facilitates the development of an ongoing governance structure that permits the short, medium and long term management practice accountabilities that influence and guide the ongoing operations of the community pastures
- Use strategic business practices that consider and measure profitability using social, environmental and financial indicators as a measure of success, while ensuring that free market trading or international free trade agreements are never compromised
- Ensure that the historical investments by the people of Canada are carried forward in a manner that respects public policy interests of the province and the various interest groups now and into the future.
- Demonstrate the ability of First Nations to manage and work with various provincial stakeholders towards achieving successful and long lasting outcomes that serve first nations, provincial and national economic, environmental and social interests.

Project Funding

Initial project funding has been secured through several First Nation funding opportunities and a focused budget has been developed aligned with key project deliverables. Strategic Stakeholder Partners may contribute financial or expertise resources to this project as well, and these investments will be assigned to key action areas as agreed to by the Steering Committee.

Proposed Governance

Following is a proposed governance framework that profiles the planning and reporting structure intended (but not approved) for this joint venture initiative.



Initial Action Plan (12 months):

Following are the initial action items, and can be adjusted based on input/insights from key stakeholders.

Project Components/Key Activities		
Key Activity	Description	Expected Completion Date
1. Project Definition Phase	The Project Manager will work and consult with various bands and first nation stakeholders and assess the current situation regarding the federal government's decision to discontinue the community pasture program and its impact throughout Saskatchewan. He/she will develop potential remedial proposals that will secure and advance all stakeholder interests and develop funding proposals to support and enable future actions.	August 21, 2012
2. Establish Interim Steering Committee	Establish a joint venture Steering committee that will guide the early stages of the project including the defining of key expectations, stakeholder consultations, development of a sound and responsive governance structure and initial public release information and communications.	September, 2012
3. Stakeholder Engagement	Engage and meet with the various federal and provincial based stakeholders with an eye on developing common positions and defining joint strategic and public policy goals. Present key findings and recommendations to various stakeholder groups to acquire reactions and insights prior to finalizing governance and business planning requirements.	September – October, 2012

4. Governance & Accountability Model	Develop and propose a governance model that will facilitate the ongoing management and administration of the First Nation Sustainable Land Management Joint Venture. This will include an examination of current models being used globally, possible alternatives that would best serve first nation interests, a risk analysis on preferred options and recommendations on best fit. The result expected is a sound governance framework and identification of initial Board Members.	October – November, 2012
5. Stakeholder Review and Identification of inaugural Board of Directors	Meet with federal, provincial and industry stakeholders and their representatives to secure support for proposed governance framework and proposed initial Board of Directors.	December, 2012
6. Facilitate the development of Transitional Plan	Introduce initial Board and facilitate the development of the transitional planning activities, including key deliverables and timelines.	January, 2013
7. Plan Review and Initial Negotiations	Based on Board direction, develop an initial transitional plan that would facilitate the movement of federally managed pastures to the newly formed First Nation Sustainable Land Management Joint Venture.	February, 2013
8. Plan Revisions and Finalize Transitional Negotiations	Based on negotiated agreements with federal, provincial and industry stakeholders revise transitional plan and negotiated financial and investment considerations.	March – April, 2013
9. Transitional Plan Implementation and Public Communications	Recruit Management Team and implement the key transitional plan action items.	August, 2013

HERITAGE RANGE LANDS AT RISK: HELP SAVE PFRA COMMUNITY PASTURES

LORNE SCOTT
Conservation Chair, Nature Saskatchewan, Room 206, 1380 Lorne St., Regina, Saskatchewan S4P 2L7.
Email: info@naturesask.ca

Extended Abstract: After 70 years of managing the Prairie Farm Rehabilitation Administration (PFRA) Community pastures, the Federal government decided in 2012 to end the PFRA program and turn the management of the pastures, that are on provincial crown land, over to the Prairie Provinces. The Government of Saskatchewan said it did not want to take over the management of the 62 pastures in the province and would offer them for sale or lease to existing patrons. Many patrons indicated they were not in a position to buy the pastures. The PFRA pastures were among the best managed environmentally and agriculturally speaking, and contain the largest blocks of native prairie grasslands remaining in Saskatchewan and Canada. Many saw the disposal of these pastures as the end of the last large tracts of heritage rangelands and the loss of their critical biodiversity values.

Background

- The 62 PFRA pastures in Saskatchewan contained about 1.6 million acres of native grasslands and aspen parkland landscape.
- Some 1,800 patrons grazed about 85,000 cow/calf pairs on the pastures.
- Managed livestock grazing created a healthy landscape for our native flora and fauna.
- Some 32 known Species-at-Risk were found across 55 of the provinces 62 pastures.
- When livestock were removed from the pastures in the fall, many were open for access by thousands of licensed hunters to harvest game birds and animals.
- The pastures were very important to producers in providing grazing opportunities.
- Soaring land prices made it impractical for many smaller producers to purchase the pastures.

The PFRA pastures were among the best-managed rangelands in the province, with full-time professional land managers operating the pastures, managing the grass and accommodating the needs of patrons while ensuring a healthy landscape for native plants and animals.

Why are these PFRA pastures so critical to biodiversity?

- Overall, the Prairie Provinces have lost 80% of our natural landscape south of the forest fringe. We have one of the most modified landscapes in North America.
- Close to 50% of the original wetlands are gone.
- 20% of the native plants are rare and disappearing at an alarming rate.
- Three out of four grassland bird species are declining in numbers, including Burrowing Owls (*Athene cunicularia)*, Sprague's Pipits (*Anthus spragueii)*, and familiar well-known species like Western Meadowlarks (*Sturnella neglecta)* and Killdeer (*Charadrius vociferous)*.
- Sage Grouse (*Centrocercus, urophasinaus)* once found throughout the southwest corner of Saskatchewan are now confined to Grasslands National Park with as few as 50 birds now surviving.
- Many mammal, amphibian, reptile and insect species are also declining in our highly developed landscapes.

- The prairie grasslands of western Canada contain more Species-at-Risk than any other region of the country.
- The PFRA pastures contain 10 to 15% of our remaining grassland and aspen parkland natural landscape and are critical for species diversity and survival.

International Significance

The International Union for the Conservation of Nature (IUCN) reports that the temperate grasslands biome (which includes southern Saskatchewan) is the most endangered, the most altered, and yet the least protected biome on the planet.

Only 3.4% of this biome has some form of biodiversity protection. The next most threatened biome has 8.3% of its natural landscape protected.

The Heritage Range Lands Group Goal

- The province should retain ownership of all PFRA pastures.
- With input from government, producers, conservation interests, industry and others, develop a provincial management plan for all pastures, as Manitoba has done.
- Such a plan would encompass the management initiatives designed and developed by the PFRA.
- The plan would manage grass sustainably, accommodate and be fair to producers and maintain a healthy landscape for native flora and fauna.

Progress

Thus far the Saskatchewan Association of Rural Municipalities (SARM), Agriculture Producers Association of Saskatchewan (APAS), Nature Saskatchewan (NS) and the Saskatchewan Wildlife Federation (SWF) have passed resolutions calling on the province to retain ownership of the PFRA pastures (as of February 2013). The Saskatchewan ENGO community, including, Nature Saskatchewan, the Saskatchewan Wildlife Federation, and Ducks Unlimited Canada, have spoken to the Saskatchewan government regarding the disposal of the divested federal community pastures. While much progress has been made, securing conservation easements and a promise to ensure the pastures are not subdivided, there are still many concerns, particularly regarding management and retaining public ownership. In January, 2013 some 250 pasture patrons gathered in Saskatoon and formed the Community Pasture Patrons Association of Saskatchewan. The organization is working to obtain information and is looking at potential options regarding the future of the PFRA pastures.

What you can do

We need people to write a short, courteous letter to the Premier, telling why you think the PFRA pastures are important to you and the people of Saskatchewan. Ask the Premier to retain ownership of these very important lands not only for producers but all the people of Saskatchewan, and tell the Premier that you look forward to his reply. Send your letter to: Honourable Brad Wall, Premier of Saskatchewan, Legislative Building, Regina, SK S4S 0B3, or Email the Premier at: premier@gov.sk.ca. Please be sure to include your name and full address on all correspondence, and ask for a response to your letter. From all of us concerned about the loss of these heritage rangelands, thank you very much for your support.

Community Pasture Patron's Views

BRYCE BURNETT
Swift Current - Webb Community Pasture, Saskatchewan.

Abstract: The recent decision by the Government of Canada to end the federal community pasture program has created tremendous uncertainty for both community pasture patrons and the provincial government. Patrons are currently working independently to determine if there is a business model which will work for their pasture. Numbers are not available for potential land prices or lease rates. No one has any sense of how the improvements – many of which have been paid for by patrons – will be valued and handled. There is uncertainty around the impact of treaty land claims on any transaction of this crown land. A process for establishing security of tenure has not been discussed for patron groups who plan to lease their pasture. The list of risks and uncertainties is long. This uncertainty creates a risk for the farms and ranches that depend on community pastures for a significant portion of their grazing lands.

PUBLIC PASTURES—PUBLIC INTEREST

TREVOR HERRIOT
Regina, Saskatchewan. Email: trevorherrior@gmail.com

Abstract: Public Pastures—Public Interest is a citizens group that wants to see Saskatchewan's community pastures remain under the Crown. Saskatchewan's federal and provincial community pastures, totaling more than 2.5 million acres of grassland, most of it native, are ecological and cultural treasures that belong to all of us. They protect local soil and water quality, and provide ecological goods and services that reach far beyond the pasture land itself. At the same time, these pastures provide fair access and affordable grazing for local livestock producers in a balanced system of environmentally sustainable agriculture. Public Pastures-Public Interest (PPPI) supports the position taken by many producers, PFRA pasture patrons, and farm people around the province, including the Saskatchewan Association of Rural Municipalities and Agriculture Producers of Saskatchewan, which both passed strong resolutions requesting the Government of Saskatchewan retain ownership of the PFRA Pastures. However, PPPI members are concerned that if this transition for the 62 PFRA pastures in Saskatchewan is not handled well, the lands could end up in the hands of corporations or private organizations who, for a variety of reasons, are unable to continue managing them in ways that balance short-term profit with the wider, long-term interests of conservation.

THE 'WHY' OF RIPARIAN: LESSONS LEARNED IN BUILDING ECOLOGICAL KNOWLEDGE THAT MOTIVATES CHANGE

LORNE FITCH and **AMANDA HALAWELL**
Cows and Fish, Alberta Riparian Habitat Management Society, 2nd floor, 530-8th Street South, Lethbridge, Alberta T1J 2J8. Email: riparian@cowsandfish.org

Understanding the ecological function of riparian areas is the first step in realizing how they may help us and how important they really are. Riparian areas are formed by the interaction of water, soil and plants (Gregory et al. 1991). Similar to a clock with its many interconnected parts all working together to keep perfect time, a riparian area is healthiest when all of its ecological functions are working. If people are unaware of riparian areas, don't appreciate them and are unconvinced of their merits it will be a difficult challenge to have them accept responsibility for them.

The 'why' of riparian is about building a cumulative body of knowledge, including:

- how these systems function and link us,
- how watersheds work,
- the vital signs of landscape health,
- the essentials of how people need to work together,
- how solutions need to benefit us all, and
- the kinds of information that will enable us to restore or maintain natural systems and build ecologically resilient communities and economies.

What are Riparian Areas?

Riparian areas are the green zones around lakes and wetlands, the emerald threads of vegetation that border rivers and streams, and the lush fringe in valleys. Riparian areas run through our lives, just as the water that forms them, runs through our bodies. If you drink water, farm or ranch, have a lakeside cottage, fish or watch birds, riparian areas are important to you. They make up a small portion of our landscape but are much more important to us than their small size would indicate. Part of successfully fitting ourselves and our activities into a landscape is the process of learning about landscape types, how they are formed and function, and appreciating the values of these bits of the earth.

Education and Riparian Areas

Repetitive surveys demonstrate that people who are informed and educated about aspects of their environment provide greater support for programs and undertake actions to improve environmental quality (Coyle 2005, Statistics Canada 2013). Unfortunately, support is difficult to tap, because the public's ecological knowledge still appears to be too low to achieve a positive outcome. Recent surveys provide evidence of this low knowledge level. In 2011, Unilever, RBC and the Canadian Partnership in the UN Water for Life decade commissioned a survey of 2,066 Canadians about water (RBC et al. 2011):

- 77% of Canadians felt Canada has enough water for long term needs (this is up from 70% in 2009), although Canada has only 6.5% of the world's renewable, fresh water and we are the second largest waster of water on the planet;
- 60% (incorrectly) believe that the oil sands cause more water pollution than farming/agricultural practices;
- Only 17% identify the agriculture sector as the biggest user of fresh water; and
- 28% of Albertans have no idea what the original source of their tap water is.

It would seem the basic factual knowledge required to make an informed choice (or even to recognize there are choices to be made) and an ecologically sound decision are lacking. One thing that becomes immediately evident is that even on the broader basis of helping people become aware of a program, a significant time step is required. To achieve progress on practice change, where landscape health, biodiversity and sustainability goals are beginning to be achieved requires another level of effort and intent in our extension, outreach and awareness programs.

Cows and Fish

The Alberta Riparian Habitat Management Society (Cows and Fish) spends a considerable amount of time, energy and resources on awareness as a prelude to further engagement leading to management action. The approach to awareness is predicated on three elements: the message, the messaging and the messenger. Put differently, content, delivery and who delivers the message are critically important. Each is considered as a guide to how well the information will be received, absorbed and acted on. What is also clear is that success is based on two things: continuity and persistence. To build a requisite body of knowledge in an audience takes multiple presentations and information items, conveyed in different ways and delivered over time.

Picture a simple grazing management shift, a livestock producer decides to install a solar-powered watering system, both to move cattle off an eroding stream bank and to get better grazing distribution. Can we determine how much we invested in awareness to motivate this producer to make such a change?

Many of the agricultural producers we work with are part of a community-based watershed group. Our experience has shown it takes between three to five years from initial contact, and working through the capacity building steps of awareness, before most people make their first management change (Bateman 2004). In that time period an individual would have participated in a long list of community watershed activities with Cows and Fish. Those activities include presentations on riparian ecology, grazing management, riparian health field days, plant identification workshops and tours of riparian demonstration sites to learn what's working for others.

Cows and Fish interacts with about 5,000 people annually, of which roughly 1,200 are agricultural producers (Alberta Riparian Habitat Management Society 2011). For the 720 producers (that's the 60% that make a change), Cows and Fish spends about $300 on each interaction with each individual to realize a practice change. So, by the time the off-stream watering system I started to describe is up and operating, we might have up to $1,000 invested in getting that individual to that point. We are unaware of anyone else who has determined the costs of delivering stewardship so it is unclear to us if our costs are high or about right. What we do know is the endpoint is an engaged individual who makes a management change with the full understanding of why change is necessary.

The approach is designed to help people grasp ecological functions, which are the processes that inevitably contribute to fish, forage, wildlife, recreation, and ecosystem resilience. We believe the functions are more important concepts for people to grasp initially than the products, services and benefits of riparian systems. Talking about the products first generally leads to arguments over whose product is more important rather than an intelligent discourse on how those products are achieved and whether multiple products are possible.

Cows and Fish promotes the use of a pathway to help guide communities towards a more sustainable future, using stewardship as a motivator**.** Stewardship has three indivisible elements: awareness, ethics and action. The first element of the pathway is awareness, creating a cumulative body of knowledge in individuals and in the community as the foundation for management change. Awareness lays down the foundation of 'why'. In a limited number of cases, communities have not engaged in awareness programming as a prelude to management change and little change has occurred. Often the lessons we learn come from failure, rather than success. Nature is a hard teacher; the test is given first, followed by the lesson.

By themselves things seldom get better; only proactive participation and action produces positive results. Once a system has deteriorated beyond a certain point, where all the necessary pieces for restoration are missing, ecosystem function is extremely difficult to restore. There is a need to create a sense of urgency; to encourage people to start something before it is too late to do anything without high costs and a dubious outcome.

Messages (and how they are delivered) should pare away at the complexity, present risk and uncertainty clearly, deal with anger through reason and allow the development of a thinking pathway that shows clear consequences (both positive and negative) of choices and actions. A case for the message needs to be built by returning people to the basics, to ecological principles and processes. The terms have to be meaningful to people and show what is in the realm of the possible for them. Often overlooked, but intuitively clear, the message has to be based on an understanding of the audience, their knowledge level and how they might react.

What should the messages contain and how should they be conveyed to better address the 'why' of riparian?

1. Environmental literacy:
    a. assisting land/water users to understand ecological function and landscape processes as a foundation for better decision-making;
    b. build capacity and a cumulative body of ecological knowledge in individuals and communities as an enabling mechanism for stewardship decisions;
    c. develop a common language to move from disputes over landscape health to agreement about what needs to be done.
2. Community-based action:
    a. empowering those that can have the most influence on a piece of the landscape (and the attendant landscape products) to make land use decisions that maintain or restore functions, processes and products;
    b. use the effectiveness of peer pressure and group dynamics to effect change in a non-regulatory way.
3. Environmental/Economic mix:
    a. link sustainable environmental actions with pragmatic economic ones to create enlightened self-interest;
    b. instead of paying for conservation, instill it as part of a business operation, because it makes economic sense to do so (e.g., water, forage, shelter are necessary to sustain a livestock

operation and link that to biodiversity, water quality/quantity and ecological health as a package of sustainable land uses); c) demonstrate change without initial individual risk, make change less threatening through demonstration sites and the strategic injection of resources and expertise, provide guidelines, goal posts and the 'principles' of management change, provide choice and alternatives and let decisions be made in the context of understanding and choice.

4. Create allies through shared concerns:
    a. change the philosophy of confrontation from 'what you must do' to teams, partnerships and communities with greater interdisciplinary, interjurisdictional aspects of 'what can we do together?';
    b. Find shared vision where issues can be dealt with through a critical mass of concern, rather than individual, fragmented ones. Projects that Cows and Fish are involved in follow the 80/20 rule that Dave Naugle, University of Montana, prescribes: focus on the 80% in shared values versus the 20% that divides partners.
5. Deliver messages via an arm's length arrangement from agencies to increase levels of trust and credibility. This aids in positive engagement, the uptake of messages and the rate at which voluntary practice change occurs.
6. Landscape/Watershed scale of attention:
    a. move from management of 'islands' and band aid 'fixes' to larger ecological landscapes and solutions;
    b. move across artificial boundaries to allow engagement of people at ecologically meaningful scales like watersheds (e.g., urban and rural interests).
7. Measuring sticks of progress and performance:
    a. measurements of landscape health provide a benchmark against which future management changes can be assessed;
    b. current landscape status can motivate change if combined with management options to provide a positive trajectory;
    c. measurement of awareness uptake and attitudinal change provide indications of program effectiveness.
8. Use an extensive array of tested extension materials to convey information and add value to personal interaction.
9. Create an informed public that has a higher degree of ecological literacy and is a supportive constituency for positive land and water use decisions.
10. Choice about our future:
    a. make riparian/landscape health a 'movement' with a modest investment of time and resources now, leading to an entrenchment of this philosophy as a given in the future;
    b. provide people with a perspective on the choices to be made and the future outcomes given the choices made now (e.g., healthy or degraded landscapes).

Science cannot give us all the answers. At best it can provide an answer to the consequences of our decisions. Good science is necessary but may not suffice when decision-makers and the greater constituency have a low level of ecological knowledge. This is particularly true if the science flies in the face of our strongly held values.

It may be that the path to higher knowledge levels begins by instilling curiosity, interest and respect for the natural world. Those qualities have always been important and perhaps now are more crucial than ever to create a solid footing upon which science and conservation management can find some traction. Without some traction in the minds of the skeptics and non-believers we will remain trapped in a spiral of research, devising better and better ways of measuring and monitoring but effecting little change.

Until we collectively ‘see’ riparian areas for the biologically rich, dynamic systems they are that coincidentally perform many vital ecological functions for us we will remain trapped in a spiral of loss and contention. We think the world was given us with no strings attached. Aldo Leopold observed that “Nothing so important as an ethic is ever written. It evolves in the minds of a thinking community.” Knowledge isn’t achieved until it is shared. Knowledge isn’t effective until it is understood.

We are pretty good and getting better on the ‘what’ and ‘how’ questions of better management techniques, reclamation and restoration. The path to those vital steps is and has to be, inevitably through ‘why’. Unless you can engage the minds, the beliefs and the will of others to support your work then even after you have done all that you can do, your work will not live after you. It may not even outlive you. Build the ‘why’ of riparian first; the rest will be dramatically easier. The results will be a legacy of healthy riparian areas in a watershed where people know and care about them.

Literature Cited

Alberta Riparian Habitat Management Society. 2011. 2010-2011 Program Highlights. Lethbridge, Alberta. www.cowsandfish.org/about/documents/ CowsandFish2010-11fnlrprt1pghighlights.pdf

Bateman, Nancy G. 2004. Cows and Fish Staff Interaction Evaluation Report prepared for Cows and Fish, Report No. 025. Lethbridge, Alberta: NGB Evaluation Solutions Inc. 172 pages.

Coyle, K. 2005. Environmental Literacy in America: What ten years of NEETF/Roper research and related studies say about environmental literacy in U.S. The National Environmental and Education Training Foundation. Washington, D.C.

Gregory, S.V., F.J. Swanson, W.A. McKee and K.W. Cummins. 1991. An ecosystem perspective of riparian zones. *Bioscience* 42: 540-551.

RBC, Unilever and the UN Water for Life Decade. 2011. 2011 Canadian Water Attitudes Study. RBC and Unilever Canada. 45 pages.

Statistics Canada. 2013. Households and the environment 2011. Catalogue no. 11-526-X. Ottawa, Canada.

MULTISAR: A LOOK BACK ON 10 YEARS OF COLLABORATION.

BRAD A. DOWNEY[1] and BRANDY L. DOWNEY[2]

[1] Alberta Conservation Association, #400, 817-4th Ave South, Lethbridge, Alberta T1J 0P6.

[2] Alberta Environment and Sustainable Resource Development, 200-5th Ave South, Lethbridge, Alberta T1J 4L1.

Extended Abstract

The Grassland Natural Region (GNR) boasts an incredible array of plant and wildlife diversity. In an area that makes up only 14.6% of Alberta's total land surface, about 60% of the 274 species of birds, fish and mammals, 37% of the 452 species of invertebrates, and 52% of the 1163 vascular plants recorded by the Alberta Biodiversity Monitoring Institute in the province are found, for a total of 925 species (ABMI 2013). Yet this is one of the most impacted regions in the province, with a human footprint covering 61% of the area. Much of the region has been converted to farmland, industrial land, urban and suburban areas, and to transportation corridors. What remains sustains more than 75% of Alberta's Species-at-Risk, and is facing an increasing amount of human development pressure, and supports complex land uses. Attempting to maintain or return multiple prairie wild species to sustainable population levels over such a large region and under these circumstances presents a formidable challenge to fish, wildlife, and rangeland managers.

The concept of multi-species conservation and stewardship at the landscape level was introduced ten years ago in the Alberta Grassland Natural Region and evolved into a project recognized by landowners, Fish and Wildlife staff, land managers, and conservation groups. *MULTISAR*, as it became known, is a multidisciplinary collaborative project involving three organizations; the Alberta Conservation Association, Alberta Environment and Sustainable Resource Development, and the Prairie Conservation Forum. It was initially focused in the Milk River basin landscape where an important density of Species-at-Risk and the availability of large tracts of relatively intact natural grasslands remain, but was later expanded into the adjacent St. Mary River and Pakowki Lake Basins to include some important Species-at-Risk habitats. An extension component of the project was developed in 2007, which widened its application into the entire GNR and the adjacent Foothills Parkland and Montane Natural Subregions.

MULTISAR is a partnership between agencies (Alberta Conservation Authority, Alberta Environment and Sustainable Resource Development, and Prairie Conservation Forum), resource managers (wildlife and range), and ranchers. Together as a team including wildlife biologists, range agrologists, and landholders, they developed Habitat Conservation Strategies that identify how to manage for healthy rangelands, conserve and maintain habitat for a variety of Species-at-Risk, and contribute to a sustainable ranching operation. The strategies are developed based on the wildlife that occurs on the ranch, the range health of the ranch, and the needs of the individual ranchers operation. Beneficial Management Practices, developed by MULTISAR, are used to support the recommendations in each Habitat Conservation Strategy. The first Habitat Conservation Strategy was initiated in 2004 on a 60,000 acre ranch in the Milk River Basin. Today MULTISAR collaborates with over 25 land holders on 269,712 acres of habitat for the implementation of its core program. The development of a Habitat Conservation Strategy is only the first step in the MULTISAR process. Upon completion of a Habitat Conservation Strategy, the team works to implement the strategy based on activity priority and budget. Habitat improvement projects have ranged from simple changes in grazing systems to the development of new watering

sites, changes in fence lines, and native grassland restoration. Since 2005, MULTISAR has completed 61 habitat improvements as described in 25 separate Habitat Conservation Strategies.

Early on, MULTISAR recognized that conservation groups continue to face the challenge of demonstrating to stakeholders that projects are accomplishing their objectives and goals. Without effective evaluations or monitoring there is no systematic way of measuring the effects of the project. In 2010 MULTISAR implemented its evaluation and monitoring program. The Evaluation program allows the MULTISAR team to revisit each Habitat Conservation Strategy once every five years to determine if the strategy is having the desired effects. Adaptive management is applied to the strategy if changes are necessary.

To support the evaluation program, a monitoring program of all existing habitat improvement sites was also established in 2010. The monitoring program allows MULTISAR to reassess each habitat improvement on an annual or biannual schedule to determine the impact of the improvement. Range health and wildlife biodiversity are systematically measured at each site. The monitoring program supports the MULTISAR evaluation program as well as the review of MULTISAR tools, including the Beneficial Management Practices.

In 2007 as a result of expanding interest in the MULTISAR program, the Species-at-Risk Conservation Plan (SARC) Program was initiated. SARCs are based on the Habitat Conservation Strategy Program but instead of the detailed wildlife and range baseline surveys being completed on each ranch, a quick habitat assessment is completed. Landholders are then given a short summary of Beneficial Management Practices that could be implemented on their ranch. To date, SARCs have been completed for 89 landholders on 163,249 acres.

Conclusion

The MULTISAR process is built upon partnerships and long-lasting relationships with the people on the land. Whether they are ranchers, conservationists or resource managers, each person on the MULTISAR team bring a unique perspective to the program, resulting in a holistic management approach. Over the last ten years, MULTISAR has developed a process to bring people together to change how grasslands and Species-at-Risk are managed at a landscape level.

MULTISAR is a collaborative effort of three agencies, ranchers, and many other participants. It is succeeding because of the cooperative teamwork of all partners. This demonstrates a special open-minded attitude that goes beyond commitment and pride in any one organization, and is indicative of a desire in our society for multi-species and landscape level conservation. In the future MULTISAR will continue to build on its existing relationships and build new ones in the Grassland Natural Region to develop partnerships with a focus on the implementation of recovery actions, management of healthy diverse rangelands, and strong ranching communities.

Evaluation of Conservation Efforts - Converting Good Intentions into Effective Programs.

KERRI O'SHAUGHNESSY [1], NORINE AMBROSE[2], LORNE FITCH[2]

[1] The Alberta Riparian Habitat Management Society (Cows and Fish), #306 J.G. O'Donoghue Building 7000-113 Street Edmonton, Alberta T6H 5T6. Website: www.cowsandfish.org; Email: koshaugh@cowsandfish.org

[2] The Alberta Riparian Habitat Management Society (Cows and Fish), 2nd Floor, YPM Place, 530 - 8th Street South, Lethbridge, Alberta T1J 2J8. Emails: nambrose@cowsandfish.org; lfitch@cowsandfish.org

Abstract: How can we improve current conservation programs and efforts to improve wildlife (including Species-at-Risk), land, and water management, in a way that will lead to healthier ecosystems? There are many programs and organisations working to improve these areas. Yet, despite these efforts, we continue to see new land use issues, loss of biotic populations and habitats, and decline in ecosystem health. This paper will highlight experiences related to Cows and Fish program delivery in riparian extension, monitoring and management, as well as more broad research on addressing the knowledge needs of our audiences, conservation perspectives and actions related to biodiversity and habitat. Recognising that resources to work on conservation issues are limiting, we will discuss efforts that can increase effectiveness of conservation programs and contribute to long lasting ecosystem health, benefitting ecosystems and species. A critical element to success is recognition of the value of local commitment and community involvement in conservation programming. These efforts require a suitable framework, longevity, consistency, and diversity of content and approach to reach audiences. Increasing the knowledge of our audiences' results in action, leading toward long-term impact and change in our landscapes.

Introduction

Rarely do conservation organizations or programs have the funding, capacity, interest or longevity to evaluate their effectiveness unless it is a cornerstone of their way of doing business. The Alberta Riparian Habitat Management Society, commonly known as Cows and Fish, committed to incorporating evaluation into our program approach at inception about 20 years ago, to ensure program development and delivery included lessons learned by our own program work, and that of others.

Cows and Fish works by invitation with watershed stewardship groups, landowners, and other agencies and organizations in both urban and rural Alberta. Our goal is to increase the understanding of the value and importance of riparian areas (the green zones of water-loving vegetation next to a water-body), and to provide practical management options and alternatives to maintain or improve the health and function of these sensitive lands.

Reflections from Cows and Fish Process

Conservation efforts and programs designed to address the challenges facing our natural landscapes and species require changing peoples' behaviours and attitudes, which can be a complicated and potentially overwhelming task. Using a framework called the Cows and Fish Process has provided the structure and thoughtful approach to developing riparian awareness programming and promoting management change. The

Cows and Fish Process is comprised of five elements that can be applied broadly to conservation and natural resource issues, beyond just riparian specific work (Figure 1). This paper focuses on results from the monitoring and evaluating of our program delivery, including application of the Process in achieving outcomes of increased awareness and management changes on the ground.

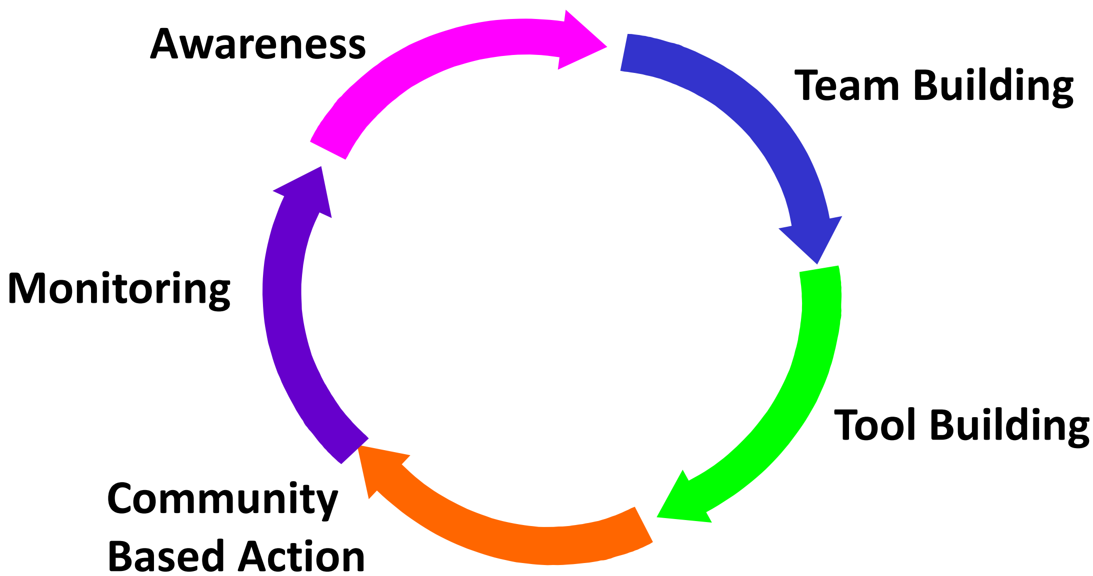


Figure 1. Cows and Fish Process.

Awareness is the critical foundation element in the Cows and Fish process and begins with building capacity by providing information in a variety of formats (eg. written, visual, hands-on, in-person) that are engaging and inspirational to encourage people to think more about how the landscape functions and motivate management change. Team building links landowners, community residents, and natural resource managers together to form local partnerships and address local issues.

Tool building is about developing useful scientific information and sharing innovative, practical techniques and alternatives for managing landscapes. Community-based action is about working at the local level through all elements of the process. Landowners and the community provide the direction and act as primary decision-makers on identifying the issues and how and when they tackle those issues. This recognizes that community members are in the best position to make management changes and benefits from those changes.

Monitoring answers the questions, *where are we at*, *where do we want to go*, and *did we make it*? Monitoring establishes a baseline of ecological function, compares effectiveness of activities or tools, and evaluates impact on recipients. Incorporation of evaluation results into program delivery helps set goals, measure success and failures, and identifies lessons that can be shared as we progress towards our goals of healthier landscapes and communities.

Lessons Learned from Evaluation

Cows and Fish does extensive ecological monitoring of riparian areas with communities and agencies using riparian health assessment and inventories. We also incorporate social science evaluation to monitor knowledge and behavioural change throughout our own program. This includes formal, independent evaluations of tools, messages, and programs, as well as informal feedback and input before we develop a new awareness document. Like ecological monitoring, program evaluations benefit from establishing benchmarks, good planning, and sometimes, having considerable periods of time to measure change.

Our riparian health work shows there are a lot of riparian areas that are in need of improvement, with 75% of riparian sites rated less than *healthy* (properly functioning) (Figure 2). This health rating indicates there is considerable impairment to ecological functions (Ambrose *et al.* 2009, Cows and Fish 2013, Fitch *et al.* 2009), emphasizing the need for improved riparian awareness and management. Our experience shows that landscape health improvements are being made voluntarily by communities, but these changes take time (Bateman 2001) and are best achieved with a process in place (Bateman 2004).

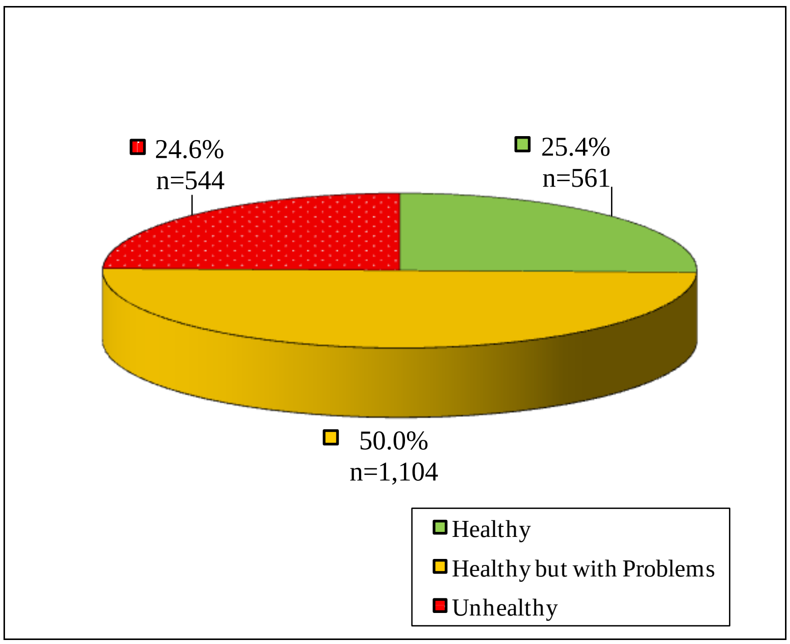


Figure 2. Provincial Riparian Health Results (n = 2,209*)**includes most recent data for sites assessed by Cows and Fish between 1997 and 2012.*

Recognizing that resources to work on conservation issues are limiting, we should design our programs to ensure the most effective, long-lasting impact, including who we work with and how we engage them. Numerous American researchers have indicated that a critical element to successful conservation programming is recognition of the value of local commitment and community involvement (USDA 2006, Shindler et al. 1999, Van Riper 2003).

Like the American research, evaluation of our program shows that community involvement is more successful because it leads to greater learning and more practice change (Figures 3 and 4) (Bateman 2001, Bateman 2004). People who participate as part of local community stewardship groups have the opportunity to learn from each other, to develop networks, to be influenced by social norms and peer pressure, and to have a diversity of opportunities to learn. Since people who feel they are part of a community group learn more, have better awareness, and are more likely to implement practice change, this suggests that program delivery should emphasize a strong community-based approach.

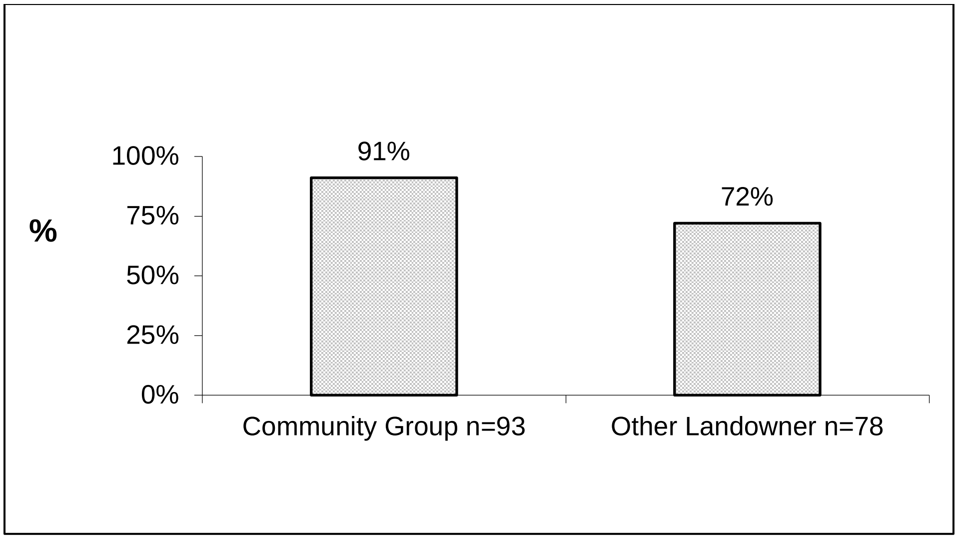


Figure 3. Awareness Raised by Role: members of community groups compared to other landowners who increased awareness or learned new information (modified from Bateman 2004).

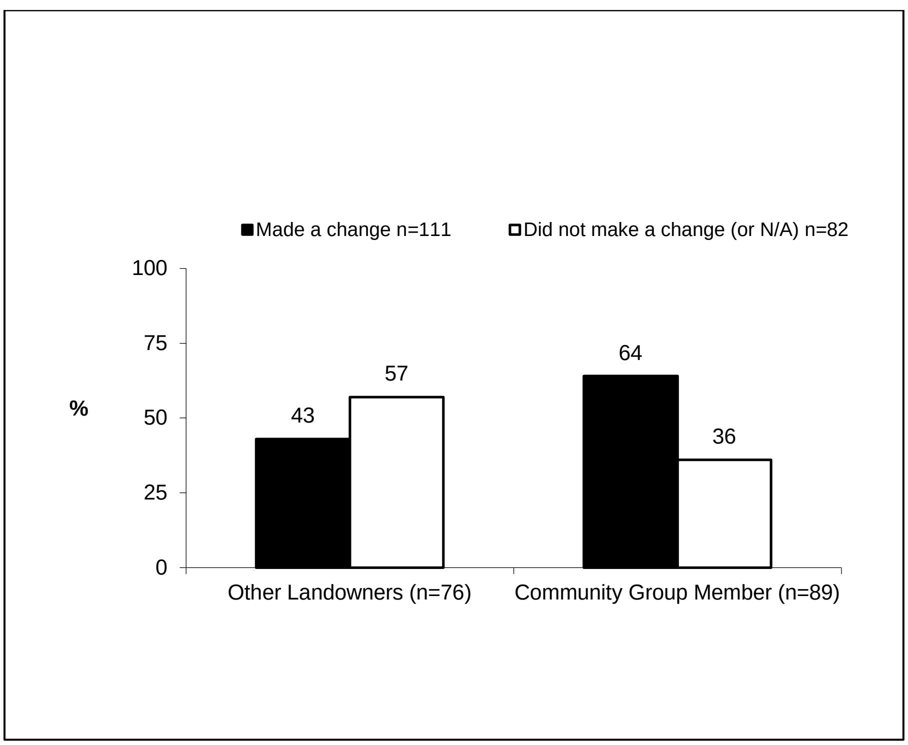


Figure 4. Practice Change by Role: members of community groups compared to other landowners (modified from Bateman 2004).

When asked what staff characteristics promote people to make a change, being seen as knowledgeable and understanding of practicalities facing landowners were emphasized as key factors (Bateman 2004). Being a strong motivator by being enthusiastic, credible and trustworthy are also important to motivate change (Bateman 2004). Van Riper (2003) found that the greatest impediment to cooperative riparian restoration efforts in the western United States was a lack of communication and trust. Our program delivery focus of having a diversity of tools and a community approach to awareness and skill building is a primary means to developing relationships with the community. Relationships take time to develop through repeated interactions. As a result, program delivery approaches should incorporate these factors if we are to develop trusted and credible relationships with the individuals and communities we work with.

In our staff interaction evaluation, people who felt they had frequent or in-depth contact with Cows and Fish staff were more than twice as likely to make a practice change than those landowners who had very little contact (Figure 5) (Bateman 2004). Greater contact provides the opportunity for multiple interactions at awareness and riparian management activities, a diversity of learning styles and messages to be transmitted, and greater networking with other landowners and community members. This shows the importance of building stewardship (through awareness, ethic, and action) and working repeatedly, to provide diverse content, follow up and support.

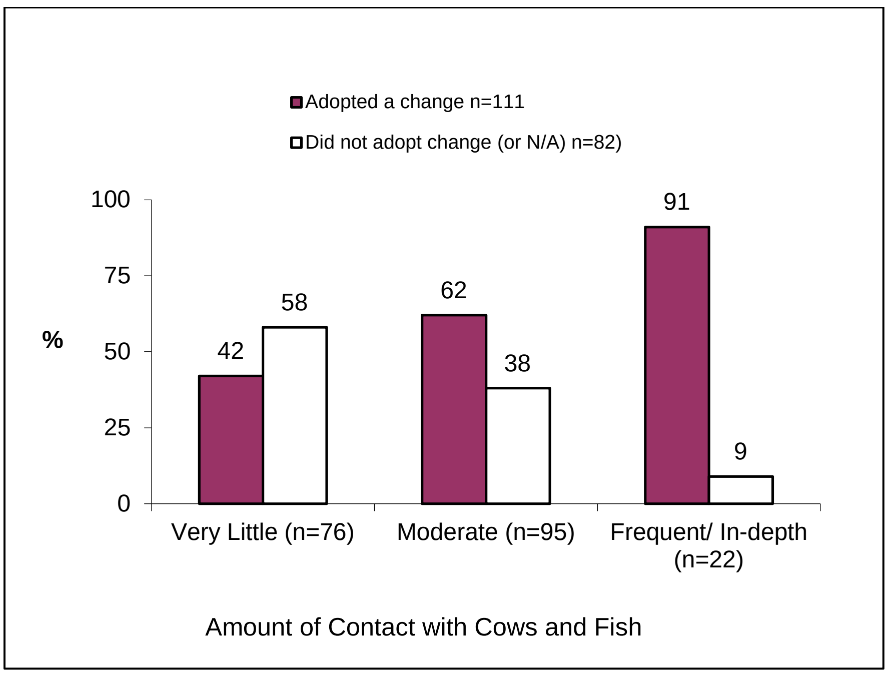


Figure 5. Practice Change by Amount of Contact with Cows and Fish Staff (modified from Bateman 2004).

A wide array of mechanisms can be successful in motivating change, and many of these can be non-financial, as shown by Bateman (2004), where 95% of responses were related to non-financial motivators and assistance (Figure 6). One American study of conservation efforts in croplands supports the need for a variety of mechanisms to influence change. It found that a voluntary incentives-based approach and suites of practices are required simultaneously to address the diversity of conservation issues and needs (USDA 2011).

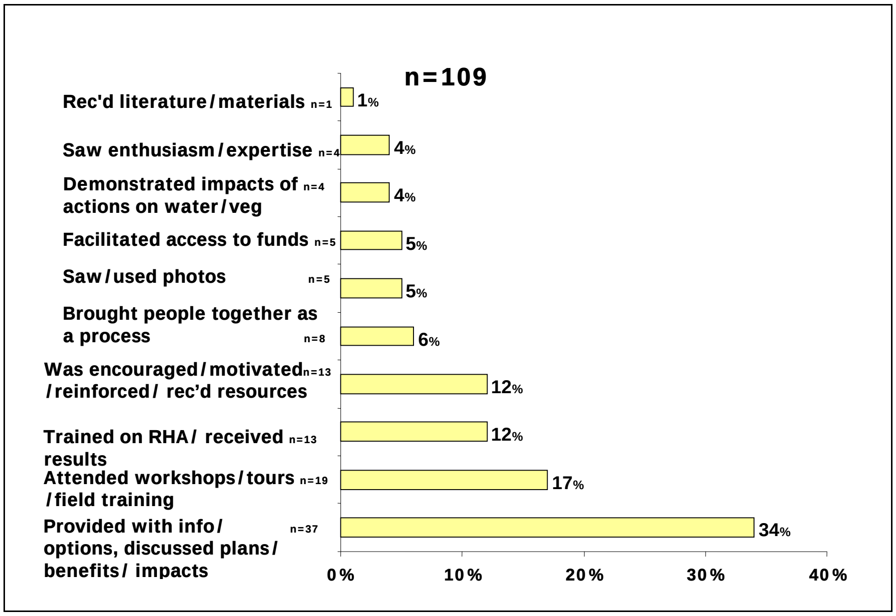


Figure 6. How Cows and Fish Staff Contributed to Practice Change (modified from Bateman 2004).

Program delivery and design should not only look at structure and approach or format; we also need to carefully examine the content we provide to reach the outcomes we desire. This requires understanding the knowledge and perspectives of our intended audiences, which can be achieved through long-standing interactions with them or by formal research. One example of using formal research for this purpose is a survey we developed on fish and fish habitat. Based on a survey of 230 Albertans, virtually no one felt they personally had any significant impact on fish or fish habitat (Palliser Environmental Services 2008). We also learned there was a surprising lack of knowledge about fish and fish habitat, since 60% of respondents either thought sediment was good for fish, or did not know that it has a negative impact on fish. The results of this survey led us to develop a new presentation on fish ecology and natural history to address gaps in knowledge and help people connect their actions to fish and fish habitat. We also incorporate these findings when we speak to other education and natural resource organizations, to help them in their program delivery.

Conclusions and Recommendations

Since the beginning of our work, Cows and Fish has emphasized that we must give landowners and communities ownership of the issues and let them lead the decision making, including identifying the issues, the solutions and the timelines. Shindler et al. (1999) found that openness and genuine inclusion of the public in decisions led to greater success. Similarly, our evaluations support this approach, with those participating as part of community stewardship groups learning more information and more likely to make changes. Establishing a more knowledgeable and engaged community of individuals will create greater longevity and commitment to healthier landscapes because, although individual members of the community may move on, the community still remains. Working with individuals is still valuable, and is often the final component of helping make a change on the ground.

Diverse formats and content are needed because not everyone learns the same way, or has the same needs and we know that those with increased interactions are more likely to make a change. As such, structuring and planning for multiple and diverse interactions in program delivery is necessary.

Understanding your audience's knowledge of the issues is critical to delivering content that is meaningful, addresses misconceptions and offers useful management options and alternatives, while at the same time increases stewardship ethic and motivates change. Identifying such knowledge and perspectives should be a first and ongoing step.

For successful engagement and interaction with people, program delivery staff characteristics are important when it comes to influencing and motivating practice change. Being knowledgeable, trustworthy and seen to understand the practicalities of the landowners situation were the most important characteristics in our evaluation. These characteristics come from having people with the right education and experiences, by fostering these characteristics in our staff and by how we deliver our programs. Building relationships with your audiences relies upon developing a good reputation, trust and credibility – these should not be seen as just establishing good public relations, but rather as means to effectively deliver conservation programs.

Evaluation measures the effectiveness of extension and awareness efforts and practice change, offering us information on ecological as well as social change. It provides insight into what makes landscapes better and how to improve our assistance to landowners, producers and their communities. Monitoring and program evaluation should be seen as integral and ongoing within program delivery and design to help set goals, measure success and failure, allowing us to incorporate what we learn, make improvements and more effectively reach goals of healthier landscapes and greater stewardship efforts.

Literature Cited

Ambrose, N., G. Ehlert, K. Spicer-Rawe. 2009. Riparian Health Assessment for Lakes, Sloughs and Wetlands - Field Workbook. Second Edition. Modified from Fitch, L., B.W. Adams and G. Hale, 2001. Riparian Health Assessment for Streams and Small Rivers - Field Workbook. Cows and Fish Program, Lethbridge, Alberta. 96 page.

Bateman, N.G. 2001. Evaluation Report of the Cows and Fish Community Riparian Health Assessment Process. Prepared for Cows and Fish - Alberta Riparian Habitat Management Program, Lethbridge, Alberta. Cows and Fish Report No. 014. 72 pages.

Bateman, N.G. 2004. Cows and Fish Staff Interaction Evaluation Report prepared for Cows and Fish, Report No. 025. Lethbridge, Alberta: NGB Evaluation Solutions Inc. 172 pages.

Cows and Fish (Alberta Riparian Habitat Management Society). 2013. Alberta Lotic and Lentic Wetland Inventory Form User Manual and Lotic Wetland Inventory Form (Current as of 5/24/2013). Lethbridge, Alberta. http://cowsandfish.org/riparian/health.html. Accessed October 1, 2013.

Fitch, L., B.W. Adams and G. Hale. 2009. Riparian Health Assessment for Streams and Small Rivers - Field Workbook. Second Edition. Cows and Fish Program, Lethbridge, Alberta. 90 pages.

Palliser Environmental Services Ltd. 2008. The Magic and Mystery of Fish Survey: A Survey of Albertans. Prepared for: Alberta Riparian Habitat Management Society - Cows and Fish and Trout Unlimited Canada. Cows and Fish Report No. 037. 38 pages.

Shindler, B., K. Aldred-Cheek, and G. H. Stankey. 1999. Monitoring and Evaluating Citizen-Agency Interactions: A Framework Developed for Adaptive Management. USDA Forest Service Pacific Northwest Research Station. General Technical Report PNW-GTR-452.

United States Department of Agriculture. 2011. Key Findings from the CEAP-Cropland Assessment of the Effects of Conservation Practices on Cultivated Cropland in the Chesapeake Bay Region. 1 page. USDA Natural Resources Conservation Service website www.nrcs.usda.gov. Accessed February 15, 2013.

United States Department of Agriculture Forest Service. 2006. People Power: the Social Side of Watershed Restoration. *Wildland Waters* FS-848. 24 pages. USDA Forest Service website: http://www.fs.fed.us/wildlandwaters/. Accessed February 15, 2013.

Van Riper, L. 2003. Can agency-led initiatives conform to collaborative principles? Evaluating and reshaping an interagency program through participatory research. Ph.D. dissertation, University of Montana, Missoula, Montana. 321 pages.

TANKS AND COWS: A SUMMARY OF THE MULTI-YEAR RANGE RESOURCE INVENTORY OF CAMP WAINWRIGHT

ANGELA BURKINSHAW
Environment and Sustainable Resource Development, 10 Floor, 9915-108 St, Edmonton, Alberta T5K 2G8.

Abstract: Within the Department of National Defense – Camp Wainwright, four grazing associations graze 28,300 AUMs (animal-unit-months) on approximately 148,590 acres and Alberta Environment and Sustainable Resource Development is responsible for the range management. A range resource inventory consisting of detailed vegetation inventory, range health assessment, invasive species and rare plant survey, took place over a 6-year time period. The site is unique since such a large portion of native rangeland receives periodic landscape-scale burning and provides us with a glimpse of what the area may have looked like prior to European settlement. The goal of the inventory was to inform on how current management is impacting ecological status and integrity and provide recommendations to guide future management considerations. A soil landscape polygon map was developed to base the range inventory on. A summary of the findings and highlights from this work will be provided in this presentation.

Rare Plant Rescue: Conserving Rare Plants through Landowner Stewardship

S. L. VINGE-MAZER
Nature Saskatchewan, 206 – 1860 Lorne Street, Regina, Saskatchewan S4P 2L7.

Abstract: The Rare Plant Rescue program engages landowners in voluntary stewardship actions to conserve 16 rare, ambassador plant species and their prairie habitat in southern Saskatchewan. The program covers 100% of the provincial range of seven plant Species-at-Risk that are federally listed as Endangered, Threatened, or Special Concern. While the program focuses on a small number of species, ultimately an array of other species benefits from Rare Plant Rescue's conservation activities, for which the ultimate goal is prairie habitat conservation. The success of the Rare Plant Rescue program is attributed to the creation of lasting, respectful relationships with landowner participants through outreach and education initiatives. Outreach activities are extremely important in southern Saskatchewan where the majority of remaining native prairie is either privately owned or managed. Landowner participants in the Rare Plant Rescue program commit to conservation by signing voluntary, non-binding agreements. Voluntary agreements are an effective, non-threatening way to engage landowners in Species-at-Risk conservation, but also serve as a step towards legally-binding agreements such as conservation easements. The program, created in 2002, currently has 72 landowner participants who are conserving over 70,439 acres (28,527 hectares) of native prairie. The program also contributes to the repository of knowledge about target species through standardized searches conducted for new rare plant occurrences, and monitoring of known rare plant populations. Contact Information for the Rare Plant Rescue Program: Kristen Martin, Rare Plant Rescue Coordinator, Nature Saskatchewan, 206 – 1860 Lorne Street, Regina, Saskatchewan, Phone: 306-780-9417, Email: rpr@naturesask.ca.

OPERATION BURROWING OWL, SHRUBS FOR SHRIKES, AND PLOVERS ON SHORE: HABITAT CONSERVATION THROUGH LANDOWNER STEWARDSHIP IN SASKATCHEWAN

R. MAGNUS and **L. WEEKES**
Nature Saskatchewan, Room 206, 1380 Lorne St., Regina, Saskatchewan S4P 2L7.
Email: info@naturesask.ca

Abstract: Nature Saskatchewan's Bird Species-at-Risk programs engage landowners in voluntary stewardship actions to conserve ambassador bird Species-at-Risk and their prairie habitats in southern Saskatchewan. Launched in 1987, Operation Burrowing Owl (OBO) is a nationally-recognized and awarded stewardship program that conserves grassland habitat, and raises awareness about the Burrowing Owl (*Athene cunicularia*) as well as other prairie species and their habitats. OBO was initiated following a 1986 Burrowing Owl habitat survey on the Regina Plain that found the Burrowing Owl population to be very low, and the owl's habitat to be rapidly vanishing. Modeled after OBO, Shrubs for Shrikes (SFS) was launched in 2003. SFS strives to conserve disappearing prairie and shrub habitat for the Threatened Prairie Loggerhead Shrike (*Lanius ludovicianus excubitorides*). Plovers on Shore (POS) was launched in 2008 after the Government of Canada designated critical habitat for the Endangered Piping Plover (*Charadrius melodus circumcinctus*). POS targets both landowners with nesting Piping Plovers and critical habitat. Participating landowners, through voluntary stewardship agreements, commit to maintain Burrowing Owl, Loggerhead Shrike, and Piping Plover nesting habitat by not cultivating their land, destroying shrubs, shelterbelts, or shorelines. Participants report annually the number of owls, shrikes, and/or plovers on their land, and any habitat changes. In 2012, 406 OBO participants were conserving over 160,000 acres of grassland habitat, 118 SFS participants were conserving over 18,000 acres of grassland habitat, and 35 POS participants were conserving over 57 miles of shoreline habitat on private and public land, across southern Saskatchewan.

OPERATION GRASSLAND COMMUNITY - PROGRAM EVALUATION AND STAKEHOLDER COLLABORATION TOWARD SUSTAINABLE LAND MANAGEMENT SOLUTIONS FOR SPECIES-AT-RISK IN SOUTHERN ALBERTA

K.J. GRISLEY, D. WATSON, R. MACKAY, and **M.E. ERICKSON**
Operation Grassland Community, Alberta Fish and Game Association, c/o Alberta Fish and Game Association, 6914-104 St., Edmonton, Alberta T6H 2L7.

Abstract: For more than 20 years, Operation Grassland Community (OGC) has worked hard to build relationships of trust and mutual respect with its landholder membership (> 300 ranchers and farmers), and has committed time, effort, and finances toward on-the-ground habitat protection and enhancement activities. With a shared commitment to habitat and wildlife preservation, OGC continues to partner with our membership toward sustainable land use solutions. The question is: Just how effective have these protection and enhancement activities been for prairie wildlife? In 2012-2013 Operation Grassland Community is 'taking stock' – evaluating our past programming, and assessing how well it is working toward achieving our long-term vision of balancing ecology with economy. Where are we now, and where can we most intelligently go from here? To assess our past activities we are re-visiting 50-60 sites where we have, in partnership with our ranching membership, implemented habitat protection and enhancement activities over the past ten years. We are conducting socio-economic and ecological evaluation through one-on-one landholder visits, expert consultations, and on-the-ground habitat assessments, habitat modeling, and mapping queries. Results from these broad surveys will be complemented with the implementation of four formalized multi-stakeholder collaborative workshops. This community-centred, professionally facilitated collaborative effort will provide Operation Grassland Community with clear directives on where our future programming will most effectively meet both the needs of land managers and land-users (who are responsible for nearly 95% of this multi-valued landscape), and the needs of wildlife that depend upon these prairie habitats.

ENGAGING PRAIRIE COMMUNITIES IN CONSERVATION VIA THE IMPORTANT BIRD AREAS PROGRAM

C. ARTUSO[1], M. MICO[2], **P. ROWELL[3]** and **D. TROWSDALE-MUTAFOV**[4]
[1] Bird Studies Canada, P.O. Box 160, 115 Front St., Port Rowan, Ontario N0E 1M0.
Email: generalinfo@bsc-eoc.org
[2] Nature Manitoba, 401 - 63 Albert Street, Winnipeg, Manitoba R3B 1G4.
[3] Nature Alberta, 3rd Floor, Percy Page Centre, 11759 Groat Road, Edmonton, Alberta T5M 3K6.
Email: info@naturealberta.ca
[4] Nature Saskatchewan, Room 206, 1380 Lorne St., Regina, Saskatchewan S4P 2L7.
Email: info@naturesask.ca

Abstract: Initiated in the 1980s by BirdLife International, the Important Bird Areas (IBA) program exists today as 11,000 sites in 170 countries around the world. The goal of the IBA Program is to identify, monitor and conserve a network of sites that provide essential habitat for significant bird populations. Canada adopted the IBA program in 1994. Today it is coordinated nationally through a partnership with Nature Canada and Bird Studies Canada. With almost 600 sites across the country, the program is delivered regionally by the provinces and territories. Across the Prairie Provinces, Alberta has 48 IBA sites, Saskatchewan has 53 sites and Manitoba has 38 sites. Many of these sites are recognized as globally or internationally significant because they provide habitat for large congregations of migrating and staging waterfowl and shorebirds. A number of sites also provide habitat for Species-at-Risk. In the past, program focus was on site identification and the development of site conservation plans. In more recent years, attention has shifted to soliciting site caretakers, building a caretaker network and designing an appropriate IBA site monitoring program. Like any landscape, IBAs face a number of challenges. Having strong local champions is the best insurance these sites have of competing in a very busy and changing prairie landscape.

SESSION 23: GRAZING STEWARDSHIP AND WILDLIFE INTERACTIONS

RELATIONSHIPS BETWEEN GRAZING AND WATERFOWL PRODUCTION IN THE CANADIAN PRAIRIES

PAULINE. M. BLOOM[1], DAVID W. HOWERTER, ROBERT B. EMERY, and **LLWELLYN M. ARMSTRONG**
Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada, Box 1160, Stonewall, Manitoba, R0C 2Z0. Email: [1] p_bloom@ducks.ca

Abstract: We address key uncertainties about the linkages between grazing, vegetation physiognomy, and the survival and density of duck nests in the Canadian Prairie Pothole Region at three spatial scales. Using data from 2,554 nests, we found that vegetation physiognomy impacted nest survival at both the field and nest-site scales, such that nest survival increased with nest-site vegetation density and late-season field vegetation density. Nest survival also responded to early-season within-field variation in vegetation height in a quadratic manner, such that survival was greatest in fields with moderate variation in vegetation height. Nest survival was negatively related to the intensity of grazing and to the amount of cropland in the surrounding landscape. Both the abundance of wetlands and the average vegetation height in the field had a positive influence on nest density. Fields idled during the breeding season had greater densities of nests than fields grazed either early or late in the breeding season. Leaving lands idled may be the most effective way to increase both waterfowl nest survival and nest density. Where grazing must be carried out during the breeding season, low to moderate stocking rates should be encouraged as these rates appear to have the least negative impact on both waterfowl nest survival and nest density. These stocking rates also will maintain rangeland in good condition to the long-term benefit of producers. Published as: Bloom, P. M., D. W. Howerter, R. B. Emery, and L. M. Armstrong. 2013. Relationships between grazing and waterfowl production in the Canadian prairies. The Journal of Wildlife Management 77:534-544.

INVOLVING LANDOWNERS IN THE PROTECTION OF NATIVE GRASSLANDS THROUGH MANAGED GRAZING

M. DENBOW
Critical Wildlife Habitat Program, Manitoba. Email: mdenbow@mhhc.mb.ca

Abstract: The twice-over grazing system has been documented to enhance grassland habitats, increase desirable grass species, reduce bare ground, inhibit non-native plant species, trees and shrubs resulting in an increase in the productivity of these pastures and an increase in economic returns to the landowner. This has been demonstrated by a livestock weighing program on twice-over project pastures through the Manitoba Mixed-grass Prairie Habitat Stewardship Project. This presentation will describe the twice-over grazing system and the positive impacts on livestock producers through landowner testimonials. Native grasslands continue to be lost across the Prairies Ecozone. Landowners must be directly involved in protecting native grasslands on private lands. Grassland habitat loss can occur through degradation of native plant communities as a result of improper management. Species composition can change with an increase in non-native plant species and shrubby growth, degrading the quality of the remaining prairies, impacting associated wildlife species and reducing economic returns to the landowner. This often results in the lands being converted to cropland, potato production or tame forage in the hope of generating additional revenue. The majority of native grasslands in Manitoba are private lands, used for livestock grazing. Producers have traditionally based their management on livestock numbers, not the biology of the grass. Although grazing is the most compatible agricultural practice on native grasslands, it must be done in a managed fashion. Grazing too early or too late and over stocking pastures negatively impacts grasslands. By identifying key parcels and providing information and financial incentives to landowners, they can be encouraged to adopt environmentally friendly management practices including managed grazing which will help to restore the grasslands and protect them in the long term.

CONVERSION OF ANNUAL CROPLAND TO NATIVE PRAIRIE

RON MCNEIL
LandWise Inc., #407, 210A 12A Street North, Lethbridge, Alberta T1H 2J1.

Abstract: Framework documents regarding the conversion of annual cropland to native grassland vegetative cover in the Dry Prairie and Parkland regions of Alberta were managed by the Alberta NAWMP (North American Waterfowl Management Program) Partnership and Alberta Agriculture and Rural Development (ARD) during development. The documents are designed for use by numerous parties, including professionals, for a potential protocol addition to the Alberta Carbon Offset Solutions. The documents provide information on sustainable practices related to the establishment phase (planning, seed-bed preparation, native seed mixes, timing, techniques, and pre- and post-seeding weed control) and management in the short- and long-term. Short-term verification focuses on proof of seeding and stand establishment, which may take up to three years. Long-term verification focuses on range health indicators that compare native seeded areas to similar range sites and landscapes in surrounding undisturbed native rangelands. Barriers and opportunities for the success of cropland conversion to native cover are also discussed.

REDUCING WOODY COVER ON MIXED-GRASS PRAIRIE IN SOUTHWESTERN MANITOBA

K. MURRAY
Critical Wildlife Habitat Program, Manitoba. Email: kmurray@mhhc.mb.ca

Abstract: In southwestern Manitoba, woody species encroachment degrades the quality of mixed-grass prairie habitats, including grazed pastureland. Western Snowberry (*Symphoricarpos occidentalis*) and Wolf Willow (*Elaeagnus commutata*) are common native shrubs which can form dense colonies. The resulting shade favours an understory dominated by the shade-tolerant invasive grass, Kentucky Bluegrass (*Poa pratensis*). Though grazing is recognized as the most compatible management for prairie habitats, reversing extensive shrub encroachment requires a more targeted approach. A tractor with a brush mower was used to mow four grazed mixed-grass prairie pastures in June and August of 2009, 2010 and 2011. Vegetative cover by species and woody stem height and density were measured prior to each mowing event. Vegetative biomass was measured annually, and songbird point counts were conducted during the breeding seasons of 2010 and 2011. As expected, mowing initiated a flush of new Western Snowberry stems in the spring of 2010. By the third year of mowing, stem counts had declined significantly, and biomass of current year's growth was lower in mowed areas versus controls. Twenty-one (21) songbird species, including two species of conservation concern: Sprague's Pipit (*Anthus spragueii)* and Bobolink (*Dolichonyx oryzivorus*), were recorded. Songbird species were a mix of obligate and facultative grassland birds in both mowed plots and shrubby controls, though facultative birds were more abundant in control plots. Results of this study will be used to guide future management plans for degraded mixed-grass prairie pastures in Manitoba.

SESSION 24: PRAIRIE CONSERVATION PLANNING

PLANNING FOR ENVIRONMENTAL PROTECTION: ENVIRONMENTALLY SIGNIFICANT AREAS AND RED DEER COUNTY

KEN LEWIS
38106 Range Road 275, Red Deer County, Alberta T4S 2L9. Phone: 403-342-8653,
Email: klewis@rdcounty.ca

Abstract: This presentation describes the Environmentally Significant Areas (ESA) Inventory conducted by Red Deer County. It also discusses the public consultation process undertaken, and the subsequent development of policies in the Red Deer County Municipal Development Plan that address ESAs. Finally, it looks at how the policies are being put into action through County staff and County programs.

In the Red Deer County ESA Inventory, there are 27 ESAs identified, totaling around 100,000 acres (about 10% of the County's area). These ESAs include aquatic, riparian, valley/coulee and upland environments.

Among others, two of the main ESA policies now being put into action in Red Deer County are: i) an Environmental Review policy (for major developments), and ii) a policy on the continued delivery of voluntary programs for ESA landowners to participate in, such as cost-share programs that help landowners cover the costs of environmentally beneficial management practices that they choose to adopt on their land.

INVENTORIES OF ALVAR PRAIRIES IN MANITOBA: DOCUMENTING A GLOBALLY RARE ECOSYSTEM

CHRIS FRIESEN[1], **R. NEUFELD**[2], and **C. HAMEL**[2]
[1] Manitoba, Conservation Data Centre, Box 24, 200 Saulteaux Crescent, Winnipeg, Manitoba R3J 3W3. Phone:204-945-7747, Email: chris.friesen@gov.mb.ca
[2] Nature Conservancy of Canada, Suite 200, 611 Corydon Ave., Winnipeg, Manitoba R3L 0P3

Abstract: Alvars are globally rare ecosystems found where limestone bedrock occurs at or very near the surface. In Canada, the distribution was until recently thought to be confined to areas around the Great Lakes in Ontario. However, they have now been documented in the Northwest Territories and Manitoba, with additional surveys being conducted in Quebec and Newfoundland and Labrador. This presentation described the 2012 survey efforts of Manitoba Conservation and Water Stewardship, together with the Nature Conservancy of Canada, to determine the extent and distribution of this unique ecosystem in Manitoba.

CONSERVATION PLANNING FRAMEWORK: NATURE CONSERVANCY OF CANADA

DANA BLOUIN[1] and **RIK ANAKA** [2]

[1] Nature Conservancy of Canada, 830-105 12th Ave., SE, Calgary, Alberta T2G 1A1. Phone: 877-262-1253.

[2] Nature Conservancy of Canada, Suite 700, 1777 Victoria Ave., Regina, Saskatchewan S4P 4K5.

Abstract: The Nature Conservancy of Canada (NCC) uses conservation planning to define where we are working in Canada and where we are putting our valuable donor dollars to work to maximize conservation benefits. Our conservation planning framework enables us to plan at three distinct scales (ecoregion, natural area, property) to account for targets, or what defines that particular project, threats to those targets, and resultant actions. We then close the planning loop by feeding our experiences back into the iterative planning process through our effectiveness monitoring program. Although this planning is happening all across Canada, this presentation focused on conservation planning in the three Prairie Provinces (Alberta, Manitoba, and Saskatchewan) and highlighted the unique approaches to conservation planning NCC has employed since the inception of Conservation Blueprints.

Website: www.natureconservancy.ca

CONSERVATION AGREEMENTS (EASEMENTS) AND THE OIL INDUSTRY IN MANITOBA

CURTIS HULLICK
Manitoba Habitat Heritage Corporation, 545 Conservation Drive, Brandon, Manitoba R7A 7L8.

Abstract: The Manitoba Habitat Heritage Corporation (MHHC) is a Crown Corporation within the Province of Manitoba and has been a leader in the delivery of Conservation Easements on private land in Manitoba since 1998. Through this period of time, Manitoba has struck oil and most of the oil development is in the south western part of the province, where MHHC has had a lot of success and uptake in the delivery of the Conservation Easement Program. This presentation will outline the challenges that MHHC faces with Legislation in Manitoba and how that affects the level of protection that a Conservation Easement can provide. I will also explain the examples of success stories within the oil industry in Manitoba to recognize the importance of natural areas and reducing their impacts on Conservation Easements held by the MHHC. MHHC is actively engaged with partners and the industry to influence a paradigm shift in the recognition of wildlife and wildlife habitat within the oil zone in Manitoba. My presentation will provide some insight into the opportunities created by building relationships and the need to create awareness of the impacts of the 'four-acre lease site'.

THE SASKATCHEWAN PRAIRIE CONSERVATION ACTION PLAN: ACHIEVING HEALTHY NATIVE PRAIRIE ECOSYSTEMS THROUGH PARTNERSHIPS

N. WILKIE
The Saskatchewan Prairie Conservation Action Plan, Box 4752, Regina, Saskatchewan S4P 3Y4.
Phone: (306) 352-0472, Email: pcap@sasktel.net

Expanded Abstract

Since 1998, The Saskatchewan Prairie Conservation Action Plan (PCAP) Partnership has brought together agencies and organizations representing producers, industry, provincial and federal governments, non-government organizations, research, and educational institutions under a common vision for healthy native prairie ecosystems as vital parts of our vibrant & strong communities. Our mission is to work together to deliver prairie conservation activities that represent shared objectives that benefit the social, cultural, economic and ecological fabric of Saskatchewan. PCAP's five priority areas of focus include:

- At Home on the Prairie: Connecting to Native Prairie,
- Prospering With Prairie: Sustainable Land Use and Development,
- Caring for Prairie: Managing Invasive Alien Plant Species,
- Accounting for Prairie: Valuing Ecological Goods and Services, and
- A Working Prairie: Grazing Management in Prairie Ecosystems.

Accomplishments over the first four years of PCAP's 2009-2013 Framework are highlighted in the following table, organized by focus group.

Table 1: Summary of PCAP Accomplishments from 2009-2012.

AT HOME ON THE PRAIRIE: Connecting to Native Prairie	
Objective	**2009-2012 Results**
More people are aware of and appreciate native prairie ecosystems and support and are engaged in sustainable, prairie related activities.	7,400 students engaged in Eco-extravaganza, Owls & Cows tour and Pitch for Pipits and Plovers Game Show.
	Two new educational programs are being developed: Taking Action for Prairie & Adopt a Rancher.
	13,000 people reached via the newsletter, Facebook page and website.
	1,100 people engaged via Native Prairie Appreciation Week (NPAW) and the Native Prairie Restoration & Reclamation workshops (NPRRW).

PROSPERING WITH PRAIRIE: Sustainable Land Use and Development	
Objective	**2009-2012 Results**
PCAP Partners to identify, adopt, implement, and promote best management practices, planning processes, policies and / or regulatory requirements, important for the conservation and sustainable use of native prairie in Saskatchewan.	A spreadsheet was developed and sent to partners to collect information for the creation of a dynamic inventory of the top three activities of each partner group. In 2010 and 2011, 17 partners completed the survey.
	440 participants from government, environmental NGOs, universities, the oil & gas industry, consultants and naturalists attended the 2011 and 2012 NPRRW which focused on how to successfully restore/reclaim native prairie, bridging the gap between native seed providers and users and various methods for managing restored/reclaimed prairie.
	A literature review was conducted in 2011 about the quantity of native prairie remaining in SK and included seven key recommendations for discussion and next steps.
CARING FOR PRAIRIE: Managing Invasive Alien Plant Species	
Objective	**2009-2012 Results**
Prairie land managers understand the importance of managing alien plant species on the prairie landscape and Saskatchewan has a coordinated approach to invasive alien plant species management.	21,000 people were reached by dispersal of *Gardener for the Prairies*, *Native Plant News and* Nature Conservancy of Canada's newsletter and an invasive species calendar NPSS gave invasive plant presentations to SIAST in Prince Albert, NSWMA in Winnipeg and the Early Grey Garden Club in 2011.
	Numerous PCAP partners are involved with the Saskatchewan Invasive Species Council (SISC) which has submitted a proposal to federal Invasive Alien Species Partnership Program to tackle multiple invasive species using mapping removal, awareness & education and other techniques. The project is provincial in scope with a strong, early detection and rapid response component.
ACCOUNTING FOR PRAIRIE: Valuing Ecological Goods and Services	
Objective	**2009-2012 Results**
More people are aware of the ecological goods and services provided by native prairie ecosystems and begin to account for them in decision making.	Over 11,000 people were made aware of ecological goods and services (EGS) through articles in the SK PCAP newsletter and *Beef Business* along with a brochure that was developed and distributed to PCAP partners, through its website and newsletter. An EGS news release was developed in conjunction with NPAW 2011. EGS was included as a topic in the Taking Action for Prairie education program.
	A representative from the focus group attended the Canadian EGS pilot review workshop in Ottawa in 2009. Partners joined the multi-stakeholder Saskatchewan EGS Working Group.

A WORKING PRAIRIE: Grazing Management in Prairie Ecosystems	
Objective	**2009-2012 Results**
Increased land manager knowledge and adoption of grazing management practices that benefit both prairie ecosystems and economic returns; Improved knowledge of current range health and range health trends in Saskatchewan; and Improved scientific understanding of the role of grazing management in prairie ecosystem health & biodiversity.	350 participants were engaged via field days focused on pasture management and grazing & forage research.
	650 copies of the Range & Riparian Health & Assessment booklets were updated, re-printed and distributed to over 60 organizations & individuals.
	A standardized range health database (VegISS) has been developed by the Saskatchewan Research Council (SRC). Two workshops have been held to train partners and associates on how to use the database. Minor updates have been completed and partners are now beginning to load their data.

A MULTI-SPECIES CONSERVATION STRATEGY FOR SPECIES-AT-RISK IN THE GRASSLAND NATURAL REGION OF ALBERTA

MULTISAR
Alberta Conservation Association, #400, 817-4th Ave South, Lethbridge, Alberta T1J 0P6.

Abstract: Multi-species Point Count Surveys are a tool being used by MULTISAR to identify species on the landscape. This methodology has evolved over time to more accurately reflect the landscape and the species present. We originally completed surveys along trails and riparian corridors, and switched to a 400m grid system across the landscape. The current method utilizes point counts within Grassland Vegetation Inventory polygons which allows better coverage across the landscape and improves data for correlations. Using the Grassland Vegetation Inventory has enhanced the value of the data collected by linking it to specific habitat types. Correlations can be made between habitat types and species presence. This has enabled beneficial management practices and recommendations to landowners to be refined. It has also improved the probability to enhance habitat for Species-at-Risk.

WHAT IS THE GRASSLAND VEGETATION INVENTORY (GVI)?

BARRY ADAMS, and **LIVIO FENT**
Rangeland Management Branch, Alberta Environment and Sustainable Resources Division, 200-5 Ave South, Lethbridge, Alberta T1J 4L1.

Abstract: The Grassland Vegetation Inventory is intended to meet the multitude of business needs integral to land-use planning and management in Alberta. It represents the Government of Alberta's comprehensive biophysical vegetation and anthropogenic inventory of the province's Grassland Natural Region. It addresses requirements defined by the province's rangeland management, fish and wildlife, wetland management, and land-use operations sectors. The Grassland Vegetation Inventory can be generalized as a landscape (rangeland sites), native vegetation, and land use (agricultural, industrial, and populated areas) inventory with emphasis placed on the native – public land component.

GRAZING AND RANGE MANAGEMENT APPLICATIONS

KEVIN FRANCE
Rangeland Management Branch, Alberta Environment and Sustainable Resources Division. 200-5 Ave South, Lethbridge, Alberta T1J 4L1.

Abstract: Range management is about balancing human needs and demands on rangelands with the needs of range resources (i.e., to protect soil, vegetation and water). Sustainable rangeland management applies ecological knowledge, principles and practices to dynamic rangelands ecosystems. The flexible application of rangeland management principles and practices is the best approach to promote sustainable management.

With the understanding of Grassland Vegetation Inventory site type distribution landowners can make informed decisions for pasture development (fence lines), water development, salt placement, and avoidance of sensitive areas (e.g., riparian areas, and critical wildlife areas). Grassland Vegetation Inventory can also help in development of grazing (range) management plans. Plant community composition and range health assessments can be made on Grassland Vegetation Inventory polygons to evaluate carrying capacity (forage production) and species composition. With the understanding of plant community distribution, range health and Grassland Vegetation Inventory site types, a manager can then apply rangeland management practices suited for each plant community.

GVI USE WITH PRE-SITE ASSESSMENT

MARILYN NEVILLE[1], **VARGE CRAIG**[2], and **JAMIE PICCIN**[3]
[1] Gramineae Services Ltd., 823 Kettles St., Pincher Creek, Alberta T0K 1W0.
[2] Alta Rangeland Services Ltd., General Delivery, Coaldale, Alberta T1M 1M3.
[3] Dynamic Outlook Consulting, P.O. Box 2363, Pincher Creek, Alberta T0K 1W0.

Abstract: A Geographic Information System (GIS) was used to leverage the biophysical classification of a project site where ground data is linked to the Grassland Vegetation Inventory (GVI) and used to evaluate minimum disturbance practices and options for the placement of industrial projects like well sites, access roads and pipelines. The use of Grassland Vegetation Inventory in pre-site assessment allowed for a much more comprehensive identification of an appropriate location for development with minimal amounts of disturbance. The increased number of variables and fine resolution of the Grassland Vegetation Inventory dataset allowed for the development of a better location for proposed development.

REGIONAL LANDSCAPE ANALYSIS AND PLANNING

DOUG OLSON
O2 Planning and Design, 255-17 Ave., SW, Calgary, Alberta T2S 2T8.

Abstract: The Land-use Framework establishes the following desired planning outcomes for the province:

- Healthy economy supported by our land and natural resources
- Healthy ecosystems and environment
- People-friendly communities with ample recreational and cultural opportunities

Building on the framework set out by the Land-use Framework in the Regional Plan Terms of Reference, the South Saskatchewan Regional Plan Advisory Council has developed two desired environmental planning outcomes:

- The health of ecosystems, which consists of water, land, air, and biodiversity, is valued by Albertans and needs to be sustained or improved through responsible stewardship.
- The biodiversity and ecosystem health and quality of forests, grasslands, parklands, aquatic environments, Badlands, and dunes are sustained through responsible stewardship and are valued by Albertans

The Grasslands Vegetation Inventory (GVI) provides the base data needed to conduct the analyses required to inform the planning for the desired outcomes set forth by the Land-use Framework and the South Saskatchewan Regional Plan Advisory Council.

LAND PRIORITY CLASSIFICATION: GIVING CONSERVATION FOCUS

S. GIETZ[1], **C. HAMEL**[1] and **R. ANAKA**[2]

[1] Nature Conservancy of Canada, 611 Corydon Avenue, Suite 200, Winnipeg, Manitoba R3L 0P3.

[2] The Nature Conservancy of Canada, Suite 100, 1777 Victoria Ave., Regina, Saskatchewan S4P 4K5.

Abstract: Prioritization of land parcels within a given Natural Area is needed to help determine where conservation activities should be focused. The overall goal is to direct resources towards obtaining the best impact on the defined biodiversity targets while minimizing threats to those targets. We employed a GIS analysis program, Protected Area Tools for ArcGIS, that utilizes a combination of three analysis techniques to produce the final results. These techniques included an Environmental Risk Surface (ERS), a Relative Biodiversity Index (RBI), and a modified natural breaks classification. The resultant natural breaks classification defines priorities on a relative scale of High Target Value/ High Threat Value to Low Target Value/ Low Threat Value. Fine-filter analyses incorporating Species-at-Risk are also incorporated. A conservation practitioner can use the results to focus and prioritize the geographic scope of their activities.
