PROCEEDINGS OF THE 12TH PRAIRIE CONSERVATION AND ENDANGERED SPECIES CONFERENCE

Working Landscapes

Winnipeg 2019

PROCEEDINGS

OF THE

12TH PRAIRIE CONSERVATION AND ENDANGERED SPECIES CONFERENCE

WORKING LANDSCAPES

Winnipeg, Manitoba

February 19–21, 2019

Published by

Critical Wildlife Habitat Program
Winnipeg, Manitoba
2020

Edited by

Donna Danyluk

www.pcesc.ca

Suggested citation –

Danyluk, D. (ed). 2020. *Working Landscapes.* Proceedings of the 12th Prairie Conservation and Endangered Species Conference, February 2019, Winnipeg, Manitoba. Critical Wildife Habitat Program, Winnipeg, Manitoba.

Cover photo by Tara Mulhern-Davidson, Lonesome Dove Ranch, Saskatchewan

TABLE OF CONTENTS

PLENARY PRESENTATIONS

SESSION ABSTRACT AND PAPERS

SESSION 1: PRAIRIE BIRD CONSERVATION – PART I

SESSION 2: PRAIRIE BUTTERFLY CONSERVATION

SESSION 3: TOOLS FOR MODELS AND CONSERVATION

SESSION 4: RESTORATION PLANNING AND MONITORING

SESSION 5: ADVANCING THE SARPAL APPROACH

SESSION 6: PUBLIC ENGAGEMENT – PART I

SESSION 7: LAND MANAGEMENT TECHNIQUES

SESSION 8: RESTORATION – SEEDS

SESSION 9: ALTERNATIVES IN AGRICULTURE

SESSION 10: BIG-PICTURE PLANNING

SESSION 11: MULTIPLE SPECIES AT RISK MANAGEMENT

SESSION 12: BIOLOGICAL EFFECTS OF MANAGEMENT

SESSION 13: PUBLIC ENGAGEMENT – PART II

SESSION 14: PUBLIC PASTURES

SESSION 15: INSECT CONSERVATION

SESSION 16: PRAIRIE BIRD CONSERVATION – PART II

SESSION 17: HABITAT ENHANCEMENT

SESSION 18: ADAPTIVE MANAGEMENT PLANNING WITH OPEN STANDARDS

POSTER SESSION ABSTRACTS

The Organizing Committee of the 12th Prairie Conservation and Endangered Species Conference gratefully acknowledges the generosity and support of our Sponsors

Platinum Sponsors

Funding is provided in part by the Canada and Manitoba governments through the Canadian Agricultural Partnership.

Premier Banquet Sponsor

GOLD SPONSOR

NATURE CONSERVANCY CANADA

SILVER SPONSORS

SINCE 1969 Alberta Beef Producers

Winnipeg

Critical Wildlife Habitat Program

Ducks Unlimited Canada

MANITOBA BEEF PRODUCERS

Manitoba Conservation Data Centre

MANITOBA HABITAT HERITAGE CORPORATION

Parks Canada Parcs Canada

SCA SASKATCHEWAN CATTLEMEN'S ASSOCIATION

UNIVERSITY OF MANITOBA

faculty of SCIENCE
discover the unknown + invent the future

BRONZE SPONSORS

Association of Manitoba Community Pastures
Bird Studies Canada
Manitoba Hydro
Nature Manitoba
Nature Saskatchewan
Prairie Originals
Red River Basin Commission and Chapters
The Manitoba Museum
Truax Company

TARGETED SPONSORS

Wednesday a.m. Health Break –
Sunterra Horticulture (Canada) Inc.

FRIENDS

Environmental Studies and Sciences, University of Winnipeg

Peregrine Falcon Recovery Project

Shrugging Doctor Beverage Company

The Wildlife Society, Manitoba Chapter

WE ALSO THANK THE FOLLOWING ARTISTS FROM ACROSS THE PRAIRIES WHO PARTICIPATED IN THE PRAIRIE ART SHOW AT THE 12TH PCESC

Garry Budyk
Valérie Chartrand
Pat Crandell
A. Adilia R. Cunha
Kathryn Drummond
Maria Epp
Patricia Findlay
Beth Gillespie
Meg Hainstock
Gayle Halliwell
Cain Hashimoto
Heather Hinam
Stu Iverson
Kelly Leask
Don McMaster
Rosalie Olson
Kevin Orr
Rafael Otfinowski
Joshua Pearlman
Heather Peat Hamm
Stephen Petersen
Theresa Shaw
Devin Toews
Tammy Westfall

A NOTE FROM THE EDITOR

The editing of these Proceedings of the 12th Prairie Conservation and Endangered Species Conference began in late 2019/early 2020, before the COVID-19 pandemic upended our world. Like every other aspect of our lives, the editing process was disrupted, and was finally completed in late 2020. To the conference organizers and participants, in particular the authors who prepared full-length papers of their presentations, I apologize for the lengthy delay in publication. Everything that follows in these Proceedings, including the "Welcome to the Proceedings" from the Organizing Committee on the next page, was written in 2019.

In these Proceedings, the conference plenaries appear first, followed by the presentations of the 18 conference sessions. Within each session, the presentations that only have abstracts are listed first, followed by those for which full papers were submitted. The poster session abstracts (which include two full papers) are in the order given in the conference program. The names of presenting authors are in bold, and author affiliations and organization names are as of the time of the conference. My editorial goals included improving clarity and readability of text where needed, and ensuring consistency in format and terminology where appropriate. I chose to capitalize the common names of species where the full common name is used. Species binomials are included for birds, plants, and insects, in the first instance in which they appear (other than the title) in an abstract or paper. In the reference lists of papers, lengthy URLs were replaced with a shortened version using TinyURL.com. The "accessed date" is the date provided by the author, and all were checked again in early 2020. If a URL is no longer valid, hopefully there is enough information in the reference and paper to track down the document in an internet search.

As a dedicated naturalist and prairie lover, I want to thank the many individuals and organizations who contributed to the 12th PCESC. When I began this editorial project, learning about the latest work being done in prairie conservation, monitoring and protection of species at risk, and sustainable agriculture gave me a sense of hope and optimism, an antidote to anxiety produced by the crises of biodiversity loss and climate change. As I complete the Proceedings, in a time of upheaval and indefinite uncertainty produced by a global pandemic, I hope and trust that the research and field work, the land stewardship, and the networking and partnerships facilitated by these conferences will continue in 2021 and beyond – for the sake of the wildlife species, ecosystems, and livelihoods that depend on these "Working Landscapes", our grasslands.

Donna Danyluk
Winnipeg, Manitoba

WELCOME TO THE PROCEEDINGS OF THE 12TH PRAIRIE CONSERVATION AND ENDANGERED SPECIES CONFERENCE

The Prairie Conservation and Endangered Species Conference (PCESC) was established in 1986 to provide a forum to discuss the latest issues, perspectives, challenges, opportunities, research, and trends in the conservation of prairie landscapes, species, and species at risk. The conference, occurring every three years and rotating among the three Prairie Provinces, engages people from many backgrounds, including researchers, field personnel, consultants, industry representatives, livestock producers, landowners, naturalists, educators, volunteers, NGOs, Indigenous groups, provincial and federal public servants, private organizations, and community and farm-based organizations. The conference organizing committee is pleased to present the Proceedings of the 12th Prairie Conservation and Endangered Species Conference, which was held in Winnipeg, Manitoba from February 19 to 21, 2019.

The theme of the 12th PCESC, "Working Landscapes", recognizes that the only viable approach to conserving prairie and its associated species lies in partnering with agricultural and other interests. The joint chairing of this conference by Manitoba Sustainable Development and the Manitoba Beef Producers is a further recognition of the urgent need to strengthen the partnerships of all those who live and work in the prairies. This theme was reflected in the diverse plenary and concurrent speakers and poster presenters who came together for this conference.

We were honoured to continue the tradition of the Prairie Conservation Award, acknowledging deserving individuals from each of the Prairie Provinces who have made a significant contribution to prairie and/or endangered species conservation. In addition, this was the third conference in which the Young Professional Stewardship Grant was awarded to support projects being carried out by individuals between the ages of 18 and 30 that advance the engagement of people in conservation in grassland and parkland ecosystems of the Prairie Provinces.

It is our hope that these Proceedings will provide you with new information and approaches to use where you practice prairie and endangered species conservation. We recognize that the traditions of the PCESC have evolved and that many of the participants no longer view this as an academic conference *per se*, but rather an interdisciplinary gathering to address urgent conservation needs in a multi-sectoral manner. For this reason, fewer participants have submitted full manuscripts in recent conferences and we anticipate that the format of the proceedings document will likely change in the future.

In closing, we would like to express our sincere gratitude to the many sponsors who helped make this conference a success. It would not have been possible without their generosity. We would also like to thank the members of the Steering Committee, the various sub-committees, and the numerous volunteers who gave so much of their professional and personal time to make this a successful conference.

The next Prairie Conservation and Endangered Species Conference will take place in Alberta in 2022.

We hope you enjoy the Proceedings.

The 12th PCESC Organizing Committee

12TH PRAIRIE CONSERVATION AND ENDANGERED SPECIES CONFERENCE

ORGANIZING COMMITTEE

STEERING COMMITTEE

Nicole Firlotte (co-chair) ..... ***Manitoba Sustainable Development***
Brian Lemon (co-chair) ..... ***Manitoba Beef Producers***
Christian Artuso ..... *Bird Studies Canada*
Ron Bazin..... *Environment and Climate Change Canada*
Christine Chilton..... *Nature Conservancy of Canada*
Chris Friesen..... *Manitoba Sustainable Development*
Carol Graham ..... *Manitoba Habitat Heritage Corporation*
Tracy Maconachie ..... *Ducks Unlimited Canada*
Heather Miltenburg ..... *Manitoba Sustainable Development*
Janet Moore ..... *Critical Wildlife Habitat Program*
Lauren Rae ..... *Ducks Unlimited Canada*
Diego Steinaker ..... *Saskatchewan Prairie Conservation Action Plan*
Christine Tymchak..... *Manitoba Sustainable Development*
Bill Watkins ..... *Manitoba Sustainable Development*
Rachel Whidden ..... *Association of Manitoba Community Pastures*
Colleen Wilson ..... *Manitoba Agriculture*

PROGRAM COMMITTEE

Christian Artuso (chair) ..... ***Bird Studies Canada***
Charlene Berkvens ..... *Manitoba Sustainable Development*
Marie-Ève Cyr..... *University of Manitoba*
Alexandra Froese ..... *Manitoba Burrowing Owl Recovery Program*
Elaine Gauer..... *Manitoba Agriculture*
Carol Graham ..... *Manitoba Habitat Heritage Corporation*
Tracy Maconachie ..... *Ducks Unlimited Canada*
Caitlin Mroz..... *Saskatchewan Prairie Conservation Action Plan*
Randall D. Mooi..... *Manitoba Museum*
Marika Olynyk ..... *Nature Conservancy of Canada*
Lynnea Parker ..... *Nature Manitoba*
Stephen Petersen..... *Assiniboine Park Zoo – Assiniboine Park Conservancy*
Timothy F. Poole ..... *Nature Manitoba*
Lauren Rae ..... *Ducks Unlimited Canada*
Barry Robinson ..... *Environment and Climate Change Canada*
Joanne Tuckwell..... *Parks Canada Agency*

PUBLICITY COMMITTEE

Christine Tymchak (chair) ..... ***Manitoba Sustainable Development***
Christie Borkowsky..... *Critical Wildlife Habitat Program*
Christine Chilton..... *Nature Conservancy of Canada*
Carol Graham ..... *Manitoba Habitat Heritage Corporation*
Janet Moore ..... *Critical Wildlife Habitat Program*
Duncan Morrison ..... *Manitoba Forage and Grasslands Association*
Timothy F. Poole ..... *Nature Manitoba*

SOCIAL COMMITTEE

Lauren Rae (chair) ..... ***Ducks Unlimited Canada***
Leah de Forest..... *Parks Canada Agency*
Jason Kelly..... *Manitoba Parks*
Paige Kowal..... *Ducks Unlimited Canada*

AWARDS COMMITTEE

Heather Miltenburg (co-chair)..... ***Manitoba Sustainable Development***
Bill Watkins (co-chair) ..... ***Manitoba Sustainable Development***
Christie Borkowsky..... *Critical Wildlife Habitat Program*
Brandy Downey..... *Alberta Environment and Parks*
Chris Friesen..... *Manitoba Sustainable Development*
Tracy Maconachie ..... *Ducks Unlimited Canada*
Diego Steinaker..... *Saskatchewan Prairie Conservation Action Plan*

HISTORY OF THE CONFERENCE

The first Prairie Conservation and Endangered Species Conference (PCESC) was held in 1986 in Edmonton, Alberta, as a forum to discuss the latest issues, information, research, and trends in prairie landscape and species conservation. 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 as follows:

2019 – Winnipeg, Manitoba: *Working Landscapes*
2016 – Saskatoon, Saskatchewan: *Prairie – It's a Happening Place!*
2013 – Red Deer, Alberta: *Engaging People in Conservation*
2010 – Winnipeg, Manitoba: *Patterns of Change*
2007 – Regina, Saskatchewan: *Homes on the Range – Conservation in Working Prairie Landscapes*
2004 – Calgary, Alberta: *Keeping the Wild in the West*
2001 – Winnipeg, Manitoba: *Sharing Common Ground*
1998 – Saskatoon, Saskatchewan: *Connection between Prairie Ecosystem Conservation and Economic, Social, and Ethical Forces of Society*
1995 – Lethbridge, Alberta: *Ecosystem Management for Conservation*
1992 – Brandon, Manitoba: *Partnerships between Agriculture and Wildlife*
1989 – Regina, Saskatchewan: *Implementing the Prairie Conservation Action Plan*
1986 – Edmonton, Alberta: *Endangered Species*

PUBLISHED PROCEEDINGS

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

11th PCESC – Kjoss, V.A. (ed). 2016. *Prairie: It's a Happening Place.* Proceedings of the 11th Prairie Conservation and Endangered Species Conference, February 2016, Saskatoon, Saskatchewan. Saskatchewan Prairie Conservation Action Plan, Regina, Saskatchewan.

10th PCESC – Holroyd, G.L., A.J. Trefry, and B. Crockett (eds). 2014. *Engaging People in Conservation.* Proceedings of the 10th Prairie Conservation and Endangered Species Conference, February 2013, Red Deer, Alberta. Alberta Prairie Conservation Forum, Lethbridge, Alberta.

9th PCESC – Danyluk, D. (ed). 2011. *Patterns of Change: Learning from our past to manage our present and conserve our future.* Proceedings of the 9th Prairie Conservation and Endangered Species Conference, February 2010, Winnipeg, Manitoba. Critical Wildlife Habitat Program, Winnipeg, Manitoba.

8th PCESC – Warnock, R., D. Gauthier, J. Schmutz, A. Patkau, P. Fargey, and M. Schellenberg (eds). 2008. *Homes on the Range: Conservation in Working Prairie Landscapes.* Proceedings of the 8th Prairie Conservation and Endangered Species Conference and Workshop, March 2007, Regina, Saskatchewan. Saskatchewan Prairie Conservation Action Plan, Canadian Plains Research Center, University of Regina, Regina, Saskatchewan.

7th PCESC – Trottier, G.C., E. Anderson, and M. Steinhilber (eds). 2004. Proceedings of the 7th Prairie Conservation and Endangered Species Conference, February 2004, Calgary, Alberta. Natural History Occasional Paper No. 26. Provincial Museum of Alberta, Edmonton, Alberta.

6th PCESC – Blouin, D. (ed). 2001. Proceedings of the Sixth Prairie Conservation and Endangered Species Workshop, February 2001, Winnipeg, Manitoba. Manitoba Habitat Heritage Corporation, Winnipeg, Manitoba.

5th PCESC – Thorpe, J., T. Steeves, and M. Gollop (eds). 1999. Proceedings of the Fifth Prairie Conservation and Endangered Species Conference, February 1998, Saskatoon, Saskatchewan. Natural History Occasional Paper No. 24. Provincial Museum of Alberta, Edmonton, Alberta.

4th PCESC – Willms, W.D., and J.F. Dormaar (eds). 1996. Proceedings of the Fourth Prairie Conservation and Endangered Species Workshop, February 1995, Lethbridge, Alberta. Natural History Occasional Paper No. 23. Provincial Museum of Alberta, Edmonton, Alberta.

3rd PCESC – Holroyd, G.L., H.L. Dickson, M. Regnier, and H.C. Smith (eds). 1993. Proceedings of the Third Prairie Conservation and Endangered Species Workshop, February 1992, Brandon, Manitoba. Natural History Occasional Paper No. 19. Provincial Museum of Alberta, Edmonton, Alberta.

2nd PCESC – Holroyd, G.L., G. Burns, and H.C. Smith (eds). 1991. Proceedings of the Second Endangered Species and Prairie Conservation Workshop, January 1989, Regina, Saskatchewan. Natural History Occasional Paper No. 15. Provincial Museum of Alberta, Edmonton, Alberta.

1st PCESC – Holroyd, G.L., W.B. McGillivray, P.H.R. Stepney, D.M. Ealey, G.C. Trottier, and K.E. Eberhart (eds). 1987. Proceedings of the Workshop on Endangered Species in the Prairie Provinces, January 1986, Edmonton, Alberta. Natural History Occasional Paper No. 9. Provincial Museum of Alberta, Edmonton, Alberta.

YOUNG PROFESSIONAL STEWARDSHIP GRANTS

Supporting Young Professional and Aspiring Conservationists

The Young Professional Stewardship Grant was developed to promote future work in prairie conservation and endangered species management. This grant is for professional or aspiring conservationists between the ages of 18 and 30 who live and/or work in Alberta, Saskatchewan, or Manitoba. Applicants from various disciplines are encouraged to apply and do not need to be enrolled in, or be a graduate of, an academic institution. Proposals may consider topics in the areas of land management, ecology, species at risk, or habitat enhancement, with a focus on education and community outreach, a desired outcome, or the use of an integrated management approach.

Individuals and/or groups were encouraged to submit a proposal to be considered for grant(s), the funds for which were raised during the silent auction at the 2019 Prairie Conservation and Endangered Species Conference. Applications were received from across all three Prairie Provinces and the grant recipients were announced at the PCESC Banquet on February 20, 2019.

The recipients of the 2019 Young Professional Stewardship Grants were:

Sejer Meyhoff, Alberta

Emily Putz (Stewards of Saskatchewan programs of Nature Saskatchewan), Saskatchewan

Lynnea Parker, Manitoba

Congratulations to all three recipients!

PAST RECIPIENTS OF THE YOUNG PROFESSIONAL STEWARDSHIP GRANTS

YEAR	ALBERTA	SASKATCHEWAN	MANITOBA
2016	Laura Griffin, Ann & Sandy Cross Conservation Area *Engaging Communities in Nocturnal Conservation: Why Nocturnal Preserves are Needed in Canada*	Aaron Bell, Troutreach and Saskatchewan Wildlife Federation *Population Assessment of the Imperiled Gibson's Big Sand Tiger Beetle in the Saskatchewan Sand Hills*	Jordan Becker *Manitoba Trails Project*
2013	The University of Alberta *Trends in Grizzly Bear Conservation: The Influences and Impact of the Social Landscape*	Nature Saskatchewan Stewards of Saskatchewan *Engaging Rural Landowners in Conserving Habitat for Species at Risk*	Friends of Birds Hill Park Inc. *Prairie and Parkland Habitat Education for Youth*

2019 Recipients of the Young Professional Stewardship Grants

Alberta: Sejer Meyhoff, University of Lethbridge

Validation of Stable Isotope Analysis for Determining Dietary Proportions and Trophic Dynamics in Plains Sharp-tailed Grouse

Project Summary – This two-year study focuses on the utilization of arthropods in the diet of Plains Sharp-tailed Grouse (*Tympanuchus phasianellus jamesi*) in Alberta. The project will use stable isotope analysis, esophageal crop contents, arthropod surveys, vegetation surveys, and historical data to examine the relationship between arthropod utilization by grouse and climate, weather, seasonal variability, arthropod biodiversity and abundance, plant communities, and bird health. In the face of increasing challenges imposed on prairie species at risk by climate change, landscape alterations, and pressure from agricultural development, it is important to explore grassland food webs that relate to arthropods, how they might be altered in the future, and what consequences might follow.

Many grassland birds rely on arthropods as a food source, particularly as fledglings, and are adversely affected by arthropod declines. An important facet of this study is to raise awareness around the importance of differentiating between pest and non-pest species so that arthropod biodiversity is not affected unnecessarily by insecticide use. By quantifying the extent to which Plains Sharp-tailed Grouse use arthropods as a food source, the results from this study can be used to gain information about the potential consequences of changes to arthropod biodiversity and abundance.

Saskatchewan: Emily Putz, Stewards of Saskatchewan – Nature Saskatchewan

Stewards of Saskatchewan: Habitat Conservation on a Working Landscape

Project Summary – The Stewards of Saskatchewan (SOS) Project engages and supports rural landowners in southern Saskatchewan to voluntarily conserve prairie grassland habitat, for the benefit of continuing biodiversity, ecosystem health, and the people who live and rely on these working landscapes. The SOS Project is composed of a suite of five programs, each using flagship (rare/at risk) species to promote awareness of our disappearing prairie landscapes and their biological diversity. While the focus is on species targeted by each program, these programs ultimately benefit many other prairie species and their habitats. The five programs are: Operation Burrowing Owl, Rare Plant Rescue, Shrubs for Shrikes, Plovers on Shore, and the SOS Banner Program for all other species at risk.

The goals of the programs are to conserve habitat, raise awareness, and provide support to agricultural producers; enhance prairie habitat for species at risk; and search for and monitor target species at risk populations. The main activities of the SOS project are separated into three categories: Habitat Stewardship, Site Identification and Population Monitoring, and Education and Awareness. In each program we deliver on specific actions including: retaining current and engaging new stewards, developing beneficial management plans with landowners, supporting habitat enhancement projects, surveying for and monitoring known populations of species at risk, one-on-one visits with landowners, developing and distributing outreach materials, presenting at and attending public events, and hosting opportunities for landowners to learn from and participate in a connected stewardship community.

Manitoba: Lynnea Parker

Defining Landowner Values toward Grasslands and Wildlife Conservation

Project Summary – Manitoba's prairie region has experienced a significant loss of native grasslands primarily due to cultivation for agricultural crops and other forms of land development. Much of Manitoba's remaining native grasslands are privately owned and function as pasture for livestock or hay land. These privately owned grasslands provide critical habitat for many of Manitoba's species at risk. Addressing issues of conservation concern, such as species at risk, involves the cooperation of landowners, producers, conservation organizations, and government. In 2017 the SARPAL program (Species At Risk Partnerships on Agricultural Lands) was initiated in Manitoba to engage landowners voluntarily in prairie conservation.

The objective of this research project is to define landowner values toward native prairie grasslands and evaluate the effectiveness of the SARPAL program to date. This research project will be carried out with landowners enrolled in the SARPAL program in 2017 and 2018 using both quantitative (survey questionnaire) and qualitative (interviews and working groups) methods. Outcomes of this project will help our understanding of landowner views and attitudes toward conservation initiatives. Landowner evaluations of the SARPAL program will provide critical feedback necessary for improving the overall effectiveness of the program. Project deliverables will include an interim report, comprehensive final report, research poster, and media-related materials.

2019 Young Professional Stewardship Grant recipients, from left to right: Lynnea Parker, Emily Putz, and Sejer Meyhoff, with Bill Watkins (Manitoba Sustainable Development).

PRAIRIE CONSERVATION AWARDS

The Prairie Conservation Awards, created in 1989, 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 2019 Prairie Conservation Awards were presented at the 12th Prairie Conservation and Endangered Species Conference in Winnipeg, Manitoba. The recipients were:

Joel Nicholson, Alberta

Tom Harrison, Saskatchewan

Gervin Stock Farms (Curtis and Shannon Gervin), Manitoba

Congratulations to all three award winners!

PAST RECIPIENTS OF THE PRAIRIE CONSERVATION AWARDS

YEAR	ALBERTA	SASKATCHEWAN	MANITOBA
2016	The Ross Ranch	Luc Delanoy	Peggy Westhorpe
2013	Ken & Nora Balog	Gary Seib	John Morgan
2010	Dylan & Colleen Biggs & Family	Pat Fargey	Robert Jones
2007	Barry Adams & Richard Quinlan	Lorne Scott	Marilyn Latta
2004	Dawn Dickinson	David Gauthier	Tony & Debbie McMechan
2001	Ian Dyson	Greg Reimer	Rick Wowchuk
1998	Cheryl Bradley	Miles Anderson	Nature Manitoba
1995	Francis & Bonnie Gardner	Dale Hjertaas	LGD of Stuartburn
1992	Cliff Wallis	Donald Hooper	
1989	Dianne Pachal & Vivian Pharis	Stuart Houston	

2019 Recipients of the Prairie Conservation Awards

Alberta: Joel Nicholson

Joel Nicholson was born and raised in the prairie region of rural Alberta. Living there cultivated his interest in wildlife, which led him to complete a B.Sc. (Special) degree in biology and chemistry from the University of Alberta's Augustana Campus in Camrose, Alberta.

Joel Nicholson (left) with Graham Dixon-MacCallum, who presented the award on behalf of Axel Moehrenschlager.

He has worked as a researcher on numerous wildlife projects in western Canada, as an industrial consultant, and is currently employed by Alberta Environment and Sustainable Resource Development in Medicine Hat as a Senior Species at Risk Biologist. Joel has over 20 years of experience working in the grasslands of southern Alberta on numerous species such as Greater Sage-grouse, Burrowing Owl, Swift Fox, Short-horned Lizard, Soapweed, Yucca Moth, Western Spiderwort, Tiny Cryptanthe, Northern Leopard Frog, and Prairie Rattlesnake.

Joel has a passion for the prairie landscape that he works in, and a deep understanding about that landscape and the species at risk that occur there. Joel has been able to mobilize people and resources to advance the conservation of a number of species. Over the past two decades, his efforts, and the partnerships he has built, have been instrumental in the recovery efforts for Greater Sage-grouse and many other species at risk that occur in native grasslands.

Saskatchewan: Tom Harrison

Tom Harrison has been a rancher (beef cattle producer) since 1988 and, with his wife Tracy, co-owns and operates a 250-head cow-calf operation on 4,000 acres of tame grasslands and native prairie in the Rural Municipalities of Lumsden, Longlaketon, and in the Swift Current area. He graduated with a Bachelor of Animal Science at the University of Saskatchewan in 1984, and obtained a Master's degree in Range Science, also at the University of Saskatchewan, in 1993. Tom has been an active member of the Society for Range Management, the Saskatchewan Institute of Agrologists, the Saskatchewan Stock Grower's Association, the Saskatchewan Cattlemen's Association, and the Saskatchewan Prairie Conservation Action Plan.

Tom has been delivering agri-environmental programming to agricultural producers since the early 1990s, demonstrating exceptional commitment and innovation in relation to conservation of native prairies and endangered species in Saskatchewan. More recently, as Director of the South of the Divide Conservation Action Program (SODCAP) Inc., Tom has led a number of successful initiatives to promote native habitat conservation and habitat management for endangered species in the Milk River Watershed. He is currently managing 21 projects with local ranchers, which impact nearly 100,000 acres of native prairie habitats for 15 species at risk. These projects include result-based agreements, habitat management agreements, and habitat restoration agreements.

Tom Harrison (right) with Diego Steinaker (Saskatchewan Prairie Conservation Action Plan).

Manitoba: Gervin Stock Farms (Curtis and Shannon Gervin)

Curtis and Shannon Gervin are beef producers whose cattle operation near Broomhill, Manitoba, has enormous conservation value, as it supports six of Manitoba's most threatened grassland bird species at risk.

Shannon Gervin (middle) and Curtis Gervin (right) with Alexandra Froese (Manitoba Burrowing Owl Recovery Program).

The Gervin family have been stewards of the land for generations and have been involved in grassland conservation and research for over 30 years. They take great pride in preservation and conservation of mixed-grass prairie along with the critical and threatened species that inhabit these important grasslands. They have a strong belief that livestock production under proper management can benefit and coincide with native grassland bird species. They promote habitat and species conservation on their entire farm, which is comprised of 51 quarter sections within the mixed-grass prairie region of Manitoba.

PLENARY PRESENTATIONS

PLENARY 1: The Prairie Crisis – Crossing the Ledger

Trevor Herriot

Abstract – More than 30 years after the PCESC conferences began, we have seen some progress in public awareness and even some small victories in species and habitat protection, but the overall decline of prairie species has accelerated and there are never enough funds to protect, restore, and manage the ecosystems that need it. It may be time to see the crisis in prairie ecosystems as part of the global crisis shaped by climate change and the collapse of wild systems. Industrialized agriculture and food systems figure strongly, both locally and globally, in the way we frame the crisis, but usually on the causation side of the ledger. In this presentation, naturalist and author Trevor Herriot looks at these matters and considers the potential of "regenerative agriculture" to move across the ledger, addressing climate change and biodiversity loss, while inviting more people into a culture of care for the soil, ecologies, and creatures that share our common home.

Before I begin this talk, I want to acknowledge the advice and information I received from two friends: Branimir Gjetvaj, photographer and naturalist, and Cathy Holtslander of the National Farmers Union, as well as photos from Branimir Gjetvaj.

This morning, as I skip along the surface of some very complex issues, saying a bit about how we got to where we are and how we might go forward, I want to keep in mind that this world around us, west of this city of Winnipeg all the way to the Rockies, despite all that has been lost on the surface, is still *prairie deep down in its climate and soils and topography*. And that means there is always the potential for recovery and for a healthier prairie rich with species and interrelationships feeding the grass that feeds everything.

I like that we are gathered here in Winnipeg to talk about prairie and grassland conservation measures. Because it was here that the very first cattle grazed on the Canadian Plains. In fact by 1835 there were somewhere between two and three thousand cattle here managed by Metis communities. And it was here along the Red and Assiniboine Rivers that the first *community-based regulations* for grazing and for cutting and gathering hay in Western Canada were established almost 200 years ago—regulations based on weather and moisture conditions that governed grazing rights and the exact date when haying could begin.

Full disclosure here: I have never been a farmer and I have never owned a cow. Not now, not ever. We do manage a herd of about 60,000 head of honey bees each summer. And we own about 100 acres of grass (native prairie, which the neighbour's cattle graze) and our hayland, which mostly supports gophers and native sparrows and wrens. But we have no cattle, and at the same time I am not a biologist, agrologist, or ecologist, and I barely snuck through my one science class in university . . . so I'm not sure why you should listen to me, really. The only personal stake I have in the things we talk about at this conference is my worry that we are losing the abundance and beauty of the natural prairie.

Part of what limits our capacity to even imagine a way forward for the prairie is our tendency to divide into camps: grazing and conservation; economy and ecology; rural and urban; producers and consumers; private use and public ownership; First Nations and settlers. If we act in ways that allow those dualities to divide us, everyone loses in the end. But if we look for points of common interest and unity, then I think we have a chance of doing something good for all of us.

But, as always, when we do this work and gather at meetings like this one, we come up against one of the most difficult and complex issues facing humanity: how do we use the land to grow food without doing long-term harm to the very natural systems that keep the land healthy and diverse? We are hearing more all the time about the role agriculture plays in climate change and the planet's ecological problems. We hear about it every day in the media and in the research we read—and some of us are getting weary of it, frankly.

Of course we all share certain responsibilities for the footprint of industrialized agriculture, whether we grow food or eat it. Large agribusiness corporations might deserve a larger share of responsibility but we all have a part in it, and benefit from it. So while there is increasing agreement that agriculture as we know it is causing big problems, there is very little agreement on how to solve them.

I wish I could stand up here and offer reasonable, rational, realistic solutions—ways to fiddle with the dials of our food and energy and water systems a bit until we suddenly arrive at amazing win-win solutions that restore biodiversity on the prairie, make our agricultural water and energy systems sustainable, and address climate change. I wish I could honestly do that and then just walk off the stage feeling like I am a reasonable person and not an idealistic dreamer pointing toward completely unrealistic-sounding solutions. Unfortunately I am likely going to fall more on the dreamer side of things today.

But if we look back on the last thirty years of prairie conservation in Canada, how much progress have we made with pragmatism, win-win solutions, and tweaking? Not much. Maybe the least rational perspective is to think we can keep doing things the same way, make small changes, and somehow get different results. Is that realistic? I don't think so.

A Commons Dilemma

Before I say anything about solutions emerging in agriculture, I want to look first at the language we use and the way we frame the problem and ask questions. As always we have far more questions than answers. One way to frame the range of questions is to talk about the shared public interest in what academics refer to as "The Commons"—the wildlife, water, air, public lands, and other resources that are not privately owned and which we share.

In farm country, most of the ecological problems caused by farming practices can be described as a "commons dilemma", whether it is a farmer draining a wetland, plowing the road allowance, or using pesticides that reduce insect populations. One way to define a commons

dilemma is to say that *the individual's short-term self-interests in using or degrading common resources are often at odds with long-term group interests and the common good.*

But in farm country there is something else going on. Farmers' interests are increasingly distorted and controlled by large agribusiness corporations that manage the global markets in commodities, so ultimately it's the interests of these corporations that are at odds with both the farmer's long-term interests and the public interest or the common good. Any hope we have of moving agriculture from the causation side of the ledger to the solution side, or of turning habitat from a liability into an asset, will require community-based regulations that balance the imperative for short-term private prosperity with the imperative for long-term community well-being, or the common good.

As conservationists looking for ways to harmonize the farmer's interests and the common good, we often find ourselves talking about what we call Ecological Goods and Services or EG&S. Since this conference began thirty years ago, there's been a lot of thinking and hand-wringing over what that means and how to "pay" for clean water, healthy soils, biodiversity, flood protection, etc. And conflict, as people divide into camps on the issue.

I agree completely that consumers and taxpayers need to share the responsibility for stewardship, but sometimes I cringe when I hear people talk about EG&S. Words matter. The phrase "goods and services" comes from the corporate, colonial, extractive mindset that is destroying the planet. It's a language implying commerce and transaction, consumption and production. But surely these ecological functions that give us healthy soil, clean air and water, pollination, carbon storage, flood and drought resilience, and the rich diversity of life on the land—surely these are not products or goods and services that require financial transaction; they are Gifts. They flow freely from nature as long as we don't impede or mess up the flow.

The problem with the language of EG&S is that instead of seeing these things as gifts from nature, we re-frame them as things that someone is producing and someone else is consuming. So now landowners and farmers are saying that *they* produce or provide EG&S and everyone else—city people especially—are consumers who need to recognize and pay for the production of EG&S. In a world immersed in an economic paradigm based on extraction and growth, this sounds reasonable and helpful, but the tail begins to wag the dog when we try to put a dollar value on a Burrowing Owl or a patch of fringed-orchids. I am afraid that we will lose sight of the real challenge: how do we equitably and sustainably share the burden of managing farm and ranch land in ways that allow natural processes and diversity to flourish. This may involve payments or a transfer of costs, but it has to be effective and enduring.

Photo by Branimir Gjetvaj

Moving Agriculture to the Solution Side

Apart from the language we use and the way we frame questions, as we begin this conference I think it's worth looking at some of the larger social and political forces, well beyond prairie conservation, that may help agriculture move from the cause to the solution side of the ledger.

I recently took my granddaughter to the Canadian Western Agribition in Regina (the largest livestock show in Canada, according to their website). Our day went like this: she is connecting with the animals…I show her where chicken and eggs come from…we make animal sounds…watch the auctions…see all the displays of agricultural machines systems and technologies, with brand names from Bayer to Caterpillar…how to build a bigger machine shed…displays of all kinds. We get hungry, look for food—the place is a food desert. All we can find is bad food from franchises—pizza, hamburgers, subway sandwiches—and one local food truck serving bbq meat on a bun, another with fries and mini-donuts. No better fare than at a typical summer exhibition midway. One of the continent's biggest celebrations of agriculture and there is very little focus on good healthy food.

The disconnect between farming and healthy food is one of the signs that agriculture is off-kilter. And people are beginning to notice, connecting the dots between industrial agriculture and human health issues like obesity, heart disease, and diabetes. Look at what is happening to the Canada Food Guide. There is more and more pressure for food to be healthy and therefore

for our land to be growing more than grains, sugars, and fats. This is just one of the forces that is changing agriculture.

There's more. In January 2019, CBC News reported on a study from Second Harvest (Canada's largest food rescue charity) showing that 58% of all food in Canada goes to waste, most of it at the producer and processor end of things.[1] Recently the InterAcademy Partnership, representing 130 national academies of science and medicine across the world, declared "The global food system is broken, leaving billions of people either underfed or overweight and driving the planet towards climate catastrophe."[2]

Of course, climate change may be the biggest factor in helping to transform agriculture. High-input, capital-intensive agriculture is being called out as a major cause of climate change, undermining future food production by destroying the stability of climate needed for reliable production. Another factor is increasing concern about concentration of land ownership and corporatization of land as large companies and pension funds invest in farmland and drive up land prices, threatening both food security and local communities.

There is increasing evidence that conventional, high-input agriculture does not in fact "Feed the World", as we have been led to believe. Scientists and global food security institutions have shown that food waste and distribution issues undercut any truth in the "We feed the world" PR we hear all the time: that the poor of the world cannot afford the commodities grown in the north on our vast farms, and that much of the world is fed by small-holder agriculture using low-tech, low-input systems. Canada's Arrell Food Institute at the University of Guelph has looked at the "feed the world" canard and concluded that too much land is used to grow commodities—grains, fats, sugars—which either end up in unhealthy and over-processed foods, or in feedlots and inefficient biofuel. They argue that if we switched the planet over to healthier diets we would actually free up millions of hectares of land currently being used for intensive agriculture.[3]

One of the other forces surrounding and challenging agriculture these days is happening particularly in Canada—the challenge from First Nations to the settler hold on the land. Through the Truth and Reconciliation process, some key court cases, and public discourse about the meaning of the numbered treaties, Canadians are being asked to reconsider the very foundation of our social contract and its hold on the land.

There is increasing evidence that the terms by which First Nations came to the treaty table were severely tilted in favour of colonial powers, and the oral record demonstrates that First Nations leaders had no idea that the written text of the treaties they signed stated they were surrendering rights to their own lands. A new book by Sheldon Krasowski, *No Surrender: The Land Remains Indigenous* [University of Regina Press, 2019], makes it clear that First Nations did not think they were surrendering control of the land.

So if it's true that the land and resources that benefit settler society have been secured at the cost of Indigenous lives, lands, languages, cultures, and prosperity—and that this cost continues

to be paid to this day by Indigenous people—what does that mean for our farmers and for the cause of prairie conservation? Because Indigenous people will tell you that talk of reconciliation is meaningless unless it includes a full discussion about land and land use.

This new Indigenous-led perspective around Treaties, and questions of land use and resources, is worth taking seriously for many reasons. For one, it is coming from the people who have lived on this land for thousands of years, and from Nations with cultures in which an awareness of the commons and the responsibility to share resources and the wealth of the land is still very strong.

In every issue facing prairie conservation, global biodiversity, and climate change, we see the commons dilemma over the way land is used, and that private interest is increasingly in conflict with long-term public good. In Western nations we *have* had laws and customs aimed at protecting the commons, going back to Roman law and then renewed with the Magna Carta and the Charter of the Forest in England in the 13th century, 802 years ago. That kind of commons awareness survives in our governance systems, but just barely, in regulations, environmental impact assessment processes, pollution laws, protection of species, limits on corporate and foreign land ownership.

But all of these measures to protect the commons are inadequate, too remote from the local community, and increasingly under attack from corporate interests lobbying against regulation and taxes on wealth. Private and corporate interests are pushing hard against any effective measures to defend the environment from industrial agriculture. Digging their heels in against the forces that are calling for agricultural reform and regulation, agribusiness corporations are trying to hang onto the status quo fiercely by doubling down on their rhetoric and PR work.

And so we have this phony crusade right now by the Cargills, and Bayers, and the rest of Big Agriculture, where they are claiming they will save the planet by doing more of the same stuff that has been destroying the planet and driving rural de-population and local food insecurity. To hold the line, the industry is investing millions in what they are calling "social licence" or "public trust" campaigning: using education (PR, really) to lobby our governments and convince the public that our current agricultural systems are not only sustainable but are the only possible way to feed ourselves and the rest of the world. A lot of this is coming from the Canadian Centre for Food Integrity, a front for industry funded by Bayer, Dow, Cargill, Dupont, John Deere, Syngenta, and many other corporations.

And their PR and lobbying appears to be working—at least in the short term. The federal/provincial funding framework for agriculture now includes "social licence" as one of their funding streams. In November 2018, our federal ministry of agriculture gave industry groups $250,000 to figure out how to "educate"—some would say manipulate—consumers via online campaigns.[4] In 2019 the Saskatchewan Ministry of Agriculture sponsored workshops led by these industry front groups to teach farmers public-speaking skills and get them on message so they can spread the gospel of public trust, because they know that if the message comes directly from agribusiness, the public will be skeptical.

But there is a counter movement in agriculture—not nearly as well-funded and visible—that aligns with the interests of prairie conservation: the new global Food Sovereignty movement rising in opposition to the propaganda from Team Feed the World. Sovereignty is not the same as "Food Security", which is a concept that has been distorted by agribusiness.

Food sovereignty is an internationally accepted, over-arching framework for talking about a system that actually feeds people, instead of corporations, and supports long-term health of the land. It advocates land and food governance policies that meet linked social, economic, and environmental goals—including the human right to food and food security, biodiversity conservation in agricultural landscapes, and low-carbon agricultural systems. In Canada, organizations including the National Farmers Union, the Union Paysanne in Québec, Food Secure Canada[5], and the People's Food Policy Project, among many others, are all working on building food sovereignty. These should be natural allies for the prairie conservation sector but we have not really been talking to one another.

Regenerative Agriculture

That's enough background and framing. Let's get to part two, the fun and dangerous bit—what might solutions look like? The good news is that many farmers are seeing that change is needed. There is an explosion of new thinking and ideas out there being tried by both livestock and crop producers—things that dovetail with the food sovereignty movement.
I found out very recently about Luna Field Farm in southwestern Manitoba's Aspen Parkland, which belongs to first-generation farmers Wian Prinsloo and Lydia Carpenter. Here is their mission statement: "Through the use of regenerative agricultural practices we are committed to producing the highest quality pasture raised and grassfed meats in Manitoba. We strive to sustain a viable family farm operation with respect for the animals and the land we steward. We aim to work with nature to produce and deliver food that is good for the community and for you and your family."[6]

So what is regenerative agriculture? Like sustainable agriculture, it is sometimes defined too broadly, but in its stricter definition it focuses on the foundation of soil health and values the diversity of polycultures, in which animals and plants form a complex, symbiotic, robust system. It seems to be presented as the opposite of extractive models. Extractive agricultural practices focus more on machinery, inputs, and land-clearing methods that maximize production. Extractive models value the gains from the extraction but don't discount the losses. They measure crop and animal yield and translate that into sales and profit, but don't account for or track the soil, nutrients, biodiversity, air and water quality lost during production.

Regenerative systems, on the other hand, work on both sides: minimizing inputs and maximizing yields, but also taking steps to minimize nutrient and biodiversity loss and degradation of water and soils. How is this done? With things like integrated crop and livestock production, cover crops, crop rotation, biodiverse annual and perennial mixes, stream buffers and grassed waterways, organic fertilizers, biological pest control, and keeping some uncultivated land to control erosion, capture water, and protect habitat for beneficial organisms and other plants and animals.

Of course, some of these things are already done even by conventional farmers, and that's wonderful. But the regenerative agriculture movement wants to go beyond things like rotational grazing and glyphosate-dependent no-till cropping in order to close the circle of production and waste and minimize the negative effects of growing good food. Many regenerative practices have a climate-change angle aimed at soil carbon retention: introduction of pasture phases in cropping systems, stubble retention, improved fertilization, and so on.

So how does the prairie conservation sector help out these positive developments in agriculture? By partnering with regenerative agriculture, agro-ecology, carbon-farming, and Food Sovereignty groups, and accessing funding to figure out which new methods actually result in real improvements in ecosystem health, water quality, and biodiversity at the landscape scale. Once we get that kind of rigorous research into these questions, it will be easier for government agencies and prairie conservationists to join the bandwagon.

But then what? Well, we advocate for policy that will help make this kind of agriculture affordable and possible for more farmers. But what policy levers have to be pulled to transition farming to a more positive force on the prairie, one that works on both sides of the ledger and helps producers and the wider public account for ecological losses and externalities, as well as yields and profits?

Here is a quick list of possibilities—by no means a complete list—of what needs to be done to stop the industrial overproduction of food that drives habitat loss, food waste, and agricultural emissions in Canada:

- we need equitable land access, affordable farm land, especially near urban centres, and we need to put some regulatory constraint on the accumulation of land;
- we need strong supply management programs, antitrust enforcement, and market reforms;
- how about a youth corps that encourages young people to spend time working in agriculture after graduation before they start their careers;
- a carbon tax system that rewards low-input farms and legitimate carbon storage additionality through the rebate structure;
- interest-free loans to small landholders who follow a set of agro-ecological standards;
- markets and market instruments that provide incentives for farmers to adopt such standards;
- wean farmers off hidden and perverse subsidies for the industrialized, high-input, export-driven agricultural production sector;
- instead, subsidize local food self-sufficiency and regenerative models of farming;
- internationally, focus on fair trade instead of free trade agreements;
- disengage our universities and governments from the lobbying and private interests of agribusiness.

I know—pie in the sky. Impractical. Unrealistic. But what choice do we have if we don't find ways to remove the hidden subsidies that prop up the current system, and devise policy that would elevate the growing of good food—healthy for people and the land—to the status it deserves at the centre of a more sane, moral, and sustainable economy?

Photo by Branimir Gjetvaj

Native Grassland Needs Grazing

I would like to focus the rest of my remarks on an endangered form of agriculture that we know already supports grassland conservation: the grazing of livestock on native grass. For the last ten years or more, the global beef industry has been under a lot of pressure from science and the wider public, from every angle: animal rights and veganism, water quality, human nutrition, biodiversity, and climate change.

But recently we've seen some new reports in respected scientific journals, including *Nature* and *The Lancet*, that have really intensified this pressure to new levels by connecting the dots between overall levels of beef production and consumption, human health, and climate change. The critique is gaining momentum. Here is just one example from a study published in *Nature* in October 2018 by a research group led by Dr. Marco Springmann:

> "If we continue with our current levels of meat consumption, it's very likely that we will have more flooding, more hurricanes, extreme weather that is associated with exceeding the two-degree target for climate change ... if nothing is done then those pressures could increase by 50 to 90% and by that time it will basically exceed all

environmental limits or so-called planetary boundaries that define a safe operating space for humanity."[7]

Of course the critique oversimplifies things and completely forgets that the planet's temperate grasslands need to be grazed. We all know that, and we know there are good arguments opposing some of this criticism of the industry. Eventually, we can hope, public opinion may come to a more complex and balanced understanding of how grazing livestock fits into our climate change and environmental issues.

When and if that happens, the side of the industry that will be able to justify itself will be the pasture-raised side, especially livestock raised sustainably on native grasslands, with a minimum of finishing on grain. There are two elements of the beef industry that will lose out and be harder to justify in the future: 1) cattle grazing in places where they should not be—in de-forested landscapes, for example; and 2) the portion of the industry that depends heavily on cheap corn, soy, and grain grown in unsustainable, carbon-intensive systems.

In time, ranchers using native prairie and diverse perennial grasslands are going to need to distinguish themselves from the rest of the industry. I can't see any way to do that other than withdrawing from the mainstream feedlot-finishing supply chain, and finding other ways to finish their animals and get them to market as a product that is healthy for the land and our bodies. That will allow ranchers to demonstrate that their product is more climate-friendly and biodiversity-friendly, and that should also mean they will receive better prices. Just as people today are willing to pay higher prices for things like free-range eggs, many of those who want to continue eating some beef are going to be willing to pay a premium for it.

Two things would help our remaining grasslands survive the coming decades, when there will be more pressure on the beef industry to reduce its ecological and climate change footprint:

1) We need a science-based watchdog report on grassland, i.e., two or three scientists who produce an annual report on the state of the grasslands in the Prairie Provinces, and what is being done to improve the climate footprint of Canadian beef produced on native grassland.
2) We need to address the growing technical knowledge gap in rangeland management. In recent years we have seen an overall reduction in government capacity to provide extension services that will meet the increasing demands for ecologically informed management on private and publicly managed grassland.

Prairie Canada needs a federally funded agency or branch that will provide that extension capacity in range management and grassland conservation, while also developing sound policy on the most complex and challenging issues faced in the grassland regions. Things like:

- Managing grassland for climate change;
- Managing grassland for species at risk and biodiversity;
- Fostering and supporting the culture of ranching stewardship;
- Meeting protected areas targets in grassland;
- Meaningful and equal partnerships with First Nations and Metis people on all of the above.

In Conclusion

I have said a lot, and much more could be said, but it comes down to this: if we want prairie biodiversity to recover or even survive the coming decades, we are going to need solutions developed and enforced by the community, backed by good science and government policy that combines the best of settler and Indigenous land ethics.

In the 19th century, long before Manitoba was a province, the Metis here used community-based ethics to regulate grazing rights and something they called "the hay privilege", a two-mile strip of land just back of each Metis family's river lot where they claimed first rights to cut hay for their wintering livestock. By 1870 the hay privilege was at the centre of the conflict between the Metis and the Canadian government, and that dispute led to the founding of the province of Manitoba. The settler governments immediately removed Metis concepts of land tenure, and replaced them with the land tenure and governance systems we use today, which are proving to be less than adequate.

That bears some thought, in the light of the challenges we face in balancing the interests of private land users with the interests of the community and the wider public.

Photo by Branimir Gjetvaj

Notes

1. https://www.cbc.ca/news/canada/toronto/food-waste-report-second-harvest-1.4981728

Second Harvest (https://secondharvest.ca/) is "the largest food rescue organization in Canada and global thought leader on food recovery. We work across the supply chain from farm to retail to capture surplus food before it ends up in the landfill" (from their website).

2. https://www.theguardian.com/environment/2018/nov/28/global-food-system-is-broken-say-worlds-science-academies

3. The Arrell Institute (https://arrellfoodinstitute.ca/) says we have enough food already to feed the planet but distribution is an issue because prices fluctuate and many people are too poor to be able to buy the food we produce, leading to political instability and conflict. The Arab spring rebellions began as food riots.

4. See press release at: https://www.canada.ca/en/agriculture-agri-food/news/2018/11/investing-in-innovative-approach-to-strengthen-public-trust-in-canadas-agricultural-sector.html

5. See https://foodsecurecanada.org/five-big-ideas. Food Secure Canada is "a pan-Canadian alliance of organizations and individuals working together to advance food security and food sovereignty through three interlocking goals: zero hunger, healthy and safe food, and sustainable food systems." (from their website).

6. See https://www.lunafieldfarm.com.

7. Springmann, M., M. Clark, D. Mason-D'Croz, *et al.* (2018) Options for keeping the food system within environmental limits. *Nature* **562,** 519–525. https://doi.org/10.1038/s41586-018-0594-0

Trevor Herriot is a naturalist, writer, and co-chair of Public Pastures – Public Interest. He is the author of several award-winning books, including *Grass, Sky, Song* and the national bestseller *River in a Dry Land*, both of which were short-listed for the Governor General's Award for Non-fiction. He is the 2017 recipient of the Cheryl and Henry Kloppenburg Award for Literary Excellence. *Towards a Prairie Atonement*, published in October 2016, took two Saskatchewan Book Awards, as did *Islands of Grass*, a book of his essays accompanying the photographs of Branimir Gjetvaj, released in the fall of 2017. He has published essays and articles in *The Globe & Mail*, *Brick*, *Border Crossings*, *Canadian Geographic*, and several anthologies. Herriot is featured regularly on CBC Radio and is a frequent guest on the call-in show, Blue Sky. He and his wife, Karen, live in Regina, have four adult children, and spend much of their time on a piece of Aspen Parkland prairie east of the city. Email: trevorherriot@gmail.com

PLENARY 2: Lessons from the South of the Divide – A Facilitated Panel Discussion

Moderators **Sheldon McLeod**, SLMcLeod Consulting
Karl Zimmer, Environment and Climate Change Canada

Panel Presenters **Chay Anderson**, Rancher
Robin Bloom, Canadian Wildlife Service, Environment and Climate Change Canada
Tom Harrison, South of the Divide Conservation Action Program Inc.
Jeff McManus, Crescent Point Energy
Sue Michalsky, Rancher, Rancher Stewardship Alliance
Beatriz Prieto, Saskatchewan Ministry of Environment

Abstract – The South of the Divide Action Plan (2017) targets nine federally listed species at risk inhabiting the Milk River basin of southwestern Saskatchewan. The nine species, largely dependent on short-grass native prairie habitats, are: Black-footed Ferret (*Mustela nigripes*), Burrowing Owl (*Athene cunicularia*), Eastern Yellow-bellied Racer (*Coluber constrictor flaviventris*), Greater Sage-grouse (*Centrocercus urophasianus*), Loggerhead Shrike (*Lanius ludovicianus*), Mormon Metal Mark (*Apodemia mormo*), Mountain Plover (*Charadrius montanus*), Sprague's Pipit (*Anthus spragueii*), and Swift Fox (*Vulpes velox*). The goal of the plan is to conserve these and other species at risk, and their supporting habitats, through cost-effective measures and collaboration with landowners and other land users or stakeholders. This plenary discusses perspectives and lessons learned from some of the key partners involved in the development and implementation of the South of the Divide Action Plan to hopefully provide guidance for other cooperative multi-species ecosystem-level planning initiatives in other prairie priority areas.

Chay Anderson is from Fir Mountain, Saskatchewan, where he ranches alongside his father, Lloyd. The ranch, a cow-calf operation that grasses their own yearlings as well, has collaborated with Saskatchewan Stock Growers Association (SSGA), South of the Divide Conservation Action Program (SODCAP) Inc., and Grasslands National Park on species at risk projects. Chay received his agribusiness degree from the University of Saskatchewan in 2014, and is involved in the SSGA's youth mentorship program.

Robin Bloom has worked for the Canadian Wildlife Service (CWS) for 17 years (in the Prairie Region since 2005). His roles have included technical fieldwork on grassland songbird and prairie plant species at risk, coordination of habitat stewardship funding, and development of policy advice for prairie habitat conservation incentives under the Species at Risk Act. He has worked with conservation organizations as well as individual farmers and ranchers who own and manage prairie habitats important to species at risk. Robin currently works as a funding coordinator in the CWS Prairie Stewardship Unit, developing funding relationships with the agricultural sector to achieve prairie conservation outcomes under Environment and Climate Change Canada's Species at Risk Partnerships on Agricultural Land initiative (SARPAL). Email: robin.bloom@canada.ca

Tom Harrison ranches with his wife Tracy and daughter Kaitlyn, running a 250-head herd of Angus and Speckle Park cows near Regina and Swift Current. Tom has served as the executive director for South of the Divide Conservation Action Program (SODCAP) Inc. since 2014, and was involved with the SOD planning process from 2007 to 2013. He has a B.S.A. (1984) and M.Sc. (1993) from the College of

Agriculture, University of Saskatchewan, and more than 25 years of experience as a Professional Agrologist in agri-environmental programming, both as a consultant and with agencies such as Saskatchewan Wetland Conservation Corporation/Water Security Agency, Saskatchewan Indian Agricultural Program, and Agriculture Canada. Email: ed@sodcap.com

Jeff McManus is the Surface Land Manager at Crescent Point Energy, and has over 23 years of oil and gas experience in all four western provinces and the US. Jeff has a degree in journalism from the University of Montana. He has been involved in various roles with South of the Divide Conservation Action Program (SODCAP) Inc. since its inception including Co-Chairing the Board of Directors. Jeff was also involved with Crescent Point's partnership with the Calgary Zoo for the reintroduction of the Swift Fox in southwestern Saskatchewan. Email: jmcmanus@crescentpointenergy.com

Sue Michalsky is a beef and lamb producer with ranch holdings in southwestern Saskatchewan and southwestern Alberta. The grasslands she owns and manages support at least 11 federally listed species at risk. Sue is a graduate of the University of Alberta and has worked throughout North America as a rangeland ecologist and conservation practitioner, in the areas of livestock and range management, conservation planning, and agri-environmental policy. She is a co-founder and director of the Ranchers Stewardship Alliance Inc. Email: suemichalsky@sasktel.com

Beatriz Prieto is a Terrestrial Ecologist with the Saskatchewan Ministry of Environment. With a background in Conservation Biology, Beatriz has extensive experience in planning and developing wildlife and endangered species conservation and management projects in different countries and contexts. She has been involved with the South of the Divide project since the very early stages and is leading the implementation actions for the Saskatchewan government. Email: beatriz.prietodiaz@gov.sk.ca

PLENARY 3-1: Beyond Pesticides – A Systems-Level Solution for Agriculture and the Environment

Christy A. Morrissey

Department of Biology and the School of Environment and Sustainability, University of Saskatchewan
Email: christy.morrissey@usask.ca

Abstract – There is an urgent need for coordinated scientific and economic evidence to support agroecosystem redesign to improve the sustainability and resilience of Canadian agriculture. In Canada, the Prairies represent the largest agricultural region covering an area of 40.1 million ha and providing over half of the nation's agricultural food exports. The region is dominantly under monoculture production of the major commodities of the Prairies: cereals, oilseeds, pulses, and livestock. Our research confirms the negative environmental effects of pesticides to wetlands and biodiversity, while producers face additional challenges from pest resistance, tighter chemical restrictions, degradation of soil health, and rising cost of production.

The Canadian Prairie Agroecosystem Resilience Network (CPARNet) was conceived and developed by 34 academics from 7 institutions working in tandem with agro-industry groups, government scientists and policy makers, NGOs, First Nations, and farmers, with the goal to conduct participatory whole-farm studies in the Prairies. The Network plans to use a holistic systems approach to simultaneously study environmental, agronomic, and economic processes across a gradient of farming practices and geographic conditions. Researchers will also work with farmers to apply ecological intensification methods and look at the costs and benefits. We hope to provide farmers with alternative strategies for reducing risk while increasing productivity and profitability by enhancing landscape diversity and ecosystem services. This innovative approach will address multiple challenges facing Canada, including crop stability, climate change, pollution, and loss of biodiversity, by giving the agricultural industry tools and strategies to increase the sustainability and resilience of Canadian food production systems now and in the future.

Christy Morrissey is an Associate Professor at the University of Saskatchewan in the Department of Biology and the School of Environment and Sustainability. Her research expertise is in avian ecotoxicology, aquatic ecology, ecophysiology, and wildlife conservation. Christy has 20 years of experience (with over 55 publications) on issues related to environmental contamination from pesticides and other chemicals, and the use of birds as indicators of environmental change. She has been an advisor and member of the IUCN Task Force on Systemic Pesticides and works closely with provincial and federal governments on regulatory issues of pesticides, wetlands, and the conservation of migratory birds. Dr. Morrissey has been featured widely in national and international media including CBC's Quirks and Quarks and The Nature of Things, Audubon Magazine, Science Daily, and a full feature documentary film about songbird declines called "The Messenger".

PLENARY 3-2: Applying the Principles of Regenerative Agriculture in Manitoba

Ryan Boyd

Email: rboydy@yahoo.ca

Abstract – I have been applying the principles of Regenerative Agriculture for several years on our farm and describe some of the changes that have been made. Creating an integrated crop-livestock system has been challenging and comes with many successes and failures. I share my experiences and offer insights on what it will take to implement Regenerative Agriculture at scale and get more widespread adoption of profitable, productive, and conservation-minded approaches to farming.

Ryan Boyd is a family farmer who is passionate about soil health, forage-efficient cattle, and no-till cropping systems. Ryan operates a mixed farm just north of Forrest, Manitoba, with his wife Sarah, daughter Piper, son Bingham, and parents Jim and Joanne Boyd. The farm focuses on integrating cattle and grain crops to capitalize on the many synergies that exist between the two. The farm consists of approximately 300 Black Angus beef cows, calving in June, and a diverse crop rotation. Ryan was recently awarded a 2019 Nuffield Farming Scholarship.

PLENARY 4: What is Indigenous-led Conservation?

Shaunna Morgan Siegers

Indigenous Leadership Initiative; Email: smorgan@borealcanada.ca

Abstract – I've often heard that the greatest biodiversity is found on the lands occupied and used by Indigenous peoples. A 2017 headline (IPS News Agency) reported: "Indigenous Peoples Guard 80 Per Cent of World's Biodiversity." Indigenous peoples across Turtle Island (aka North America) and around the world have been the original conservationists – although they would never phrase it like that as the term "conservation" is so foreign to them and even has negative connotations given its hierarchical nature that places humans in a position of power as managers over plants, animals, water, etc.

The common ground in the Indigenous-led "conservation" of plants, animals, and other living organisms often comes from the value many Indigenous peoples place on all life. You've probably heard the term "all my relations", and if you've heard a prayer translated from an Indigenous language into English you would likely hear the Elder thanking all the elements of life – air, water, earth, fire, the four directions, and all the living creatures. It's all about relationships and the act of carefully nurturing and maintaining those relationships. All relationships are multidimensional, intraspecific and interspecific, like an infinite-dimensional web; everything is connected. For many Indigenous peoples who follow a traditional way, relationships are guided by the seven sacred teachings: love, respect, courage, honesty, wisdom, humility, and truth – these are the laws that govern their decisions and actions. These values and teachings – once nearly stripped away by colonization, religious conversion, and residential schools – are being taught by the Elders once again.

Like the diversity of Indigenous cultures around the world, Indigenous-led conservation can take many shapes. I present three forms of Indigenous-led conservation promoted and supported by the Indigenous Leadership Initiative: Indigenous Guardians, Indigenous Land Use Planning and Indigenous Protected Areas, and connect how each of these relates to species at risk. I also talk about considerations for collaboration and reconciliation through Indigenous-led conservation.

Shaunna Morgan Siegers is Operations Manager for the Indigenous Leadership Initiative (ILI). Born, raised, and currently living in southern Manitoba, she is a member of The Crees of Waskaganish First Nation situated on the southern shores of James Bay in Eeyou Istchee. A scientist with B.Sc. and M.Sc. degrees in botany, she has more than 25 years of research, Indigenous Knowledge, and environmental science experience. Shaunna has lived and/or worked with many First Nations across Canada, and has a deeply held sense of responsibility to protect the environment and keep it healthy for future generations. She seeks well-balanced solutions to address the complex environmental, social, cultural, and economic challenges we all face.

SESSION ABSTRACTS AND PAPERS

SESSION 1: PRAIRIE BIRD CONSERVATION – PART I

Session Moderator – Ron Bazin, Environment and Climate Change Canada

The Status of Red-headed Woodpeckers in Southern Manitoba: Can They Persist Without Grazing?

Ken De Smet

Wildlife and Fisheries Branch, Manitoba Sustainable Development; Email: Ken.DeSmet@gov.mb.ca

Abstract – Results from playback surveys for Red-headed Woodpeckers (*Melanerpes erythrocephalus*) in suitable habitat within southern Manitoba during 2018 are discussed. The importance of doing this survey was highlighted by the fact that Red-headed Woodpeckers were recently declared as Endangered in Canada, and the national status report identified Manitoba as supporting about two-thirds of Canada's nesting population, yet provincial population estimates and known nesting locales were found to be woefully inadequate. Atlas squares identified as hotspots during surveys for a recent 5-year Breeding Bird Atlas (2010–2014), as well as other recent nesting sites identified in the Manitoba Conservation Database, were visited. Any former nesting site or suitable-looking habitat within 300 m of a road was visited, and minimal numbers of responding pairs (or presumed pairs) were recorded. Minimal and presumed population estimates for the province are discussed and related to population estimates used in arriving at the species' national status. The reliance of this species on moderate to heavily grazed woodlots and other aspects of woodlot composition are also discussed.

Comparing Population Trends of Grassland Bird Species at Risk between a Large, Intact Native Prairie and Breeding Bird Survey Data at Multiple Spatial Scales

Nancy A. Mahony[1], Brenda C. Dale[2] and David A. Miller[3]

[1] Wildlife Research Division, Environment and Climate Change Canada; Email: nancy.mahony@canada.ca
[2] Canadian Wildlife Service, Environment and Climate Change Canada
[3] Department of Ecosystem Science and Management, Pennsylvania State University

Abstract – The steep and ongoing decline of grassland bird populations points to agricultural intensification on the breeding ground as a cause. While this is undoubtedly a major factor, it is unclear whether factors in migration and wintering areas or changes in climate and weather patterns are contributing. We explored these varied influences by comparing population trends between Breeding Bird Survey (BBS) routes at three spatial scales and Suffield National Wildlife Area, a large (459 km^2), intact native mixed-grass prairie in a region dominated by cropped agriculture. We predicted that if agricultural intensification is driving trends, then BBS data will show steeper declines compared to Suffield. Conversely, if trends at Suffield are similar to BBS data, then other factors may be contributing.

We estimated Suffield trends from 1994 to 2016 for 16 passerine and shorebird species and compared those trends to BBS data at regional, national, and North America-wide scales. Almost all species with declining BBS trends, including five species at risk, are stable or increasing at Suffield. BBS routes with a higher percentage of rangeland versus cropland show intermediate results. This suggests that ongoing agricultural activities which dominate breeding areas of North American grassland birds are responsible for population declines, highlighting the critical importance of conserving native prairie habitat.

Grassland Bird Diversity and Abundance Responses to Alternative Grazing Practices

Jeannine Randall[1] and Mark Boyce[2]

[1] Natural Resources and Environmental Studies, University of Northern British Columbia;
Email: randallj@unbc.ca
[2] Department of Biological Sciences, University of Alberta

Abstract – Prairie ecosystems are a globally important habitat type that is under pressure from multiple sources including livestock production. Grasslands support diverse ecological communities, including grassland birds that are experiencing widespread population declines largely due to habitat degradation. Given this, it is important to determine how alternative grazing practices influence the abundance and diversity of birds that depend on grassland and shrub-grass habitats. We compared avian diversity and abundance on ranches using traditional grazing practices (continuous and slow-rotational) and those using adaptive multi-paddock (AMP) management practices with high stocking rates and fast rotation of grazing animals among pastures. Using point-count surveys, we assessed the diversity and abundance of breeding birds at 27 pairs of sites (one traditional and one AMP), across the Canadian prairies of Alberta, Saskatchewan, and Manitoba. After controlling for vegetation type (native or seeded) and survey conditions, abundance data and diversity indices (Shannon and Simpson indices) were not different between management regimes. Our findings suggest that despite the intensity of AMP grazing, there appear to be few consequences for grassland birds. Both AMP and rest-rotation grazing practices ensure that portions of the ranch are ungrazed during the key breeding season of late May through June each year.

Enhancing Grassland Bird Habitat in a Semi-urban Landscape

Renny W. Grilz and Eryn Tomlinson

Meewasin Valley Authority; Email: rgrilz@meewasin.com

Abstract – With the dramatic loss of native prairie and the steady decline in grassland bird populations across the prairies, ranchers, landowners, and conservation agencies have a challenge to maintain existing native prairie sites while trying to meet their objectives for the land and also providing habitat for grassland bird species. The challenge is even more difficult when the native prairie is surrounded or adjacent to large urban centres with public access to the site.

Meewasin is responsible for several native prairie sites within the City of Saskatoon and surrounding area. These sites provide important habitat for numerous grassland bird species, including several species at risk: Sprague's Pipit (*Anthus spragueii*), Bobolink (*Dolichonyx oryzivorus*), and Short-eared Owl (*Asio flammeus*), to name a few. Over the last three years, with funding from Environment and Climate Canada's Habitat Stewardship Program, Meewasin has been utilizing an integrated approach to enhancing grassland bird habitat with numerous conservation tools including prescribed burning, targeted conservation grazing, conservation mowing, invasive species management, and awareness/outreach. This presentation discusses the integrated approach to enhancing grassland bird habitat in the Saskatoon region.

Trials and Tribulations from 40 Years of Grassland Bird Monitoring in Southwestern Manitoba

Ken De Smet

Wildlife and Fisheries Branch, Manitoba Sustainable Development; Email: Ken.DeSmet@gov.mb.ca

Abstract – The highs and lows from over 40 years of monitoring the status of Ferruginous Hawk (*Buteo regalis*), Loggerhead Shrike (*Lanius ludovicianus*), and Burrowing Owl (*Athene cunicularia*) populations in southwestern Manitoba are discussed. When weather patterns change drastically, huge swings in productivity and number of breeding pairs occur. Given that southwestern Manitoba is at or near the edge of the breeding range for many of these species, can they hang on during extended wet weather period or during extended climate switches? As wildlife managers, what do we do when populations reach dangerously low levels?

SESSION 2: PRAIRIE BUTTERFLY CONSERVATION

Session Moderator – Stephen Peterson, Assiniboine Park Zoo and Assiniboine Park Conservancy

Collaborative Conservation for the Endangered Poweshiek Skipperling: Working Together to Save a Species

Melissa A. Grantham and Cary D. Hamel

Nature Conservancy of Canada – Manitoba Region; Email: melissa.grantham@natureconservancy.ca

Abstract – The prairie endemic Poweshiek Skipperling (*Oarisma poweshiek*) butterfly is listed as Endangered under Canada's Species at Risk Act and the US Endangered Species Act. Its global population is estimated to be < 500 individuals. Species' recovery is challenging, due to rapid declines and local extirpations, remnant populations occurring in complex agricultural-residential landscapes and in multiple jurisdictions, and numerous knowledge gaps such as basic life history and cause of decline. Multiple research projects and novel recovery approaches regularly present new information that should be incorporated into decision-making.

In response, 23 Canadian and US partner agencies and organizations have formed the Poweshiek Skipperling International Partnership to collaborate on range-wide recovery. Guided by a cross-border conservation strategy, partners work together to address research, habitat management, captive rearing, fundraising, and outreach priorities. Here we present the coordinated and cooperative approach taken by the partnership, along with some of the challenges and successes experienced through working within an adaptive management framework.

Ex-situ Prairie Conservation in Zoos: A Case Study of the Poweshiek Skipperling, an Endangered Grassland Butterfly

Laura D. Burns[1], Cale Nordmeyer[2], C-Jae C.M. Breiter[1], Paulson G. Des Brisay[1], Erik B. Runquist[2] and Stephen D. Petersen[1]

[1] Assiniboine Park Zoo; Email: lburns@assiniboinepark.ca
[2] Minnesota Zoo

Abstract – Modern zoos have become a valuable and unique tool in the conservation of endangered species, specifically as ex-situ conservation centres. With animal care teams and specialized facilities, they are ideal for captive rearing, breeding, and release programs. As more invertebrates are added to endangered species lists, the need and capacity for zoos to lead ex-situ invertebrate conservation programs is growing. Assiniboine Park Zoo and the Minnesota Zoo have partnered to develop the world's only Poweshiek Skipperling (*Oarisma poweshiek*) ex-situ conservation program. The Poweshiek Skipperling is a highly specialized tall-grass prairie butterfly species that has experienced dramatic population declines across its range. By bringing skipperlings into human care during the egg stage, rearing them through their vulnerable larval stages, and releasing them as adults back to their natal sites the following year, we hope to increase annual recruitment until the last populations return to self-sustaining thresholds. This highly collaborative and science-based adaptive management conservation program had its first major success in the summer of 2018, when both zoos successfully released adults into the wild for the first time. The Poweshiek Skipperling recovery project is an example of how zoos can be a vital piece of the prairie conservation puzzle.

Assessment of Oviposition Behaviour and Larval Microhabitat Location for Potential Reintroduction of the Endangered Poweshiek Skipperling in Tall-grass Prairie in Manitoba

Justis Henault and Richard Westwood

Department of Biology, University of Winnipeg; Email: henault-j@webmail.uwinnipeg.ca

Abstract – The Poweshiek Skipperling (*Oarisma poweshiek*) is an endangered butterfly endemic to the tall-grass prairie in North America. Historically occurring in Manitoba and in the northern mid-US, the Poweshiek Skipperling is now only found in the Tall Grass Prairie Preserve in Manitoba and at four small prairie fen sites in Michigan. Habitat loss is the primary factor contributing to the decline of this species but biological and structural factors within its habitat also regulate survival. Poweshiek Skipperling lay eggs in microhabitats with certain characteristics needed to provide food and shelter requirements for immature stages. Of special interest is the identity of larval host plants which are unknown in Manitoba. This information is critical to initiate a rearing program to reintroduce this species into sites where it has now disappeared. Female oviposition activities were observed to locate larvae and determine actual host plant species in tall-grass prairie in Manitoba. New behaviour of larvae on host plants in Manitoba is reported. This research will guide future management and reintroduction efforts for the long-term survival of Poweshiek Skipperling in Manitoba.

Pesticides and the Disappearance of Threatened and Endangered Prairie Butterflies

Erik Runquist

Minnesota Zoo; Email: erik.runquist@state.mn.us

Abstract – Prairies are home to a diverse assemblage of butterflies, but recently many have declined dramatically. Indeed, the Poweshiek Skipperling (*Oarisma poweshiek*) and Dakota Skipper (*Hesperia dacotae*) are now listed as Threatened and Endangered species in the US and Canada, despite formerly being predictable and widespread across the Upper Midwest. Many interacting factors have likely contributed to their declines at local, regional, and global scales, but one of the key hypothesized drivers of their recent range-wide collapses is movement of non-target insecticide from adjacent agriculture. The Minnesota Zoo and partners have been studying the extent of pesticide occurrence in prairie remnants that house(d) these protected butterflies. Broad-spectrum insecticides primarily applied against economically damaging pest soybean aphids (particularly chlorpyrifos, bifenthrin, and lambda-cyhalothrin) have been commonly found at all sampled prairies in Minnesota and South Dakota. Similar monitoring efforts are underway at the last global strongholds of Poweshiek Skipperling in Manitoba and Michigan. Experiments are underway to estimate the biological consequences of pesticide exposures to prairie skippers. Efforts to restore and manage prairies for prairie butterflies should be cognizant of potential exposure to non-target pesticides.

Habitat Characterization of Saskatchewan's Dakota Skipper Population

Kelsey M. Seidle[1], Eric G. Lamb[2] and Jean-Michel DeVink[1]

[1] School of Environment and Sustainability, University of Saskatchewan and Dillon Consulting Limited; Email: kseidle@dillon.ca

[2] Department of Plant Science, University of Saskatchewan

Abstract – The Dakota Skipper (*Hesperia dacotae*) is an at-risk butterfly that inhabits the mesic mixed-grass prairie. Currently, there is little knowledge of habitat associations and availability of Saskatchewan populations. The first objective was to understand environmental associations of Dakota Skipper habitat. Data collected in 2015/2016 resulted in 46 surveyed sites; 9 were positive (i.e., present) and 37 were negative (i.e., not detected). Results indicated that plant community composition was not a significant predictor of Dakota Skipper presence, but three plant species were significantly associated with the species. No soil or climate variables were significant predictors of Dakota Skipper presence; however, the species was significantly associated with steep slopes, and warmer maximum and average ground-level temperatures.

The second objective was to determine Dakota Skipper habitat suitability and distribution through a landscape-level habitat distribution model. From a total of 66 survey sites, 28 were positive and 38 were negative. Results indicated that only 11% of the native prairie region contains exceptional habitat. These areas contain a significantly lower mean diurnal temperature range and higher ammonium soil contents. Therefore, although the Dakota skipper inhabits the native mesic mixed-grass prairie, environmental constraints restrict this species to a more limited area of available habitat than initially thought.

SESSION 3: TOOLS FOR MODELS AND CONSERVATION

Session Moderator – Carla Church, Manitoba Sustainable Development

MULTISAR – Enhancing Habitat Conservation Strategies with GIS solutions: Applying ArcGIS Model Builder and Grassland Vegetation Inventory (GVI) to Expedite Wildlife Surveys for Species at Risk and Management Plans for Producers in Southern Alberta

Mike Verhage

Alberta Conservation Association; Email: Mike.Verhage@ab-conservation.com

Abstract – The MULTISAR program provides tools for landholders interested in conserving species at risk. A Habitat Conservation Strategy is a detailed, in-depth, and free customized ranch plan that balances healthy rangelands with wildlife habitat through grazing recommendations and habitat improvements. The process includes detailed wildlife surveys, range inventories, riparian health assessments, and information on current management practices and ranch history.

We start this process by overlaying a biophysical grassland dataset on the property. The Grassland Vegetation Inventory (GVI) is a comprehensive GIS product that represents Alberta's vegetation inventory for the Grassland Natural Region. It is comprised of ecological range sites based on soils information for areas of native vegetation and general land use for areas of non-native vegetation.

To expedite our surveying process, we built a customized tool in ArcGIS Model Builder that determines and refines the locations of point counts. The model applies buffers to existing roads, trails, fence lines, and edges of GVI polygons to ensure that survey points occur in areas representative of each unique GVI site type, and away from anthropogenic features that may affect the presence, composition, and abundance of birds. MULTISAR biologists used this process to complete over 330 wildlife surveys in the spring of 2017.

Is the Picture Worth a Thousand Animals? Individual Differences Drive Space Use in Prairie Elk Populations

Levi J. Newediuk, Christina M. Prokopenko and Eric Vander Wal

Biology Department, Memorial University of Newfoundland; Email: j.newedi@gmail.com

Abstract – With rapid environmental change in the Anthropocene, predicting changes in species distributions through time and space has become a priority for conservation biologists. Predictive models are commonly predicated on the notion that populations respond as units to changing habitat suitability, but individual animals select habitat differently because of nuanced trade-offs between acquiring resources and avoiding risk. Thus, to understand how external factors influence habitat selection in changing environments, we also need to consider the qualities of the individuals making decisions.

Elk in Riding Mountain National Park and the Rural Municipality of Stuartburn in Manitoba inhabit complex landscapes ranging from deciduous forest to native prairie to heavily modified agricultural habitat. Tracking GPS-collared individuals from both populations, we compared the ability of population-level and individual-level habitat selection models to predict individual space use. Performance in individual-level models varied drastically, but consistently outperformed population-level models in both populations. We argue that considering differences among populations, within populations, and within individuals improves predictions of future species distributions. Understanding space use by mobile mammals is particularly important in prairie landscapes, as their movements indicate landscape connectivity as well as environmental changes precipitated by human activities.

Are You Seeing the Whole Picture? Applied Uses for High-resolution Elevation Data (LiDAR) in Biodiversity Conservation and Land Management

Jordan Becker and Cary D. Hamel

Nature Conservancy of Canada – Manitoba Region; Email: Jordan.Becker@natureconservancy.ca

Abstract – The recent and open availability of Light Detection and Ranging (LiDAR) data represents a new era of remote sensing for decision-makers and landscape planners. These data provide researchers, landowners, and resource managers the ability to see the landscape in a new light and make management decisions with greater confidence and precision. These high-resolution elevation data can detect vertical changes smaller than 10 cm, and sets the stage for a new era of decision-support tools and discovery on the landscape.

Although traditionally used in hydrological modelling, LiDAR data can also inform biodiversity, conservation, and land management decision-making. We present our experience in utilizing these data for: identification of native prairie, vegetation classification, discovery of freshwater springs, investigation of geological anomalies, identification of hydrological impoundments, inventories for karst features like hibernacula, identification of cultural features, and threat ranking in conservation planning. The use of LiDAR allows conservation land managers to see landscape features that cannot be observed with orthophotography or even the naked eye, and has proved to be an exceptionally useful tool in advancing conservation work on-the-ground.

Policy Instruments and Incentives for Conservation on Working Landscapes

Jeremy Pittman

School of Planning, University of Waterloo; Email: jpittman@uwaterloo.ca

Abstract – Working landscapes provide an opportunity to enhance grassland and species at risk conservation efforts on the Canadian Prairies. They can provide a significant amount of habitat for various species and enhance ecological connectivity by facilitating species movement across landscapes. However, working landscapes also require the development of policies and programs that can help ensure conservation objectives are met, while aligning with the various human livelihoods and ways of life that working landscapes are also intended to support. This presentation provides an overview of existing and emerging policy instruments and incentives for conservation on the Canadian Prairies and discusses their potential to contribute to working landscapes that protect biodiversity and support human livelihoods.

The analysis is based on a recent survey of practitioners (n=77) working with conservation and agricultural organizations. The survey gathered their perceptions and perspectives on the potential of the instruments and incentives to enhance uptake of conservation programs on working landscapes. The survey covered four policy instruments (easements, land securement, conservation management agreements, and certification) and five different types of incentives (assurances, market-based premiums, cost-sharing, annual payments, and one-time or periodic payments). The findings provide insights into the design of effective conservation policies and suggest that a mix of approaches may be most effective to spread conservation programs across landscapes.

Evaluating Grassland Ecological Function: Manitoba's New Range and Pasture Health Assessment Method

Mae Elsinger

Science and Technology Branch, Agriculture and Agri-Food Canada; Email: mae.elsinger@canada.ca

Abstract – For almost two decades Alberta has used a rangeland health assessment method to evaluate the capacity for their rangelands and pastures to provide ecological functions, including capture and release of water, climate change resilience, food for livestock and wildlife, and nesting opportunities for wildlife and species at risk. Alberta practitioners have used this method on grazing lands, whether they are native grasslands or forested lands, are planted to tame forages, or are modified with the invasion of exotic grasses. Currently, they also use it to evaluate the quality of revegetation efforts after industrial disturbances on grasslands.

Now Manitoba can do this for native and modified grasslands! In 2018, workers on behalf of the Manitoba Forage and Grassland Association completed development of the *Range and Pasture Health Assessment Workbook* for native grasslands, and some of the associated background documents, including rangeland ecosite descriptions and maps, and a set of plant community descriptions for Aspen Parkland and Assiniboine Delta areas of southwestern Manitoba. Our version of the method has taken into consideration the specific landscapes, climate, and land management practices in southwestern Manitoba. This paper describes how the current workbook and supporting documents were developed and how to use them.

Basics of Range and Pasture Function

Grassland is land dominated by herbaceous plants: grasses, grass-like plants (sedges, rushes, etc.), and broad-leaved herbs (aka forbs; SRM 1998). In Manitoba, grassland is found plentifully in range and pasture. *Range* or *rangeland* is land with native or exotic vegetation (often but not always grassland; could be forest or shrubland) that is grazed or has potential to be grazed, and is managed as a natural system (SRM 1998); that is, without periodic reseeding, fertilization, or irrigation. *Pasture* is land devoted to producing native or tame forage, to be harvested by grazing (SRM 1998); it is likely to be the subject of planting to tame forages and periodic renovations or fertilization.

Range and pasture supply us with goods and services, resulting from natural ecological functions and processes. *Health* is the ability of any of these systems to perform ecological functions (Adams *et al.* 2016). Some key examples of range and pasture functions are provided in Table 1.

Range and Pasture Health Assessment uses key indicators, observed in the field, to evaluate the ability of the range or pasture to function. The Alberta Range Health Task Group released a rangeland health assessment method in 2003 with 7 to 10 distinct indicators (Adams *et al*. 2016). A similar working group in Manitoba recently released their modified version for native grasslands only (MFGA 2017). The indicators adopted by Alberta, Saskatchewan, and Manitoba

for the different range and pasture types are in Table 2. An excerpt containing the scoring categories for two of the eight indicators from the *Draft Manitoba Range and Pasture Health Assessment Workbook* illustrates the style of the assessment (Figure 1).

TABLE 1. Key range and pasture functions and their importance. (Adapted from Adams *et al.* 2016.)

Range and Pasture Functions	Why is the Function Important?
Productivity	• Healthy rangeland and pasture plants use water and solar energy more efficiently for stronger growth and biomass production • Healthy rangeland and pasture plants provide forage for livestock and wildlife • Healthy rangeland and pasture plants provide abundant food for all life forms (e.g., insects, decomposers, etc.)
Site Stability	• Stable sites maintain potential productivity • Stable sites protect soils that have taken centuries to develop • Stable sites support stable long-term biomass production
Capture and Beneficial Release of Water	• Healthy rangeland or pasture stores and filters water and release it slowly • Captured and stored water is available for plant growth and other organisms • Captured water results in less runoff and potential for soil erosion • Water storage and capture enable more ecosystem stability during drought
Nutrient Cycling/ Carbon storage	• Conservation and recycling of nutrients provides for healthy soils supporting plant growth • Rangelands and pastures are thrifty systems not requiring the input of fertilizer
Plant Species Diversity	• Healthy rangelands and pastures maintain a diversity of grasses, forbs, shrubs and trees – creating resilience in the event of climatic events such as drought or flood • Diverse plant assemblages include high quality forage plants for livestock and wildlife • Diverse plant communities support high biodiversity and abundant wildlife habitat

TABLE 2. Health indicators adopted by Alberta (A), Saskatchewan (S) and Manitoba (M) for three different range and pasture types. (Interpreted from Adams *et al.* 2016, SK-PCAP Greencover Committee 2008, and MFGA 2017.)

Native Grassland[A,S,M]	Tame Pasture[A]	Forested Range[A,S]
Plant community seral status (by relative species abundance)[A,S,M]	Relative abundance of introduced forages[A]	Plant community seral status (by relative species abundance)[A,S]
Representation of structural layers[A,S,M]	Representation of tall, productive plant types[A] Representation of weedy plant types[A]	Representation of structural layers[A,S]
Variety, abundance and distribution of plant litter[A,S,M]	Abundance and distribution of plant litter[A]	Thickness of plant litter[A,S]
Soil erosion[A,S,M]	Soil erosion[A]	Soil erosion[A,S]
Soil exposure[A,S,M]	Soil exposure[A]	Soil exposure[A,S]
Cover of noxious weeds[A,M] (or invasive species)[S]	Cover of noxious weeds[A]	Cover of noxious weeds[A] (or invasive species)[S]
Distribution of noxious weeds[A,M] (or invasive species)[S]	Distribution of noxious weeds[A]	Distribution of noxious weeds[A]
Cover of woody vegetation[M]	Cover of woody regrowth[A]	N/A
N/A	Distribution of woody regrowth[A]	N/A

2.1 Are the expected plant layers present?	**Score**
The structural layers closely resemble the reference plant community (RPC).	10
Compared to the RPC, one life form layer is absent or significantly reduced.	7
Compared to the RPC, two life form layers are absent or significantly reduced.	3
Compared to the RPC, three or more life form layers are absent or significantly reduced.	0

2.2 Is the site subject to brush encroachment?	**Score**
Woody vegetation is either absent, or present in expected cover amounts, compared to the reference plant community (RPC).	5
Woody vegetation is newly present or exceeds expected RPC levels by up to 15% cover.	3
Woody vegetation exceeds expected levels by over 15% cover.	0

FIGURE 1. Excerpt from the *Draft Manitoba Range and Pasture Health Assessment Workbook* (MFGA 2017) showing the style of indicator criteria for plant community structure and woody vegetation.

Fair Comparison Using Appropriate Reference Conditions

In a range and pasture health assessment, indicator status is determined by comparing against expected natural conditions, or a *reference plant community* (RPC). This is a plant community that would eventually establish as a result of succession on a specific ecological site (*ecosite*) under the current climate without interference by humans (SRM 1998). Such interference could include disruption of natural fire cycles and native herbivore migrations.

Reference plant communities are identified and described in a rangeland plant communities guide. Such a guide also shows possible early to mid-seral communities, and communities modified by brush encroachment or invasive alien plant species [e.g., Kentucky Bluegrass (*Poa pratensis*)], to help us interpret how the current plant community arrived at its present state. A well-constructed guide will have a conceptual map (called a *state and transition model*) that is unique for each ecosite, and that shows how plant communities transition from one type to another as a result of natural succession and various management (or mismanagement) practices. As of 2018, Manitoba has one plant communities guide to cover multiple ecosites only in southwestern Manitoba. It identifies and describes 94 plant communities (including 18 reference plant communities) for 8 ecosites (Pyle *et al.* 2018). As a result of data collections from actual plant communities, this guide has detailed information for most of the 94 plant communities on species composition, ground cover, structure, successional status, and response to grazing or other pressures.

Not all land has equal potential, so in order to select the correct reference plant community we need to find the correct ecosite section of the plant communities guide. This requires determining the natural ecological site conditions at our health assessment location. The *Rangeland Classification for Agri-Manitoba* report (Thorpe 2014) has grouped the various regional and local environmental conditions of rangeland in the agricultural extent of Manitoba into rangeland ecoregions and ecosites. Figure 2 shows Manitoba's 9 rangeland ecoregions, and Table 3 shows definitions for 10 selected ecosites.

Thorpe's *Rangeland Classification* report has identified how to determine which rangeland ecoregion and ecosite pertain to the location of our health assessment (Thorpe 2014). He interpreted the Manitoba Soil Survey GIS map data (AAFC 2002) to assign up to three possible ecosites for each soil polygon in the agricultural extent of Manitoba. This GIS mapping layer is reliable for an initial assignment of up to three most likely ecosites for any location, but is limited by the data collection and mapping effort possible from the Manitoba Soil Survey. In some cases soil associations (clusters of soil types) are identified and mapped but not unclustered in the maps as individual soils. In addition, it is unreasonable to expect identification and mapping of soils in southern Manitoba at a high resolution. Thus, not all the possible soils for a heterogeneous area are mapped, and for those that are, the mapping is not always precise and accurate.

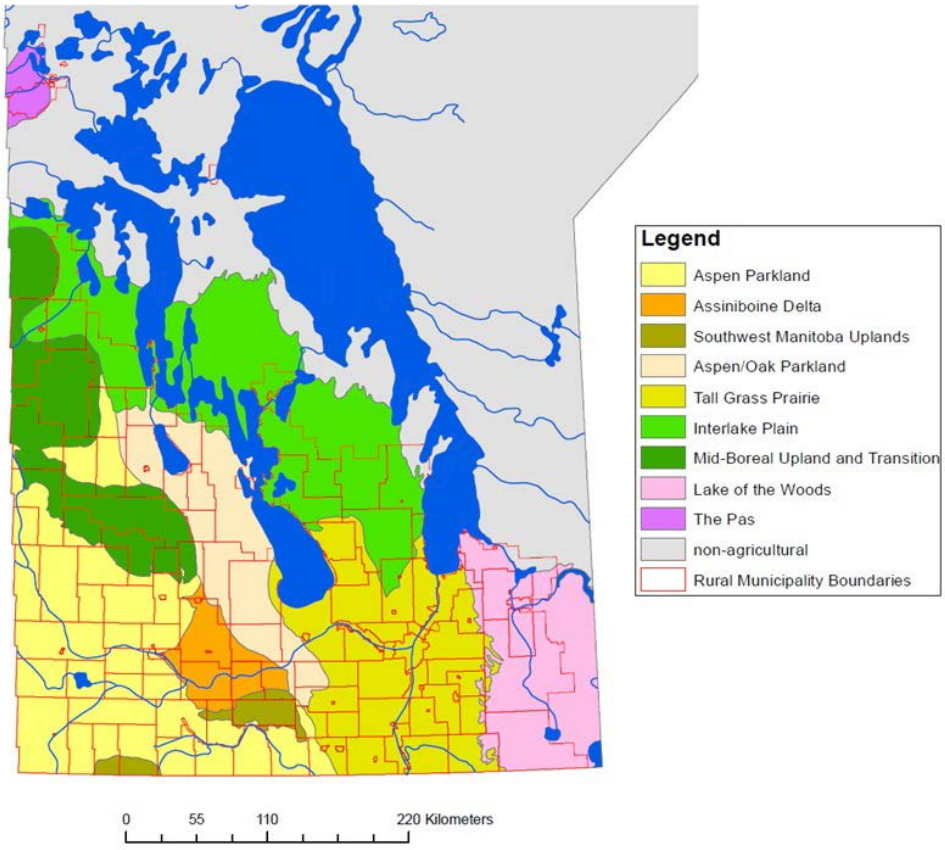

FIGURE 2. Rangeland ecoregions of Manitoba, with Rural Municipality boundaries. (Adapted from Thorpe 2014.)

TABLE 3. Examples of definitions for 10 of Manitoba's 21 ecosites (Thorpe 2014).

Ecosite	Definition
Shallow to Limestone	Calcareous bedrock, exposed or covered with shallow soil.
Eroded Slopes	Steep valley slopes from natural erosion; thin soil profile.
Dunes	Sand deposits shaped into hills and ridges by wind.
Sand	Rapidly to well drained uplands; sand or gravel; not dunes.
Moist Sand	Imperfectly drained sites on soil materials with sand, gravelly, or sandy loam texture.
Loam	Well drained uplands; loam, silt loam, or clay loam texture.
Moist Loam	Imperfectly drained; loam, silt loam, or clay loam textures.
Wet Meadow	Wet low-lying sites that are normally flooded for 3-4 weeks in spring, on poorly drained Gleysolic soils.
Shallow Marsh	Wetlands that are normally flooded until July or early August, on very poorly drained Gleysolic soils.
Moist Saline	Imperfectly drained sites; moderately to strongly saline.

The GIS map layer for ecosites is available for the entire agricultural extent of the province, and is also available in smaller files for clusters of rural municipalities in southwestern Manitoba (Thorpe 2017a). A rangeland ecoregions layer is also available. Not everyone has access to GIS software, so PDF maps for ecosites in southwestern Manitoba are also available (Thorpe 2017b). They are limited by having only one of the three most likely dominant ecosites occupying any location. Regardless of even the best map quality, ground truthing is always essential for identifying correct site conditions, and the *Rangeland Classification* (Thorpe 2014) gives the procedure of how to identify an ecosite in the field by taking into account such conditions as soil texture, influence by ground or surface water, position in the landscape, topography, signs of salinity, etc.

A Summarized Procedure for Performing Grassland Health Assessment in Manitoba

Note that only the native grassland assessment workbook is currently available. The *Draft Manitoba Range and Pasture Health Assessment Workbook* cannot be used on its own. We must identify the rangeland ecoregion and ecosites of the location(s) we are assessing, with the guidance of the *Rangeland Classification for Agri-Manitoba* report and available ecosite map information. Then we need to identify the correct reference plant communities for those ecosites, using a rangeland plant communities guide from the correct rangeland ecoregion. These materials (except for plant communities guides for areas other than southwestern Manitoba) are available via the "Research (MFGA-led Research)" section of the Manitoba Forage and Grassland Association website (www.mfga.net).

1) Become familiar with the history of the parcel or area of land to be assessed; use maps, old reports, photographs, and interviews with land users (note that areas of tame pasture or forested range cannot be assessed with the current Manitoba method because those assessment methods and supporting plant communities guides are not currently available).

2) Match up the location for the parcel or area of land to be assessed with the relevant ecosite PDF maps or GIS layers to identify which ecosites are most likely to be encountered in field assessments (ArcGIS or similar software will provide better results than PDF maps).

3) Find the most likely reference plant communities (RPCs) in the rangeland plant communities guide for the appropriate ecoregion and ecosites; they will be the baseline for scoring the indicator questions in each assessment.

4) Go to the site and select the actual assessment areas; for each area, make observations to confirm the ecosite identification using the steps in section *3.4 Identifying Rangeland Ecosites* of the *Rangeland Classification* guide (a shovel or soil sampler is required to find the groundwater influence). Make sure each assessment area has relatively homogeneous soils, landscape position, proximity to ground water, and land management practice (i.e., only one ecosite class and management block). If the selected assessment area has multiple ecosites or management regimes (e.g., a spring calving paddock versus a midsummer grazing paddock), you should either split the area and do multiple assessments or chose the dominant ecosite/management area and stick to it for sampling.

5) For each assessment area, answer the questions in the *Range and Pasture Health Assessment Workbook*; compare what you see on the site with what is listed in the reference plant community (RPC) for the identified ecosite.

Limitations and Future Work

The development of range and pasture health assessment methods for Manitoba is far from complete. Not only do we need to adapt Alberta's methods for tame pasture and forested range, and produce plant communities guides for the other rangeland ecoregions of the province, but we also need to gather scientific data related to how people in Manitoba should answer the specific rangeland health questions. The indicator questions and scoring categories were designed for Alberta's environmental conditions, using scientific evidence relevant to that province; we need to know how well they fit with Manitoba conditions.

This is a multi-stakeholder-driven initiative: anyone is welcome to assume a leadership role or assist by contributing scientific research, plant community data, discussions, and writing/editing services.

Literature Cited

Adams, B.W., G. Ehlert, C. Stone, M. Alexander, D. Lawrence, M. Willoughby, D. Moisey, C. Hincz, A. Burkinshaw, J. Richman, K. France, C. DeMaere, T. Kupsch, T. France, T. Broadbent, L. Blonski, and A.J. Miller. 2016. Rangeland Health Assessment for Grassland, Forest and Tame Pasture. Alberta Environmental Protection, Rangeland Resource Stewardship Section, Edmonton, AB. https://open.alberta.ca/publications/9781460127858. Accessed Mar. 12, 2020.

[AAFC] Agriculture and Agri-Food Canada. 2002. Seamless soil GIS data layer compiled from regional reports of the Manitoba Soil Survey. Agriculture and Agri-Food Canada, Winnipeg, MB.

[MFGA] Manitoba Forage and Grassland Association. 2017. Draft Manitoba Range and Pasture Health Assessment Workbook: Native Grassland, Tame Pasture, and Forested Rangeland. https://www.mfga.net/range-pasture-workbook. Accessed Mar. 12, 2020.

Pyle, L.A., M.E. Elsinger, and K. LaForge. 2018. Manitoba's Rangeland Plant Communities of the Aspen Parkland and Assiniboine Delta Rangeland Ecoregions. A First Approximation. Manitoba Forage and Grassland Association. https://www.mfga.net/plant-communities-guide. Accessed Mar. 12, 2020.

SK-PCAP Greencover Committee. 2008. Rangeland Health Assessment: Native Grassland and Forest. Prairie Conservation Action Plan, Regina, SK. https://www.pcap-sk.org/docs/5_resandlit/Native_Grassland_and_Forest-Red.pdf. Accessed Mar. 12, 2020.

[SRM] Society for Range Management. 1998. Glossary of terms used in range management, fourth edition. Edited by the Glossary Update Task Group, Thomas E. Bedell, Chairman. Society for Range Management, Littleton, CO.

Thorpe, J. 2014. Rangeland classification for Agri-Manitoba. Prepared for Manitoba Forage and Grassland Association. Saskatchewan Research Council Pub. No. 12870-1E14. https://www.mfga.net/s/Manitoba-Rangeland-Classification-v3.pdf. Accessed Mar. 12, 2020.

Thorpe, J. 2017a. Ecosites of Southwest Manitoba [GIS map data]. Manitoba Forage and Grassland Association. https://www.mfga.net/ecoregions-and-ecosites. Accessed Mar. 12, 2020.

Thorpe, J. 2017b. Ecosites of Southwest Manitoba [set of PDF maps]. Manitoba Forage and Grassland Association. https://www.mfga.net/ecoregions-and-ecosites. Accessed Mar. 12, 2020.

SESSION 4: RESTORATION PLANNING AND MONITORING

Session Moderator – Julie Pelc, Nature Conservancy of Canada – Manitoba Region

Habitat Restoration – Is It Worth It?

Scott Beaton and Maria Neumann

Manitoba Habitat Heritage Corporation; Email: sbeaton@mhhc.mb.ca

Abstract – The Manitoba Habitat Heritage Corporation (MHHC) was established in 1986 with a mandate to conserve, restore, and enhance fish and wildlife populations in Manitoba. Since 1998 MHHC has been active on the landscape, delivering conservation agreements to conserve wildlife habitat in perpetuity. More recently, MHHC has been working to restore wetlands to sequester carbon and reduce phosphorus from entering Lake Winnipeg using shorter-term agreements. MHHC also undertook an upland restoration project at Oak Hammock Marsh and learned a lot from that experience. This poster and oral presentation provide details into MHHC's wetland and upland restoration programs. It analyzes the debate over conserving what exists versus restoring what has been lost by reviewing MHHC's recent successes and challenges in the restoration program.

Grassland Restoration and Preservation: Using Sound Ecological Principles for Establishment, Rejuvenation, and Maintenance of Native Grasslands

Glen Koblun, Gord MacKay and Neill Ryan

Native Plant Solutions – Ducks Unlimited Canada; Email: g_koblun@ducks.ca

Abstract – Globally temperate grasslands are the most endangered ecosystems due to conversion to crops and other development uses; they are the original breadbaskets of the planet. There is a strong move afoot by society, and increasingly by reclamation agencies and the agriculture community, to return some of the land to its original roots, or at least its original pre-disturbed state, using native grassland species. This presentation highlights Ducks Unlimited Canada's 80 years of on-the-ground experience in both rural and urban environments in actively restoring and preserving grassland habitats. In North America, we have opportunities to protect and restore habitats that are important for all. Grassland restoration and preservation requires a common-sense effort backed by sound science, requiring agronomic knowledge with a focus on site ecology, seed selection, and pre- and post-management strategies. Strong research support in Canada has helped to improve our understanding of the sound ecological principles needed to ensure that grasslands are incorporated successfully into land-use plans.

Soil Nematodes as Bioindicators of Restoration Success in a Northern Fescue Prairie

Victory Coffey and Rafael Otfinowski

Department of Biology, University of Winnipeg; Email: coffey-v@webmail.uwinnipeg.ca

Abstract – Afforestation resulting from fire suppression, modified grazing, and climate change poses a threat to northern prairie ecosystems in North America. Trees alter the composition and function of plant and soil communities and can compromise the restoration of affected prairies. Our objective was to determine whether legacies of afforestation persist in restored prairie communities and whether soil nematodes can be used as bioindicators of changes in the soil food web during restoration. To accomplish this, we compared the structure, diversity, and functional composition of soil nematode communities along a chronosequence of prairie restoration following tree removal. Study sites were located within two historic white spruce plantations established between 1930 and 1940 on rough fescue prairies in Riding Mountain National Park, Manitoba. Within each site, we compared plant and soil nematode communities between areas of native prairie, remaining plantation stands, and three tree removal treatments.

Our observations indicate that shifts in plant community structure following tree removal were accompanied by shifts in nematode feeding groups, with fungal- and bacterial-feeding nematodes decreasing over time and plant-parasitic nematodes increasing to levels similar to those observed in native prairie. However, unlike the native prairie, the overall diversity of both the plant and nematode community declined with time and was lowest in the oldest restored treatment. Our results indicate that soil nematodes are sensitive to changes in the plant community following the removal of trees, and can be effective indicators of changes in structure of the soil food web following the restoration of northern fescue prairies. Future work aims to connect restored plant and nematode community dynamics through the analysis of root traits.

Integrating Plants, Roots, and Soil Nematodes to Restore Northern Prairie Ecosystems

Rafael Otfinowski and Victory Coffey

Department of Biology, University of Winnipeg; Email: r.otfinowski@uwinnipeg.ca

Abstract – Global changes in climate and human land uses threaten grassland ecosystems. However, evaluating grassland restoration most often focuses on plant communities above ground. Unlike other ecosystems, the below-ground structure of grasslands provides a key element of plant biomass that is fundamental to the function of restored communities. The focus of our research is to link changes in the structure, composition, and diversity of restored prairies with traits of roots that affect the structure and function of soil food webs. To accomplish this, we analyze the diversity and composition of feeding groups of soil nematodes. Our work illustrates that prairie plants and soil nematodes are intricately connected and that changes in the structure and function of roots may be key to the restoration of northern prairie ecosystems. Working in collaboration with Grasslands National Park in Saskatchewan, our research follows restored prairies over time and provides a unique insight into the below-ground function of northern prairie ecosystems. We hope that our work continues to inspire basic questions that link the above- and below-ground structure and function of restored prairies and helps refine how restoration success is measured.

Rescue the Fescue: Conservation and Restoration of Waterton Lakes National Park's Grasslands

Kimberly Pearson, Robert Sissons, Scott Murphy, Adam Collingwood, Ashley Wruth, Dianne Pachal and Dennis Madsen

Waterton Lakes National Park, Parks Canada Agency; Email: kimberly.pearson@canada.ca

Abstract – The foothills rough fescue grasslands of Waterton Lakes National Park were shaped over millennia by influences such as fire and bison. Those particular effects have been largely reduced or absent through recent decades. As of 1999, tree and shrub cover had encroached on 19% of the open grassland area that once dominated lower elevations of the park. That declining trend has continued. Invasive plants had further altered the grasslands' integrity. Additionally, the Northern Leopard Frog (*Lithobates pipiens*), an important native species of the grasslands, had been extirpated from the park for over three decades. From 2014 to 2018, Parks Canada's multi-faceted "Rescue the Fescue" project focused on conservation and restoration of Waterton Lakes National Park's grasslands. Shrub and tree cover were reduced using prescribed fire. Invasive plants were managed and monitored through an innovative system. Northern Leopard Frogs were returned to a portion of their native range within the park. Extensive public communication and engagement efforts such as interpretive programs and volunteer experiences were also key components of this successful interdisciplinary project. The Kenow Wildfire of September 2017 presented additional challenges to the park's grasslands.

Located in the extreme southwestern corner of Alberta, Waterton Lakes National Park (WLNP) is one of the few places on Earth where the mountains meet the prairies – the Great Plains abruptly interface with the mountains without a foothills transition. Alpine and grassland species intermingle here, and this varied topography results in an exceptionally high level of biodiversity within just 500 km^2. For example, the park hosts over 1,100 plant species and more than 40 species at risk.

Waterton Lakes is the only national park in Canada that protects the threatened foothills rough fescue grasslands. These have been documented as some of highest integrity foothills rough fescue grasslands remaining (Carla Koenig Environmental Services 2017). Despite being protected within a national park, these grasslands have faced several key challenges, including tree [Trembling Aspen (*Populus tremuloides*), Douglas-fir (*Pseudotsuga menziesii*)] and shrub [primarily Western Snowberry (*Symphoricarpos occidentalis*) and Saskatoon (*Amelanchier alnifolia*)] encroachment, invasive plants, disturbed sites, species at risk, and extreme intensity wildfire. To address these challenges, since 2014, Parks Canada has undertaken a cross-functional project, "Rescue the Fescue: Restoring the Ecological Function of Grassland Ecosystems in Waterton Lakes National Park", focused on improving various aspects of grassland health in WLNP.

In the absence of two key disturbance processes, regular fire return interval and presence of bison, a 19% decline in grass-dominated area occurred in the foothills parkland ecoregion of WLNP between 1889 and 1999 (Levesque 2000). That declining trend has continued. The park

has been host to a small demonstration bison herd, yet it is not large enough in itself to support an ecologically beneficial, free-ranging herd (Parks Canada 2008a). However, Parks Canada augmented its well-established prescribed fire program to return regular disturbance to the park's grasslands with low- to moderate-intensity prescribed fire. Goals established for this program were to halt the rate of tree and shrub encroachment (to 0% per year from 0.3% per year) while increasing area of fescue grasslands, through removal of 5% shrub and aspen sprout cover and 5% of mature tree cover. In addition to several smaller areas, four large prescribed fires took place in three grassland complexes between 2014 and 2017, treating over 2,900 ha. This was not a simple task given limited appropriate weather windows in wind-prone Waterton. Data analyses are underway, however preliminary image evaluation indicates that prescribed fire was an effective tool in halting the tree and shrub encroachment rate, reducing mature tree cover, and reducing shrub and aspen sprout cover (Figure 1).

The Kenow Wildfire took place in September 2017. It rapidly burned 50% of the vegetated area of the park (over 19,000 ha) over the course of one night. Forty-four percent of the vegetated area of the park was affected by high or very high severity effects of the fire (all or most organic vegetation and soil matter removed), including much of the Rescue the Fescue project focal area. This affected virtually every aspect of our work in WLNP, including further reduction of mature tree cover and shrub and aspen sprout cover in the grasslands.

The Kenow Wildfire also left a large area vulnerable to invasive plants. Approximately 10% of WLNP's recorded plant species are invasives [e.g., agronomic grasses such as Downy Brome (*Bromus tectorum*); forbs such as Spotted Knapweed (*Centaurea maculosa*)]. Parks Canada has prioritized invasive plant management in WLNP since the 1970s. The Rescue the Fescue project has helped to maintain and augment this program, such as increasing the restoration field crew to a team of 16 staff. They conducted mechanical and chemical invasive plant management along with innovative techniques such as smothering with tarps, torching, and steaming. The primary focus was 26 high-priority species. They tended to 13 medium-priority species as resources permitted, and kept an eye on 18 others on a watch list. Extensive monitoring of management effectiveness was completed and an innovative data management system was developed and utilized. Over the five-year project period, Parks Canada has performed well over 18,000 person hours of high- and medium-priority invasive plant management in WLNP. Our models are showing a positive correlation between more person hours spent at a site and lower invasive plant cover.

Disturbed site revegetation is another challenge that has been tackled through the Rescue the Fescue project. Several grassland sites were disturbed several decades ago for road-building materials or materials storage; these had shown little to no natural revegetation. We focused on four key sites. Over 30 kg of approximately 50 species of native plant seed were collected within the park. The seed was cleaned and stored in a small temperature- and humidity-controlled seed storage shed established specifically for this purpose. Some direct seeding took place and over 18,000 grass, shrub, and forb plugs were planted at disturbed sites. For evaluation purposes, the restoration team developed an innovative site restoration matrix through which to measure improvements to these sites (Table 1). The matrix takes into account various aspects of invasive species, native species diversity, and various substrate scores.

FIGURE 1. Aerial image of an aspen-shrub-grass interface near the Red Rock Parkway (lower left).

In July 2009, following a 2006 prescribed fire treatment and prior to more recent treatments.

In July 2017, following spring prescribed fire treatments in 2014 and 2017.

In July 2018, following the Kenow Wildfire of September 2017.

TABLE 1. Restoration matrix used in determining effectiveness of disturbed site revegetation efforts.

Invasive species	0	1	2	3	4	5	6	7	8	9	10
Noxious (high, med)*	≥5 (multiple species)	≥5 (single species)	4 to <5	3 to <4	2 to <3	1 to <2	<1	≤ 0.33	NA	NA	0
Agronomic (% cover)†	>75	>50 to 75	>25 to 50	>15 to 25	>10 to 15	>5 to 10	>3 to 5	>2 to 3	>1 to 2	≤ 1	0
Non-native percent cover (unlisted spp.)‡	>95	>80 to 95	>60 to 80	>20 to 40	>10 to 20	>7.5 to 10	>5 to 7.5	>3 to 5	>2 to 3	>1 to 2	≤ 1
Native diversity	0	1	2	3	4	5	6	7	8	9	10
Species planted that are present	0 to 1	>1 to 10	>10 to 20	>20 to 30	>30 to 40	>40 to 60	>60 to 70	>70 to 80	>80 to 90	>90 to <100	100
FQI value	≤ 1	>1 to 5	>5 to 10	>10 to 15	>15 to 20	>20 to 25	>25 to 30	>30 to 35	>35 to 40	>40 to 45	>45
Shannon's diversity index	0	>0 to 0.5	>0.5 to 1	>1 to 1.25	>1.25 to 1.5	>1.5 to 1.75	>1.75 to 2	>2 to 2.5	>2.5 to 3	>3 to 3.5	>3.5 to 4
Substrate	0	1	2	3	4	5	6	7	8	9	10
Bare ground	>95	>80 to 95	>60 to 80	>40 to 60	>30 to 40	>20 to 30	>10 to 20	>5 to 10	>3 to 5	>1 to 3	≤1
Litter	0	≤ 1	>1 to 5	>5 to 10	>10 to 15	>15 to 20	>20 to 25	>25 to 30	>30 to 40, >95	>40 to 55	>55 and <95
Native plant cover	≤ 1	>1 to 5	>5 to 10	>10 to 20	>20 to 30	>30 to 40	>40 to 50	>50 to 60	>60 to 75	>75 to 90	>90
Cryptograms	0	≤ 0.33	≤ 1	>1 to 2	>2 to 3	>3 to 4	>4 to 5	>5 to 6	>6 to 7	>7 to 8	>8

* Noxious species listed as high and medium priority on Waterton Lakes invasive species prioritization list;
† Agronomic grasses: introduced grasses used as forage, e.g., Smooth Brome (*Bromus inermis*) and Timothy (*Phleum pratense*);
‡ Unlisted non-native species that have not been provincially listed as prohibited noxious or noxious, and are considered low priority in Waterton Lakes National Park.

The prescribed fire, invasive plant management, and disturbed site revegetation components of the Rescue the Fescue project addressed habitat improvement for several species at risk, such as Common Nighthawk (*Chordeiles minor*) and Half-moon Hairstreak (*Satyrium semiluna*). The project also included a concerted effort to re-establish a self-sustaining population of the extirpated Northern Leopard Frog (*Lithobates pipiens*) in WLNP. A key link between wetlands and upland grassland habitats, the species was last seen in WLNP in 1980. In 2015 and 2016, we translocated 12 egg masses from Grasslands National Park in Saskatchewan to wetlands in WLNP. Egg masses were protected in enclosures until they hatched and tadpoles were able to evade predators. Despite impacts to their habitats by the Kenow Wildfire, the frogs bred at two sites in 2017 and 2018. This and several other indicators of early success suggest this effort has been effective thus far. Parks Canada will continue to augment and monitor the population.

In addition to effectiveness and efficiency, engagement is a key principal of ecological restoration in protected areas (Parks Canada 2008b). Public engagement in various aspects of grassland ecology and conservation was a key and consistent effort of the Rescue the Fescue project. On the interpretive front, this included myriad interpretive theatre programs, street theatre performances, guided hikes, and family activities. A portion of this interpretive programming focused on providing opportunities for visitors to learn about and experience local Indigenous culture, such as “Blackfoot Crafts and Stories” and “Blackfoot Drums and Dance”. Over the course of the five seasons of the Rescue the Fescue project, over 115,000 visitor contacts were made through these programs.

Volunteers have been engaged in various ways, including invasive plant management, an annual butterfly count, tending native plant gardens, collecting native seed, and planting plugs at disturbed sites. In all, 2,000 volunteers dedicated more than 16,000 hours to Rescue the Fescue projects from 2014 to 2018.

A great number of connections were made via print and online media. Over 50 media articles were published and many tens of thousands of social media views were recorded. Finally, an award-winning Ecosystem Investigator overnight camp hosted 4,800 grade-five students and accompanying adults over the five years.

Though the Rescue the Fescue project has concluded, this work is far from complete. The project enabled us to strengthen our foundations in conserving and restoring the grasslands of WLNP using prescribed fire, invasive plant management, disturbed site repair, and species at risk recovery. All while engaging approximately 200,000 members of the public in the project in some way, and dealing with a wildfire that had extreme impacts on the landscape, local communities, and all aspects of Parks Canada’s operations. Together into the future, we will continue to tackle the challenges these foothills rough fescue grasslands face.

Literature Cited

Carla Koenig Environmental Services. 2017. Range Health Assessment of the Foothills Parkland Ecoregion of Waterton Lakes National Park, AB. Prepared for Parks Canada.

Levesque, L.M. 2000. Investigating landscape change and ecological restoration: an integrated approach using historical ecology and GIS in Waterton Lakes National Park, Alberta. M.Sc. thesis, University of Guelph, Guelph, ON.

Parks Canada. 2008a. Assessing the feasibility of establishing semi-free-ranging bison in Waterton Lakes National Park. Waterton Lakes National Park, AB.

Parks Canada. 2008b. Principles and guidelines for ecological restoration in Canada's protected natural areas. National Parks Directorate, Parks Canada Agency, Gatineau, QC. https://www.pc.gc.ca/en/nature/science/conservation/ie-ei/re-er/pag-pel. Accessed Feb. 2, 2019.

SESSION 5: ADVANCING THE SARPAL APPROACH

Session Moderator – Curtis Hullick, Manitoba Habitat Heritage Corporation

Conservation Grazing: A Last Hope for Grassland Species at Risk

Christian Artuso

Bird Studies Canada; Email: christian.artuso@canada.ca

Abstract – Grazing is an ecosystem process that has shaped the prairie landscape. In the heavily impacted Great Plains, grazing still plays an important role but socio-economic and market forces are converting grassland to croplands at an alarming rate. For the conservation of Threatened and Endangered grassland birds, partnership with beef cattle ranchers provides not only a unique opportunity, it is perhaps the only mechanism that will prevent the extirpation of species at risk such as Chestnut-collared Longspur (*Calcarius ornatus*) and Baird's Sparrow (*Centronyx bairdii*) that have already lost >20,000 km^2 of their former range in Manitoba. As ENGOs, our partnership with the Manitoba Beef Producers and others under the Species At Risk Partnership in Agricultural Lands (SARPAL) in Manitoba may seem paradoxical but it is born of this necessity.

Advancing Beef Sustainability and Supporting Species at Risk?

Andrea White

Canadian Cattlemen's Association; Email: whitea@cattle.ca

Abstract – The Canadian Roundtable for Sustainable Beef is a multi-stakeholder organization focused on advancing sustainability in the Canadian beef industry. In addition to benchmarking the sustainability performance of Canadian beef production, one of its key initiatives is a Framework built around sustainability standards for telling the beef sustainability story across the value chain, and building trust with consumers by helping companies meet sustainable-sourcing goals. Landowners with species at risk habitat are trying to make a living off that native prairie. Where does the management of species at risk rank for landowners that are trying to pay the bills?

A Producer's Perspective on the Partnership between Agriculture and Conservation

Curtis Gervin

Abstract – Curtis Gervin is a beef producer whose cattle operation in the Poverty Plains of Manitoba has enormous conservation value, as it supports six of Manitoba's most threatened grassland bird species at risk. Curtis gives his perspective on where and how conservation can work with beef producers, the mutual benefits, and where there is room to strengthen this approach.

Should Conservation Groups be in the Business of Selling Beef?

Tim Sopuck

Manitoba Habitat Heritage Corporation; Email: tsopuck@mhhc.mb.ca

Abstract – Knowing what happens to land when it goes from cattle to annual crop production, the conservation community seems to appreciate that, at all scales, few strategic relationships are as important as that which we develop with the cattle industry. But when it comes to achieving a strong accord, the conservation community still has a long way to go. The conservation community and the livestock industry also need to overcome differences, past animosity, and perceptions that beef is bad for the environment. How do we move on? What can we do and say to advance the interests of the cattle industry? This presentation discusses mechanisms for working together on the Canadian prairies for the benefit of grassland ecosystems as a whole.

The theme of this conference, "Working Landscapes", is meaningful in the Great Plains context, and deserves examination at many levels. There are some key questions:

- Who is working the landscape?
- Is that "work" compatible with prairie habitat, or is it a "win/lose" outcome?
- In the course of their "work", do those interests care about prairie and species conservation?
- Most importantly, what can conservation groups gain from strategic relationships with the dominant workforces in this landscape?

You don't have to be a rocket scientist to conclude that the grazing livestock industry offers conservation groups the greatest gains from a strategic alliance.

When you look at major "working landscape" players, the results are often win/lose. That is certainly the case when landscapes are converted to annual crop production. For players mediated by regulatory systems and outcomes, as in the case of petroleum extraction, the result is often avoidance of the worst consequences, from a conservation perspective.

Where livestock production stands out from these other players is in the ability to achieve excellent conservation outcomes as a result of bottom-line business decisions. We also benefit from the fact that decision-making can also be driven by an ethic that allocates a value to maintenance and enhancement of prairie. We have a simple word for that: stewardship.

I have found no better way to explain the importance of the value of stewardship over regulation than to use the words of Lorne Fitch, one of the two "fathers" of Cows and Fish (aka the Alberta Riparian Habitat Management Society) and without a doubt, the most effective conservation educator I have ever met: "Regulations keep you from going to Hell, but Stewardship will help you to get to Heaven."

A rough estimate of the value of the beef industry to biological diversity in this country, produced by the Canadian Round Table for Sustainable Beef, is that one-third of the agricultural landscape that is dominated by cattle production produces two-thirds of the biological

diversity. I don't have comparable estimates for species at risk, but we know that a preponderance of species at risk are found on grazing land, generally because they require intact, native habitat. Species at risk exist in many cases because of grazing; it is important to remember that grazing did not make them at risk.

Moving to another suite of species, waterfowl and related waterbirds, under the North American Waterfowl Management Plan, the importance of the beef industry to conservation of critical wetlands and associated perennial cover is defined in strategic terms and in the implementation plan for the Northern Great Plains. You need grass and cattle to achieve an abundance of ducks.

So, what are we doing about it? I've been in this game for a while – coming on four decades to be precise – and almost all of that in the agricultural landscape. I would say that, until the last decade, the conservation community had a mostly antagonistic relationship, whether overtly or covertly, with the beef industry. Back then, if I had stood up in a conservation meeting and said that the cattle industry is the best friend we have, I think they would have treated me like Zog.

Who in the Hell is Zog, you ask? He is the alien that makes a brief appearance in a Kurt Vonnegut novel. He came to Earth with answers that would save humanity from wars and cancer. Unfortunately, he could only communicate through farting and tap-dancing, so he was killed upon first contact. It's a silly little analogy, for sure, but my professional journey of almost four decades has led me to what I believe is a basic understanding of the situation but, until fairly recently, I have felt that I was not really getting out of the starting blocks with many of my peers.

All you have to do is listen to a Christian Artuso presentation to appreciate the fundamental importance of grazing livestock to conservation and restoration of habitat on the Great Plains. I have taken to plagiarizing a former Director of the Manitoba Beef Producers, Glen Campbell, because he got it exactly right: "*Looked at as a group, cow-calf producers are the largest habitat conservation organization in the province*."

Knowing what happens to land when it goes from cattle to annual crop production, the conservation community generally appreciates that, at all scales, few strategic relationships are as important as that which we develop with the cattle industry. But when it comes to achieving a strong accord, and making strong public statements, we still have a way to go. In my view, the situation is mostly ours to remedy.

An Asymmetric Relationship

We all like to say that our organizations work in "partnership" with others. What exactly does that mean, and when do you have an effective relationship? Two of the fundamental points of analysis of a relationship are:

1) Are there overlapping interests?
2) Is there a power imbalance?

If there is an imbalance, the little guy should think especially hard about how they approach the relationship.

The conservation community needs the grazing livestock industry far more than vice versa. We know the landscape gains that come when the industry is growing, and we certainly know the losses when the industry is contracting. We write hopefully of a robust cattle herd in our strategic plans for prairie habitat, and assign all manner of wildlife benefits arising from it.

Looked at from the other side of the fence, what do we offer? To be sure, there are incentive programs that are funded through conservation dollars but, as laudable as they are, they do not have a significant impact on the industry. Individual producers notice these efforts more than the industry as a whole. Further, I expect that surveys of producers would show a pretty deep well of distrust toward the conservation community – my own organization included.

Then there is the promise of supporting livestock's "Social Licence" (I prefer the term "Public Acceptance") but let's be honest: our words of support are mainly spoken within meeting rooms. At the marketplace level, or in the marketplace of ideas, there hasn't been an impact. I know that increasing numbers of individuals and conservation organizations would like to make progress here, but the simple fact is that we haven't.

So the cattle folks control most of the grass, birds, and other conservation outcomes that we seek in our conservation plans, but what are we giving back? It sure sounds like an asymmetric relationship to me. And a fundamental reality of an asymmetric relationship is that the side with the weaker position generally makes the extra effort to understand and speak to the core interests of the other party.

The Effects of History

I think our expressions of support for the industry are often couched in critical terms, either implicitly or explicitly. Too often this is what the industry either hears from us, or thinks it hears from us: "Man, we'd be 100% behind ya, if only (insert one of the following): "…you just grazed your land better", "…you let us tell you how to graze your land better", "…you let us do our conservation programs without getting mad at us", or "…you were easier to get along with." For the most part, we have grown past such couched statements and that's important. (However, I cringed not that long ago when I read the draft of an extension piece on grassland birds conservation that *tutt-tutted* the extensive "grazing mismanagement" that is affecting wildlife. The target audience? Ranchers.)

It's important because a fundamental step in the development of a strategic relationship is an ability to engage without precondition. When I deal with cattle producers and their industry representatives, sometimes I hear prickly responses outright: "You (or your conservation pals) really don't have the interests of the industry at heart." Sometimes it's the silence and the body language that speaks volumes. The conservation community has evolved in its views, but one doesn't have to go back very far to see that we generally lumped cattle and cattle producers among the Enemy. Many producers, as individuals and as industry representatives, still feel the sting of old accusations.

Although this may not be a good parallel, here is a comparison that resonates personally: while my kids were growing up there was the usual tension between their actions and Dad's expectations. When they got older and left home, I was troubled to see the same kinds of

conversations come up. “Dad, why are you being critical?”, when a sensitive subject, say money management, came up. In fact, I had said nothing critical at all, and when I pointed this out, the response was, “But I know what you’re thinking!” There I was, tarred by history.

Ending History

How do we get past the history of our relationship with the livestock industry? We can start by asking this question within ourselves and, most importantly, to the industry: “What can we do and say to advance the interests of the cattle industry?” and take the answers to heart. I am confident that once the industry sees the conservation community as willing to be supportive, *without precondition*, then we will get a fair hearing in the areas where we would like to see progress. A few years ago, I asked board members of the Manitoba Beef Producers, “*How do I help you to sell more beef*?” That one question helped make a fundamental course correction in our relationship.

The first thing I learned was the importance of making clear, unambiguous statements in support of the industry where we can speak with credibility, without any *quid pro quo* expectations. The strongest statements that we can make in support of the industry are the ones we make when they are not at the table, or even in the room, and we have not been coached. Let’s not wait for the industry to tell us what to say. Rather, let’s at least begin by saying the things that need to be said about the industry’s importance to grassland and wetland habitat conservation.

Other ways to show support:

- Support in the marketplace, such as Audubon’s Conservation Ranching program and its Bird Friendly Beef initiative, essentially lending its brand to the sale of beef. This support should be unconditional; we should not be fixated on grass-finished. Animals raised on pasture and requiring dedicated pasturelands for a substantial part of their lives are “bird friendly”!
- Support in the marketplace of ideas: mass media, social media, networks. We need to defend and advocate for the social licence to produce and eat beef from the Northern Great Plains. This needs to occur at many levels, both individual and organizational, and promoted through effective mass media and social media campaigns.
- Support in the policy arena: If the beef industry needs risk management programs to the same degree as the annual cropping industry, why aren’t we fighting for that in the policy arena?
- Research support: We need carbon footprint analyses that reflect and support the imperative of the Northern Great Plains as a landscape dominated by grazing. Emissions by cattle are not additional in this context. In essence, they are historic and “background”; we just have different grazers doing the emitting.

By nature, our grounding in science makes us a conservative crowd that doesn’t like to get too “out there” in its thoughts or actions. But in this case, I ask for a little leap of faith. We may be pleasantly surprised by the results. With the few steps that I have taken thus far, I have been.

SESSION 6: PUBLIC ENGAGEMENT – PART I

Session Moderator – Marika Olynyk, Nature Conservancy of Canada – Manitoba Region

Ruminating on Restoration: How a Community Approach to Watershed Health can Drive Success

Mara E. Erickson

North Saskatchewan Watershed Alliance; Email: mara.erickson@nswa.ab.ca

Abstract – Restoring and enhancing riparian and wetland ecosystems is a common goal for many conservation organizations working in agriculturally dominated areas of the prairie and parkland natural regions. However, even with funding programs designed to finance and facilitate such activities, gaining participant trust and creating buy-in can be a tough sell. The North Saskatchewan Watershed Alliance (NSWA) and sister organization Vermilion River Watershed Alliance (VRWA) have taken a community-driven approach to implementing watershed-wide riparian and wetland enhancement projects on private land in the Vermilion River Watershed in Alberta. By first engaging a team of local stakeholders to promote and champion restoration opportunities, what began as a pilot season grew into a 3-year initiative primarily driven through local channels and word-of-mouth from pilot participants. Using an iterative process of leveraging "wins", learning from challenges, and celebrating successes, the NSWA, VRWA, and landowner partners have restored or enhanced over 150 hectares of riparian areas and wetlands in the watershed.

Ellis Bird Farm – A Success Story

Myrna Pearman

Ellis Bird Farm; Email: mpearman@ellisbirdfarm.ca

Abstract – Ellis Bird Farm (EBF), located north of Red Deer, Alberta, is a heartening example of a successful partnership between conservation, agriculture, and industry. Established in 1982 to honour the legacy of pioneer naturalists and farmers, Charlie and Winnie Ellis, EBF is a working farm as well as a conservation, education, and research site. Its success can be attributed to the foresight and cooperation of the Ellises, local naturalists, municipal governments, and industry leaders.

The 640-acre farm, which produces cereal crops as well as hay and pasture, is rented by a tenant farmer under the direction of EBF and generates revenue which supports the EBF operation. The farm management objective is to maintain a viable commercial farming enterprise while protecting and enhancing wildlife habitat.

Today, EBF attracts over 15,000 visitors during the summer months. Approximately 150 acres of the farm have been preserved as habitat and public space, and the homestead site has been developed into a demonstration Naturescape, with wetlands, shelterbelts, and wildlife gardens. In addition to popular nature-based education programs for both children and adults, EBF offers a variety of well-attended programs, festivals, and workshops over the summer. Research has been conducted on Mountain Bluebirds (*Sialia currucoides*) and Purple Martins (*Progne subis*), including studying migration and parental care using RFID, geolocator, and GPS technology.

Pronghorn Conservation: A Collaborative Effort to Help Conserve the Fastest Mammal in North America

Megan Jensen[1,2], Tracy Lee[2], Paul Jones[3], Andrew Jakes[4], Leta Pezderic[1] and Jaimee Dupont Morozoff[1]

[1] Nature Conservancy of Canada – Alberta Region; Email: megan.jensen@natureconservancy.ca
[2] Miistakis Institute
[3] Alberta Conservation Association
[4] National Wildlife Federation

Abstract – In the Northern Sagebrush Steppe, pronghorn (*Antilocapra americana*) undertake daily and seasonal migratory movements to meet life requirements. Across this region, highways fragment the landscape and cause direct mortality and/or disrupt movement patterns. Several conservation groups are collaborating and working toward a safer landscape for pronghorn in Alberta, Saskatchewan, and northern Montana. These conservation groups are actively working toward not only pronghorn conservation but also toward engaging the public in pronghorn science and conservation. "Pronghorn Xing" is a citizen-science program developed to ground truth seasonal migratory pinch-points identified by connectivity modeling across highways in the Northern Sagebrush Steppe. Wildlife sightings collected by the public will enable a better understanding of where pronghorn and other wildlife are commonly crossing, involved in collisions, or moving adjacent to the highway. This will then be used to provide a dataset to government officials and local conservation groups (such as Nature Conservancy of Canada) and will allow for the development of mitigation strategies on both highways and areas of fencelines that are barriers to movement. Nature Conservancy of Canada will also use this information as a means to prioritizing securement opportunities to provide a landscape with more connectivity for pronghorn migration and movement.

Lake Winnipeg Indigenous Collective: Challenges and Opportunities for Indigenous-led Conservation Efforts

Daniel Gladu Kanu

Lake Winnipeg Indigenous Collective; Email: daniel@lwic.org

Abstract – Much of the water on the Canadian prairies flows into the creeks and rivers that drain into Lake Winnipeg. Dramatic changes from land use and climate change felt on the prairies have led to dramatic impacts on the lake. Indigenous peoples in the watershed have witnessed these changes, experiencing them through loss of livelihoods and culture, and yet have rarely been a part of conservation and management decisions. Despite under-representation, Indigenous peoples maintain a rich body of knowledge informed by traditions, transferred through generations, and practiced by land users. In 2014, fourteen First Nations around Lake Winnipeg came together to discuss challenges and opportunities. Seeing under-representation as major issue, they took a step toward fixing it, and formed the Lake Winnipeg Indigenous Collective. Together, the collective seeks to protect the health of the lake, restore traditional livelihoods, and ensure Indigenous perspectives are influential in conservation and management decisions. This work is done in partnership with the Lake Winnipeg Foundation, who assists with promoting the issue and building the collective's capacity to become an influential voice. This presentation catalogues their journey as they work to address the gap between Indigenous people and conservation efforts.

Stewards of Saskatchewan: A Look at over 30 Years of Habitat Conservation for Grassland Species at Risk

Rebecca A.W. Magnus, Emily Putz, Ashley Vass, and Melissa Ranalli

Stewards of Saskatchewan, Nature Saskatchewan; Email: outreach@naturesask.ca

Abstract – Active landowner stewardship is integral to conservation of the remaining prairie landscape. Nature Saskatchewan's Stewards of Saskatchewan programs have been engaging landowners in voluntary stewardship since 1987, benefitting multiple species at risk, as well as species that share their habitats, across southern Saskatchewan. Through voluntary stewardship agreements, participating landowners commit to abstain from cultivating existing prairie and destroying shelterbelts or shorelines (i.e., target species at risk habitat). Participants agree to report annually the number of species at risk on their land and any habitat changes. This information, along with species at risk search and monitoring data collected by staff, is shared with the Saskatchewan Conservation Data Centre. Data are also shared with Recovery Team chairs, included in recovery strategies, and contribute to species at risk statuses/listings.

Currently, the programs have over 860 participants conserving nearly 209 kilometres (130 miles) of shoreline and 137,600 hectares (340,000 acres) of habitat (including critical habitat) for multiple species at risk and other wildlife. In partnership with participants, the programs have completed over 130 habitat enhancement projects, including putting over 6,070 hectares (15,000 acres) of cultivated land back into permanent cover. Additionally, participants are making informed management decisions through site-specific plans for beneficial management practices for species at risk and other shared resources (e.g., resources from local, national, and international partnerships).

Founded in 1949, Nature Saskatchewan (NS), or the Saskatchewan Natural History Society, initially sought to promote the conservation of our natural resources by asking its members to lobby governments and their agencies. NS also promoted our provincial publication, the journal Blue Jay. Over the years, NS has expanded its activities, encouraging the public to be involved in different ways. For example, youth are encouraged to build a relationship with nature through the Nature Quest and Inner Nature programs. These programs reach out to school groups through games, music, and story-telling, encouraging students to consider how their lives connect to nature. Another way NS brings like-minded people together to enjoy and explore the natural history of Saskatchewan is through meets and gatherings, and by encouraging people to join or participate in one of 15 local societies or affiliate groups around the province.

Through engagement with all levels of government, non-government organizations, and the public, NS strives to be a voice for nature in Saskatchewan. NS has contributed to important issues such as wetland drainage, wind farm locations, and land sales and pasture transfers through the provincial Wildlife Habitat Protection Act. Through our seven nature sanctuaries, NS works to protect the natural value of land while allowing public access by foot to natural landscapes.

Supporting citizen science, research, and education is also a priority for NS. Through NS, many special publications have been produced including *Birds of Saskatchewan* (published in 2019) and many other field guides specific to the province. NS offers the Margaret Skeel Graduate Student Scholarship, and contributes to the knowledge base of species data through, for example, the Last Mountain Bird Observatory and banding station, Important Bird Areas, and the sharing of occurrence data for species at risk (when permitted by stewardship program participants). In addition, the Stewards of Saskatchewan programs combine many of the approaches used by NS, such as face-to-face education and citizen science, to engage landowners and managers in habitat conservation through voluntary stewardship.

Recent issues of *The Plowprint Report* (an annual report published by World Wildlife Fund) show that native prairie and perennial grassland is still being converted to cropland at an alarming rate (World Wildlife Fund 2017). A recent study by Katie Doke Sawatzky highlighted that approximately 13.7–15% of grassland is left in Saskatchewan (Doke Sawatzky 2018). Active stewardship by landowners is integral to the conservation of this remaining prairie landscape, as approximately 85% of southern Saskatchewan's grasslands (both native and tame) are privately managed (Saskatchewan Wetland Conservation 2002), and approximately 40% of the remaining native grasslands are under private ownership (Michalsky and Saunders 2009). Nature Saskatchewan's Stewards of Saskatchewan programs have been working with landowners and land managers in voluntary stewardship since 1987 to conserve or enhance remaining habitat for target species at risk, also benefitting the other species that share their habitats across southern Saskatchewan.

Stewards of Saskatchewan is a suite of five programs: Operation Burrowing Owl, Rare Plant Rescue, Shrubs for Shrikes, Plovers on Shore, and a banner program that includes all other species at risk. The banner program for all other species started with Sprague's Pipit (*Anthus spragueii*) as the focus, but now has grown to monitor ten species at risk. Operation Burrowing Owl was the first stewardship program, and is one of the oldest and longest running stewardship programs in Canada. All later programs were modelled after Operation Burrowing Owl, with slight differences based on their individual target species. The target species serve as conservation ambassadors for their habitats, ultimately benefiting many other species that rely on having that same habitat intact.

To engage the public and landowners, program staff highlight the benefits of having the ambassador species on their land and why the species matters. For example, Burrowing Owls (*Athene cunicularia*) and Loggerhead Shrikes (*Lanius ludovicianus*) are both important forms of natural pest control, and having these species on their land is also an indication of the habitat's value, reinforcing that landowners are doing an excellent job caring for it.

Images and stories are also shared to help people connect with the species. Examples include: images of sweet and quirky Burrowing Owls and the head bobbing/tilting they do when curious; young Piping Plovers that look like cotton balls on sticks, born only an inch tall, then leaving the nest and running about within a few hours; the story of the iconic 3rd and 4th generation Monarchs that emerge in Saskatchewan and live the longest of any generation (up to 9 months), migrating all the way back to Mexico.

Locations of species at risk and resulting potential program participants are identified through searches and incidental sightings of species at risk from NS staff, current participants, the public, and partner organizations. Potential participants are then contacted and visited by staff to initiate a working relationship, go over relevant species, habitat information, and beneficial management practices, and introduce the Stewards of Saskatchewan programs.

By agreeing to participate in the Stewards of Saskatchewan programs, landowners and land managers commit through a voluntary stewardship agreement to not destroy the species at risk habitat on their land, and to participate in our annual census, or let program staff monitor occurrences. For plant species at risk targeted by Rare Plant Rescue, NS staff work with participants to search and monitor sites for specific plant species following established survey guidelines (Henderson 2009). For non-plant target species, participants help keep track of populations through an annual census. For example, participants are asked to report land use changes, and whether or not they observe nests, juveniles, or other species at risk. This is a great way to keep participants engaged, but it also provides a large amount of monitoring data for species at risk that would not otherwise be possible to collect by program staff alone. In return, participating stewards are provided with benefits and recognition for their stewardship.

With the permission of participants, data collected are shared with the Saskatchewan Conservation Data Center and Environment and Climate Change Canada recovery team chairs. These data can be included in recovery strategies, and ultimately contribute to species statuses, listings, and known ranges. For example, data collected through the Rare Plant Rescue program has contributed to the down-listing of several plant species at risk, such as Hairy Prairie-clover (*Dalea villosa*) and Buffalograss (*Bouteloua dactyloides*), and has expanded the range of Slender Mouse-ear-cress (*Halimolobos virgata*) approximately 90 km southeast of its previous range (S. Lee, Canadian Wildlife Service, pers. comm. March 2019).

Currently, the programs have over 860 participants conserving nearly 209 kilometers (130 miles) of shoreline and 137,600 hectares (340,000 acres) of habitat, including critical habitat for multiple species at risk. Most landowners and managers are willing to participate in a voluntary stewardship program, especially one which provides information and guidance about rare plants and wildlife, and encouragement and recognition for stewardship efforts. Another reason the Stewards of Saskatchewan programs are embraced by landowners is that voluntary actions involve a lower amount of risk to producers. The Stewards of Saskatchewan voluntary stewardship agreements are not legally binding and do not influence land value; however, they have been shown to be effective conservation measures.

A study conducted in southern Saskatchewan showed that two-thirds of land under an Operation Burrowing Owl voluntary stewardship agreement was conserved between 1987 and 1993, compared to approximately half with no agreement over the same time period (Warnock and Skeel 2004). Not only are these agreements effective at a voluntary level, but they can also lead to legal forms of protection in the future, such as conservation easements, which are promoted through printed materials and discussions during on-site visits.

Many participants are making informed management decisions through site-specific plans for beneficial management practices for species at risk. The plans highlight practices that are

currently taking place within an operation that are beneficial to the target species at risk, and make recommendations that participants could consider implementing to further benefit a particular species or multiple species at risk. These recommendations are always being updated and many partners contribute to their development. Since 2009, plans have been developed for over 300 participants.

It is understood that some of the recommended beneficial management practices may come with a cost. To encourage implementation, and as a benefit of participating in the programs, funding is provided on a 50:50 cost-share basis with participants for certain projects that can increase or improve habitat for species at risk (i.e., Burrowing Owl, Sprague's Pipit or Piping Plover (*Charadrius melodus*)). These projects are a win-win situation for both landowners and wildlife. Since initiation in 2000, Nature Saskatchewan has funded 135 projects resulting in over 6,070 hectares (15,000 acres) of land seeded back to grassland, 103 kilometers (64 miles) of strategic fencing installed, and 17 alternate watering sites established. Enhanced sites are monitored, including for use by Burrowing Owls. On average, each year 3 to 5 Burrowing Owl pairs, or 10–20% of all owls reported, have been seen nesting on these enhanced sites.

In addition to habitat enhancement funding, some of the other ways appreciation is shown and information is shared with participants include:

- conservation awareness and appreciation suppers;
- a program for sharing annual newsletters and partner updates, as well as research;
- a biannual events list sharing what partners have going on around southern Saskatchewan;
- a species at risk calendar that keeps participants informed of the life cycles of target species; for example, when migrating species usually return, or when they may be able to observe fledglings, or a rare plant blooming.

The Stewards of Saskatchewan programs partner with many organizations to provide participants with as many resources as possible including Nature Conservancy of Canada, Ducks Unlimited Canada, Saskatchewan Wildlife Federation, Saskatchewan Burrowing Owl Interpretive Centre, Saskatchewan Prairie Conservation Action Plan, Native Plant Society of Saskatchewan, South of the Divide Conservation Action Program Inc., local watershed groups, a number of universities, and various levels of government. The target species do not exist in isolation in Canada, so networking and sharing of information also happens with international partners such as Coastal Bend Bays and Estuaries in Texas, Pronatura Veracruz in Mexico, and American Prairie Reserve in Montana.

Success does not come without its challenges. Political agendas change, affecting the availability of government funding, which makes up more than half of the cash contributions to these programs. Funding priorities and the types of information required for applying and reporting are often changing as well. This can require a considerable amount of administrative time and effort to keep up and adapt. Public perception of conservation has been a challenge in the past as well, although landowners and their families are now generally open to the topic of conservation and having discussions about it. With Operation Burrowing Owl being 32 years

old, it comes with the additional challenge of ageing participants and lands changing hands, as well as landlines being disconnected in favour of cell phones.

In spite of these challenges, the Stewards of Saskatchewan programs have adapted and endured for over 30 years. Prince Philip, who was at the launch of Operation Burrowing Owl in 1987, commended Nature Saskatchewan on the program's 25th anniversary in 2012, pointing out that it is easier to start a program than to keep it running for such a long time. However, these programs are about stewardship, and their longevity is a testament to the participating stewards.

A big part of the programs' success is a direct result of the participant relationships built over the decades. Through face-to-face conversations, the learning (for both participants and staff) and sharing of information and resources is ongoing. And these efforts are worth it for all parties involved. Participants have shared testimonials over the years, and they often portray a similar view. Participants are proud to set an example and conserve habitat for biodiversity and the next generation to enjoy. They often feel that by engaging with these programs, valuable species at risk monitoring and extension events, as well as habitat enhancement projects, can take place. The Stewards of Saskatchewan team reciprocates this notion and is grateful for the opportunity to work with our committed participants.

Literature Cited

Doke Sawatzky, K. 2018. The Prairie Commons Project: A Reporter's Journey Through Saskatchewan's Grasslands. http://www.prairiecommons.ca. Accessed March 11, 2019.

Henderson, D. 2009. Occupancy Survey Guidelines for Prairie Plant Species at Risk. Prairie & Northern Wildlife Research Center, Environment Canada – Canadian Wildlife Service, Saskatoon, SK.

Michalsky, S., and E. Saunders. 2009. At Home on the Range: Living with Saskatchewan's Prairie Species at Risk. Special Publication No. 28. Nature Saskatchewan, Regina, SK.

Saskatchewan Wetland Conservation Corporation. 2002. A land manager's guide to grassland birds of Saskatchewan. Houghton Boston Printers, Saskatoon, SK.

Warnock, R.G., and M.A. Skeel. 2004. Effectiveness of voluntary habitat stewardship in conserving grassland: case of Operation Burrowing Owl in Saskatchewan. *Environmental Management* 33: 306–317.

World Wildlife Fund. 2017. Plowprint Report. World Wildife Fund website. https://tinyurl.com/2017-Plowprint. Accessed March 11, 2019.

SESSION 7: LAND MANAGEMENT TECHNIQUES

Session Moderator – Stephen Carlyle, Manitoba Habitat Heritage Corporation

Open Standards-based Approach to Biodiversity Conservation via Adaptive Grazing Management Planning

Ashley Greenley, Jordan Becker, Josh Dillabough, Rebekah Neufeld and Marika Olynyk

Nature Conservancy of Canada – Manitoba Region; Email: Ashley.Greenley@natureconservancy.ca

Abstract – The Nature Conservancy of Canada (NCC) uses grazing as a tool to manage grasslands on our properties for the purpose of biodiversity conservation. The *Open Standards for the Practice of Conservation* provides a framework for adaptive, goal-oriented, target-based conservation planning. We developed three pilot projects which used Open Standards to develop property-specific grazing management strategies. Our goal is to use science-based knowledge to guide grazing management and increase the long-term viability of biodiversity targets on NCC properties.

We used Miradi™, an Open Standards-based software tool, to prepare conceptual models and logic chains to explore the connections between biodiversity targets and their threats, and examine potential strategies and their expected outcomes. This informed the decision to implement grazing management (or not), the timing, duration, and stocking rates used, and determined what monitoring is required. The three pilot projects shared the common challenge of incorporating multiple targets with conflicting management requirements, highlighting the necessity of selecting and prioritizing specific, clear biodiversity-related goals at the project scale. Current and future work will incorporate these adaptive grazing strategies into broader property management planning.

Water Management on the Prairies: Green Technology for Water Quality Improvements

Bruce Friesen-Pankratz and Lisette Ross

Native Plant Solutions – Ducks Unlimited Canada; Email: b_friesen-pankratz@ducks.ca

Abstract – Anthropogenic sources of nutrients, such as stormwater runoff from urban areas and discharge from sewage lagoons, contribute to poor downstream water quality. While mechanical and chemical water treatment methods exist, they are often expensive and provide few, if any, other benefits to society. Alternatively, green technology offers water-quality treatment options that are affordable and that provide additional cultural benefits.

This presentation highlights the experience of Native Plant Solutions in designing and commissioning green technology solutions for water-quality improvements in both rural and urban environments. The green technology discussed includes bioswales, naturalized stormwater ponds, and constructed treatment wetlands. The water treatment function of green technology is due to natural processes such as nutrient uptake by plants and long-term nutrient storage in the sediment. As such, in order to be effective and sustainable, green technology needs to be designed based on a thorough understanding of natural ecological processes. In addition to their water treatment function, properly designed green technology systems can provide cultural values such as recreation destinations for birdwatching or nature walks. Due to their aesthetics, green technology systems can also increase the value of nearby properties.

Species at Risk Monitoring and Management in Manitoba Tall-grass Prairie: Lessons Learned

Melissa A. Grantham and Cary D. Hamel

Nature Conservancy of Canada – Manitoba Region; Email: melissa.grantham@natureconservancy.ca

Abstract – Species at risk that occur in Manitoba's tall-grass aspen parkland are threatened by loss or alteration of habitat due to woody encroachment, hydrological alteration, and incompatible grazing and fire. Established in 1989, the 4,650 ha Manitoba Tall Grass Prairie Preserve is managed through a multi-parcel, multi-year planning approach that incorporates a recurrent prescribed grazing- and fire-disturbance rotation to maintain and recover multiple species at risk and the habitats and successional stages they depend upon. Management decisions have been informed by the results of periodic species and ecosystem monitoring, assessments of management effectiveness, research, a climate-change adaptation process, and feedback from local agricultural partners. Regular assessment and integration of new information has resulted in several changes to management and monitoring approaches. We present, from a conservation practitioner's perspective, our evolving approach and lessons learned.

Integrated Invasive Species management – Multiple Arrows in the Quiver

Renny W. Grilz and Eryn Tomlinson

Meewasin Valley Authority; Email: rgrilz@meewasin.com

Abstract – Invasive species are the second largest threat to biodiversity globally, after habitat fragmentation. Conservation practitioners have acknowledged that managing invasive species can be an extremely challenging and expensive part of managing conservation lands once a site has been conserved. Meewasin utilizes an integrated invasive species management approach as part of its overall integrated resource management program. Numerous tools are being used in the battle against invasive species, including prescribed burning, targeted conservation grazing, biocontrols, mechanical methods, herbicides, and outreach/awareness. This presentation discusses the various tools used and how they can be integrated into an overall invasive species management program.

Selective Shrub Mowing to Maintain and Enhance Upland Tall-grass Prairie for Species at Risk at the Manitoba Tall Grass Prairie Preserve

Christie Borkowsky and Erin Zaharada

Critical Wildlife Habitat Program; Email: Christie.Borkowsky@gov.mb.ca

Abstract – Prairie habitat requires active management to maintain species diversity and prevent encroachment by aspen (*Populus tremuloides*), willow (*Salix* spp.), and other shrubs. At the Manitoba Tall Grass Prairie Preserve, selective mowing with an ATV and brush mower is used to reduce the cover and density of trees and shrubs, giving native grasses and forbs greater exposure to sunlight and reducing competition for water and nutrients. Since 2016, patches of aspen and shrubs have been mowed in or near areas with species at risk, including Small White Lady's-slipper (*Cypripedium candidum*), Western Prairie Fringed-orchid (*Platanthera praeclara*), Riddell's Goldenrod (*Solidago riddellii*), Great Plains Ladies'-tresses (*Spiranthes magnicamporum*), and other provincially rare species. Monitoring plots in these areas follows similar sampling protocols for plots established previously for measuring habitat changes over time.

SESSION 8: RESTORATION – SEEDS

Session Moderator – Colin Murray, Manitoba Sustainable Development

Native Seed Harvesting 101

John P. Morgan

Prairie Habitats Inc.; Email: john01@xplornet.com

Abstract – Collecting seed for prairie restorations can be a daunting task. In most of western Canada, we do not have maps or handbooks of where to obtain good quantities of native seed. Commercial supplies exist, but often are severely limited in their amounts, particularly for large projects. Agency budgets keep declining. Managers spend millions on hard infrastructure, but ignore or belittle the cost-effective natural infrastructure created by using local native seed. Using real-life examples from across the prairies, the author shows how innovative projects have addressed these issues, producing an abundance of diverse, local native seed for prairie restorations.

Cheerios-Xerces-Skinner Native Seeds Collaboration to Rewild the Working Prairie with Perennial Pollinator Habitat

Stephanie Frischie[1] and **John Skinner**[2]

[1] The Xerces Society for Invertebrate Conservation; Email: stephanie.frischie@xerces.org
[2] Skinner Native Seeds

Abstract – Native grasslands and pollinators are in decline due to a range of threats. On-farm pollinator habitat mitigates the decline by restoring biodiversity and function alongside sustainable agricultural production. The Cheerios-Xerces Pollinator Habitat Program will establish 3,300 acres of perennial pollinator habitat on working lands across the oat-growing region of the northern Great Plains of Canada and the US. The program brings together farmers, conservation districts, researchers, conservation groups, and seed companies in a collaborative effort. The program creates demand for local ecotypes of native forbs and supports the growth of local native seed businesses.

Skinner Native Seeds has been producing field-grown native seed in Manitoba for twenty years. In the spring of 2018, Skinner Native Seeds located prairie remnants and received permission to sustainably collect on six sections to increase the availability of seeds for pollinator habitat. Thirty-five species were collected in 2018. We discuss our methods for cleaning small quantities of a wide variety of forbs. We present the background and activity of the habitat program and include several case studies from participating farms. The Cheerios-Xerces program is a growing network of habitats, farms, and partners for pollinator and native plant conservation on the prairies.

Ed. Note – This paper was presented in two parts at the conference.

A New Restoration Network in Manitoba

Julie Pelc and **Marika Olynyk**

Nature Conservancy of Canada – Manitoba Region; Email: julie.pelc@natureconservancy.ca, marika.olynyk@natureconservancy.ca

Abstract – The ecological restoration community in Manitoba identified a need to network and build capacity for better restoration. To meet that need, the Nature Conservancy of Canada, in collaboration with Prairie Habitats Inc., Scatliff + Miller + Murray, and the University of Winnipeg, hosted Manitoba's first Ecological Restoration Workshop in Winnipeg on March 20 and 21, 2018. The workshop brought together a diverse group representing land managers, practitioners, local industries (e.g., seed/plant producers and consultants), conservation groups, Canadian and American not-for-profit organizations and museums, as well as independent volunteers.

Topics included the current status of ecological restoration in Manitoba, local native seed sourcing, economics of native seed production, and current research on pollinators. The presentations and breakout-session format gave participants the opportunity to share knowledge about restoration approaches, research, and networking initiatives in Manitoba and Saskatchewan, interact with one another in an open environment, and discuss perspectives on restoration. Key information was documented that will be used to produce a report to guide the steps to improve restoration capacity in Manitoba. Here we present the preliminary outcomes from the workshop and recommended next steps.

SESSION 9: ALTERNATIVES IN AGRICULTURE

Session Moderator – Duncan Morrison, Manitoba Forage and Grasslands Association

Effect of Neonicotinoid Insecticides on Mass and Behaviour in Common Farmland Birds

Margaret L. Eng[1], Bridget J. Stutchbury[2] and Christy A. Morrissey[3]

[1] Toxicology Centre, University of Saskatchewan; Email: m.eng@usask.ca
[2] Department of Biology, York University
[3] School of Environment and Sustainability, University of Saskatchewan

Abstract – Many farmland birds and migratory species are exhibiting steep population declines, which have been associated with a range of complex factors, including a shift in agricultural practices and the widespread use of neonicotinoid-treated seeds. Spring seeding coincides with the migration of many bird species through the prairie region on the way to their breeding grounds, and seed-eating birds that stop to refuel or breed in agricultural fields could potentially ingest neurotoxic insecticide-treated seeds. Therefore, we hypothesized that neonicotinoid exposure could have consequences for feeding behaviour and fuel loads.

To investigate if neonicotinoid exposure is negatively affecting seed-eating birds, we conducted controlled oral dosing studies in White-crowned Sparrows (*Zonotrichia leucophrys*) exposed to small concentrations of a common neonicotinoid (imidacloprid) and in Red-winged Blackbirds (*Agelaius phoeniceus*) exposed to one of the three neonicotinoids (imidacloprid, clothianidin, thiamethoxam). A consistent effect observed in both species was up to a 68% reduction in food consumption and 25% reduction in body mass. Imidacloprid appeared to cause the greatest toxicity of the three neonicotinoids, and White-crowned Sparrows were more sensitive than Red-winged Blackbirds. Sub-lethal effects on fueling and condition in migrating and breeding birds can have subsequent effects on reproduction and survival, with potential population-level consequences.

Beneficial Insects in Prairie Cropping Systems: Synergies for Biodiversity and Agriculture?

Paul Galpern

Faculty of Environmental Design, University of Calgary; Email: paul.galpern@ucalgary.ca

Abstract – In many parts of the prairies, much of the available land base is devoted to crop production. Non-farmed spaces containing native or “semi-natural” vegetation may be scarce relative to croplands, leaving little undisturbed habitat. I present early results from our ongoing project (begun in 2015) to sample arthropods that inhabit non-farmed spaces such as wetlands, field margins, and pivot corners, drawing on a taxonomic dataset from more than 330 sites in or near crop fields across Alberta (~150,000 bees, beetles, spiders and harvestmen). I use these data to explore the status of these spaces as arthropod biodiversity hotspots. I also report on the potential for synergies between biodiversity and agriculture that may be used to incentivize the conservation, retention, and restoration of small-patch habitats in prairie croplands.

Borderland Agriculture: Our Path to Regenerative Agriculture

Brooks and Jen White

Borderland Agriculture; Email: whites@borderlandagriculture.com

Abstract – At Borderland Agriculture, in the extreme southwestern corner of Manitoba, we focus on regenerative agriculture by incorporating bison production into a highly diverse cropping system. Our bison are the key component to our vison of improving soil health. We utilize their natural hardiness in our *#graze365* program. With this vision, we were recently recognized in the 2018 Canada's Outstanding Young Farmers Program.

Supporting Native Bees by Revegetating Agricultural Margins with Wildflowers: Year 2 Results

Mae Elsinger and Rhonda Thiessen

Science and Technology Branch, Agricultural Ecosystems Unit, Agriculture and Agri-Food Canada;
Email: mae.elsinger@canada.ca

Abstract – One objective of our Developing Pollinator Supports research project is to develop, test, and recommend a methodology for agricultural producers to establish native bee habitat in agricultural field margins. It must be affordable, make use of existing or easily available equipment and materials, and be compatible with timelines associated with a farmer's primary purpose – food production. In 2017 we planted four native bee foraging habitat plots in agricultural field margins around Brandon and Carberry in southwestern Manitoba. Our planting techniques and seed mixes were informed by restoration literature and Manitoba-based research that showed which flowering plants had the strongest relationships with native bee species. Planting techniques also considered farmers' timelines and availability of equipment. With each site having different soils, fertility, weed seed bank, and pressures from herbivores, the results are diverse and interesting after two summers. Observations of market conditions for native pollinator seed and for various alternative pollinator seed mixes have also made this project very interesting. For the agricultural setting, a variety of planting conditions and seed market challenges work against likelihood of adoption of native wildflower plantings for pollinator foraging habitat, pushing more toward various alternative pollinator mixes that are currently being directed at farmers.

Background

A commonly cited solution for shortages in bee habitat is to plant native wildflowers. But even the habitat restoration experts have difficulty and get variable results when restoring native grasslands and wildflowers! If such a practice is to have beneficial effects on bee species, it must provide food and provisions in the form of flowers preferred by bees, for the entire period that they are out foraging (at least early May to late September). Furthermore, if we are to depend on agricultural producers to implement this practice over the long term, it must be affordable; equipment and plant material must be easily available; it must not interfere significantly with farming; and it must provide timely and clearly visible success and gratification (i.e., an abundance of flowers and bees).

We planted small (~2100 m^2 or ½ acre) bee foraging habitat plots on margins of cropland within a 50 km radius of Brandon in the Aspen Parkland region of Manitoba in spring of 2017 (Figure 1). We assessed actual planting success (establishment, survival, and flower abundance), and planting feasibility (cost and availability of materials and equipment, and perceived level of success).

Planting Methods

Until 2016, our sites were annual cropland as part of a typical crop rotation. Our 2016/2017 site preparation consisted of regular glyphosate treatments before and after the crop, mowing

stubble, removing excess flax biomass from one site, harrowing, and one final application of glyphosate to emerging weeds prior to planting.

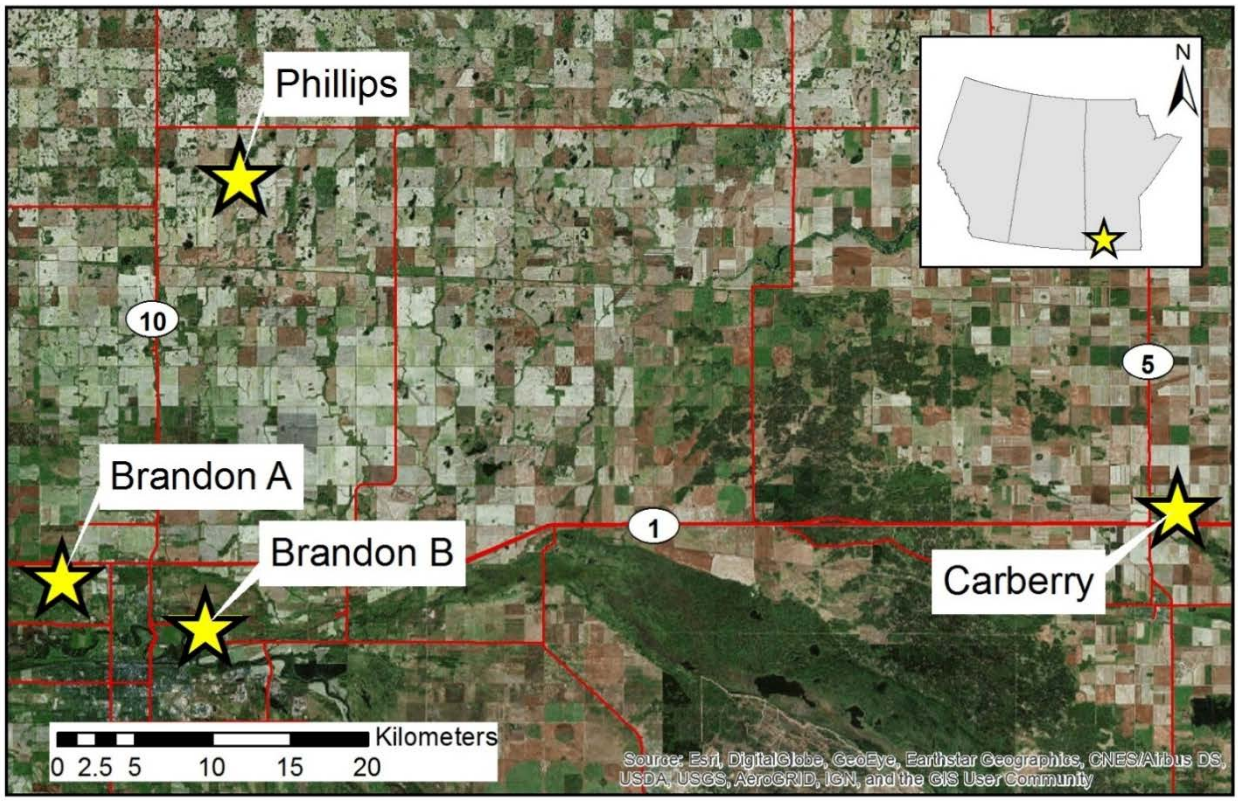

FIGURE 1. Locations of four pollinator habitat establishment trials.

A cover crop of oats (*Avena sativa*) was sown at ¾ inch depth, at ¾ bushels per acre (26 lb/ac) with a zero-till drill. Then a typical hay mixture [10 lb/ac meadow brome (*Bromus riparius*); 2 lb/ac alfalfa (*Medicago sativa*)] was planted on the control plots, outer buffer, and areas in between native species plots, with the same drill, to a depth of ½ inch. A 1:1 ratio of seed to carrier (11-52-00 ammonium phosphate granular fertilizer) was required to control bridging of meadow brome in the seeder.

The native wildflower/grass mixture was broadcasted with a small spin-spreader. The rate came out to 15 lb/ac, calculated on a basis of sowing 1244 seeds/m^2, considering recommendations of 430 to 645 seeds/m^2 proposed by The Xerces Society's bee habitat installation guides (Lee-Mäder *et al.* 2013; Vaughn *et al.* 2015), then doubling for broadcasting (Morgan *et al.* 1995; Smreciu *et al.* 2002), and then adding ~15% to take into account dormancy and viability of seed (Smreciu *et al*. 2002). The carrier for controlling against seed sorting and bridging was two parts horticultural-grade vermiculite to one part rolled corn on a weight per weight basis.

All sites were seeded from early May to early June in 2017, then packed and harrowed with a coil packer + spring harrow unit. In mid-June, approximately 100 live plants were installed in patches at each site by hand, and watered in. No more water was applied, and the only follow-

up maintenance for the sites was mowing with a rotary mower to 7–9 inch stubble in mid-summer and fall, and mowing again in fall of the following year (2018).

Our native wildflower/grass mixture (21 wildflowers from seed, 5 wildflowers/flowering shrubs from live material, and 7 grasses from seed) was based on multiple references, consultation, availability of plant material, and reasoning. Native grasses were included for erosion control, diversity of aboveground and belowground growth forms, and habitat value. They made up less than 20% of the mixture by seed count (Lee-Mäder *et al.* 2013; Vaughn *et al.* 2015), and aggressive, creeping-rooted grasses were avoided (Gerling *et al.* 1996). Most of the wildflower species chosen (Figure 2) were known to be preferable for native bees (Lee-Mäder *et al.* 2013; Vaughn *et al.* 2015; Wojcik *et al.* 2017; Robson 2014; D.B. Robson pers. comm. Jan. 16, 2016). Gaps in the coverage of preferred colours and dates of flowering were filled with generic relatives of preferred species, or additional available plants according to our own discretion. Choices were limited by the availability of Manitoba-based seed. Where seed was not available, some live plants were chosen.

Common Name	Scientific Name
Hawthorn	*Crataegus chrysocarpa*
Alumroot	*Heuchera richardsonis*
Common Yarrow	*Achillea millifolium*
Long-fruited Anemone	*Anemone cylindrica*
Whorled Milkweed	*Asclepias verticillata*
Upland White Goldenrod	*Solidago ptarmicoides*
White Prairie Clover	*Dalea candida*
Many Flowered Aster	*Symphyotrichum ericoides*
Three-Flowered Avens	*Geum triflorum*
False Indigo/Leadplant	*Amorpha nana/ A. canescens*
Wild Bergamot	*Monarda fistulosa*
Giant Hyssop	*Agastache foeniculum*
Philadelphia fleabane	*Erigeron philadelphicus*
Purple Prairie Clover	*Dalea purpurea*
Dotted Blazingstar	*Liatris punctata*
Meadow Blazingstar	*Liatris lingulistylis*
Smooth Aster	*Symphyotrichum laeve*
New England Aster	*S. novae-angliae*
Golden Alexander	*Zizia aurea*
Heart-leaved Alexander	*Zizia aptera*
Blanketflower	*Gaillardia aristata*
Prairie Coneflower	*Ratibida columnifera*
Black-eyed Susan	*Rudbeckia hirta*
Grey-stemmed Goldenrod	*Solidago nemoralis*
Sunflower spp.	*Helianthus spp.*
Stiff Goldenrod	*Solidago rigida*

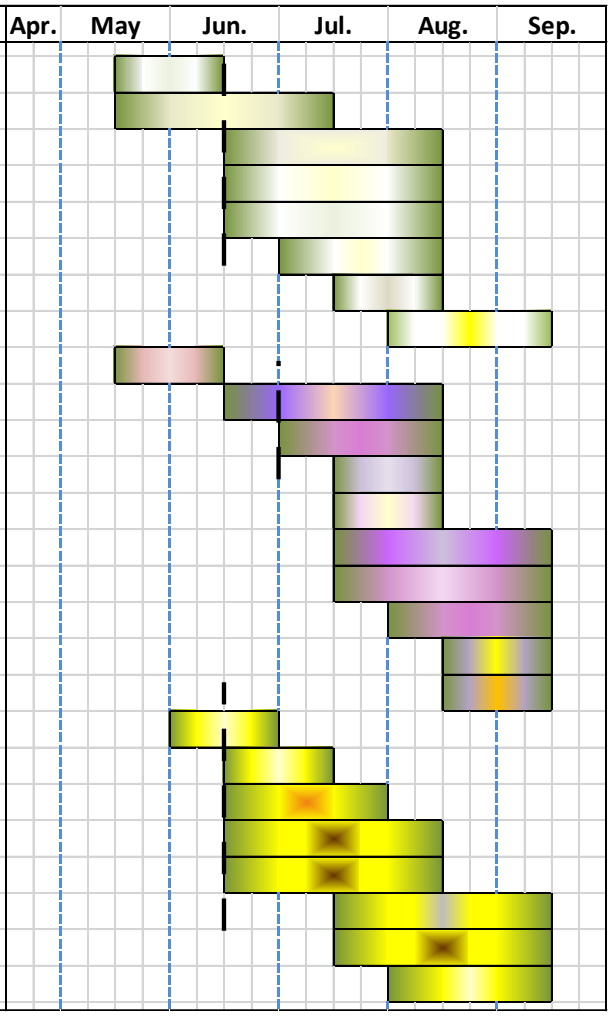

FIGURE 2. Flowering periods and colour distributions of wildflowers in the native mix. Only live material could be sourced for the periods left of the dashed lines.

Results and Interpretation

Two dry summers with an intervening winter of below-average snow cover likely affected our rate of success, especially on the sandy soils of the Brandon A and B sites. Additional pressures on the seeds and plants at these same sites came from rodents, deer, and blackbirds. Weeds and volunteer crops were abundant at all sites, and somewhat kept in check by the oat cover crop and mowing. The dry growing conditions kept plants from being stifled on most sites by an overgrowth of biomass in between mowing events.

Late in the second growing season, seeded plants were counted in four reference frames for each plot at each site and averaged. Morgan *et al.* (1995) suggest that for a tall-grass prairie planting to be successful, there should be 60 to 90 seedlings per m^2 (no less than 20/m^2), and at least five of those should be flowers. For a pollinator planting, we would like to have more than five wildflowers. Of our four sites, one is successful; two are failures; the fourth is marginal (Table 1). All control and buffer areas (the hay mixture) had acceptable establishment.

TABLE 1. Average establishment rates (plants/m^2, rounded to the nearest whole number) of seeded species in the second summer. The first number is grasses; the second is flowers; the third is total.

Seed Mix	Brandon A	Brandon B	Phillips Farm	Carberry
Hay Mix (Control)	16 – 36 – 52	15 – 29 – 43	37 – 19 – 56	22 – 41 – 63
Native Mix (Full Planting)	5 – 4 – 8	4 – 15 – 18	46 – 31 – 76	19 – 20 – 39

Standards for assessing live transplant survival are hard to find. Most of our results (Table 2) fall into the 50% to 90% range of woody plant survival experienced by 158 participants of a program for on-farm pollinator habitat establishment in Montana (Baril 2008). Only two species on only one site (Brandon A) did not achieve the lower limit, and seven of our 20 site/species combinations were better than the upper limit.

TABLE 2. Live transplant survival (%) after the second summer.

Species	Brandon A	Brandon B	Phillips Farm	Carberry
Hawthorn (*Crataegus chrysocarpa*)	73	75	100	100
Alumroot (*Heuchera richardsonii*)	56	94	91	77
Golden Alexander (*Zizea aurea*)	9	59	77	54
Three-Flowered Avens (*Geum triflorum*)	92	71	100	86
Leadplant/False Indigo (*Amorpha canescens/A. nana*)	40	77	83	100

At four times during the second growing season, flowering stems were counted in several reference frames for each plot and then averaged. The best (Phillips Farm) and worst (Brandon A) sites are presented in Figure 3. We have no standard to compare this data to, but clearly we are falling short of bee forage provisions in some colours and for some periods, even on our best site. Exotic weeds are supplementing the bee forage supply for some of those colours and periods. Field observations of multiple native bees using the abundant sow thistle (*Sonchus* spp.) at Phillips Farm in 2018 suggest that exotic weeds are an important resource. It is important to note that this second year is still an early stage of native habitat establishment; the flowering provisions are expected to improve in the future on the best sites as our diverse seeded plants mature and more of them start to flower.

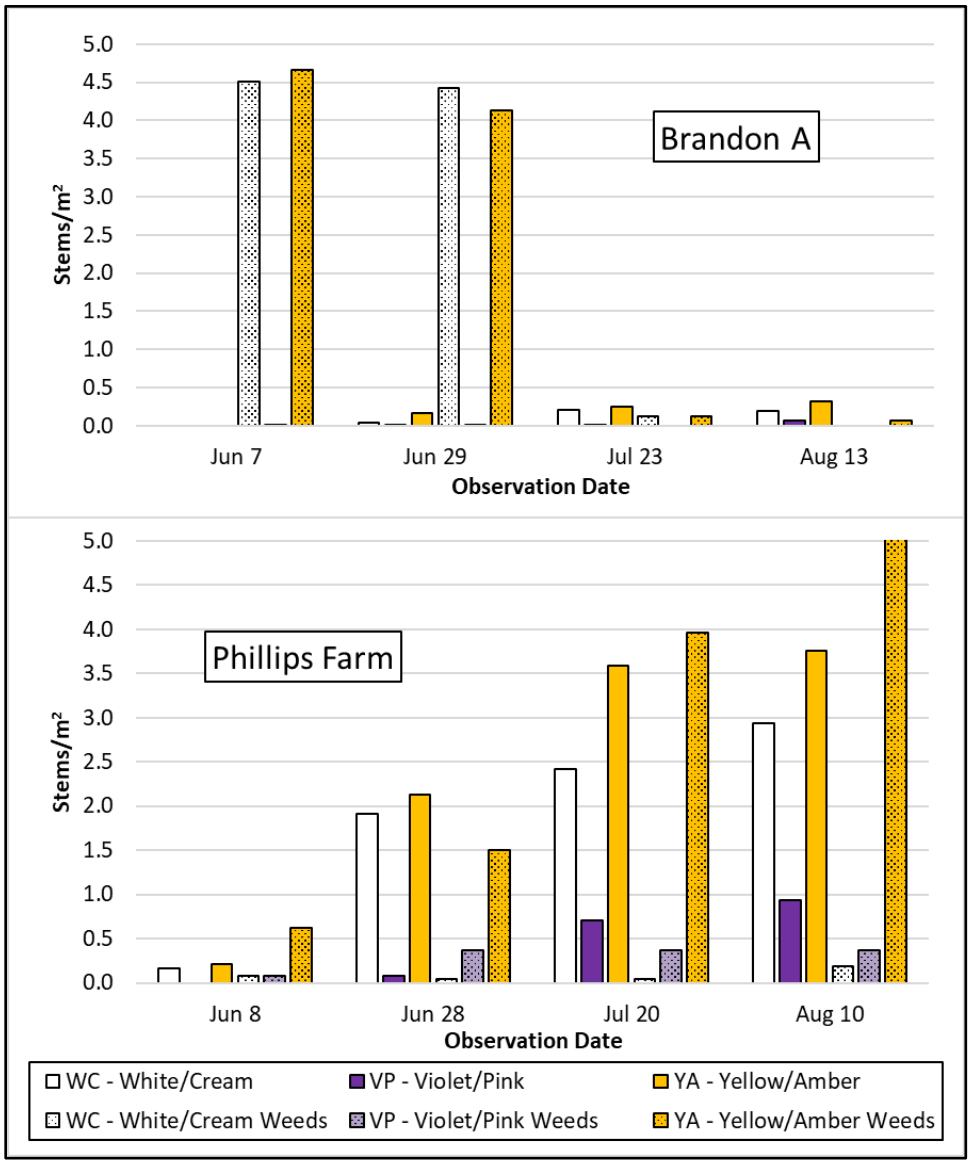

FIGURE 3. Average flowering stem counts in 2018 of the worst (top) and best (bottom) habitat plantings, grouped by flower colour and planted species versus weeds. Maximum Yellow/Amber weeds in Phillips Farm in August is cut off for scaling (actual value = 10.4/m^2).

Feasibility for agricultural producers to establish native bee habitat with native plants was determined by a detailed cost estimate for time/labour, materials, and equipment value for the multiple stages (planning, materials preparation, site preparation, planting, post-planting operations, and maintenance) required to install a one acre area (Table 3). Many of the equipment and labour costs were based on Manitoba's Farm Machinery Custom and Rental Rate Guide (Manitoba Agriculture 2018). Plant material and other supply costs were based on our actual costs, and our time expenditures were modified for realistic scenarios. Variable costs change by multiplying them by the amount of acres seeded. Fixed costs are those that remain the same regardless of how many acres are planted. The greatest cost lies in native plant material and seed, representing over 75% of the cost of the first acre. Plant material costs vary, and our actual costs are likely on the high end of that range.

TABLE 3. Costs (in $) of planting one acre of habitat, with options for planting native strips within a hay matrix to reduce cost. Variable costs are multiplied by number of acres planted. Fixed costs are the same regardless of acres are planted.

	Full Native (100%)		Hay + Native Strip (9:1)		Existing Hay + Native Strip (9:1)		Just Hay (0%)	
	Variable	Fixed	Variable	Fixed	Variable	Fixed	Variable	Fixed
Site Prep	66	22	66	22	66	22	45	22
Cover Crop	28	22	28	22	3	22		
Hay Mix	0	22	118	22			131	22
Native Mix	3,364	144	336	144	336	144		
Post-Planting	12	6	12	6	1	6	12	6
Live Plants	1,084	565	108	565	108	565		
Inspection/Mowing	42	72	4*	72	4*	7	6*	22
Total	4,596	853	672	853	519	766	188	72
1 acre	5,449		1,525		1,285		260	
10 acres	46,809		7,575		5,956		1,950	

* Revenue from hay sales to balance against cost of planting is not considered because production (tons/ac) and price ($/ton) are highly variable from site to site and year to year.

Recommendations

Alternative planting scenarios are presented in Table 3 to illustrate the cost-cutting potential of using native patches or strips within hayland, instead of 100% native habitat. One acre seeded to 90% Hay + 10% Native Strip could cost $1,525 for the first acre, compared to $5,450 for the first Full Native acre. For comparison, a pure hay stand could cost only $260 for the first acre. The alternatives do not consider income from hay because its production and revenue are variable, but that revenue may partly or entirely balance out habitat costs over the long term.

Some cost reduction may be possible with bulk purchases of seed and live material. Additionally, advance contracts made one to two years before the project, between a native seed grower and someone planning to plant native habitat, can reduce the business risk for either party, with potential for cost reduction.

Getting value for cost can be achieved with certain steps that are relatively low cost but improve the success of the planting, such as thorough pre-planting weed suppression, inclusion of a cover crop for soil protection and weed competition, strategic mowing to suppress stifling biomass, and periodic watering of live transplants. Locally or regionally grown seed will improve chances of success, because the genetics of that seed are best suited to the local growing conditions.

Live native plants have already gone through the germination, emergence, and establishment phases, and generally have a head start (Vaughn *et al.* 2015) when it comes to flowering and reproduction. Planting them in same-species clusters upwind (of the prevailing wind direction) within the native planting area will improve their prospects of reproduction, while allowing their seed to rain into the habitat planting for future spreading of that species (J.P. Morgan pers. comm. Jan. 11, 2019).

A significant barrier is the shortage of seed supply for our region (eastern Prairies). Some vendors have variety but not abundance, or vice versa. This is a priority in current discussions among restoration practitioners, with some advancement being made in increasing the seed supply. John Morgan also presents an alternative of using cheap and available equipment to harvest seed from the wild, and to spread that unsorted material with a large spin-spreader. Permission for access to harvest areas is required in some cases. Care needs to be taken to prevent damage to these areas, and to leave enough seed behind to sustain plant populations and for birds, small mammals, and insects to eat (Morgan 2019a, 2019b).

The equipment and materials used for the planting were easy to acquire. The small spin-spreader, designed to broadcast native plant seed, was purchased from a Manitoba vendor, and shipped quickly from Minnesota (under $2,500 after taxes). Vermiculite and rolled corn for carrying seed was locally available. Specialized planting dibbles and spades for the live transplants were available from local or Winnipeg garden stores, but a regular spade could be adequate if the plant is firmly planted at appropriate depth.

Real success of native habitat plantings takes two to five years to determine (USDA n.d.; MBSWR 2016), and during these first years the planting does not look great. Agricultural producers are conditioned to evaluate results within weeks of planting crops or forages, and to fight against annual weeds (which many restoration experts simply accept as early colonizers of soil disturbance). This need for perceived success makes the alternative bee habitat mixtures with exotic (non-native) plants so tempting, as some components of these mixes emerge within days of planting, and flower within weeks. These mixtures are criticized by restoration practitioners, but we can take a lesson from them. Can we use one or more flowering annuals (flax, phacelia, annual sunflower, rapeseed, or annual clovers) *in addition to* oats as a cover crop for the planting? Such temporary but fast-growing plants can provide flowers for bees during the first year of planting, and may overcome any perceived lack of success. However,

these annuals need to be seeded at very low rates (< ½ lb/ac) because individual plants can be large and overpowering against the slower-establishing perennial plants.

Summary

Native wildflowers are assumed to be most compatible with the needs of native bees. However, native wildflower plantings on agricultural field margins are challenging with respect to variable success rates, slow establishment timelines, shortage of seed supply, and significant cost. But steps can be taken by practitioners to reduce cost, improve value for the costs expended, and improve actual and perceived success. Challenges in availability and variety of seed can be mitigated with wild harvest, among other current seed production efforts.

Literature Cited

Baril, R.A. 2008 (rev. 2009). Assessment of Pollinator-Friendly Plantings on Montana Rangelands and Farms: Phase II – An On-the-Ground Approach to Determine Best Practices. Pollinator Partnership, San Francisco, CA. http://pollinator.beefriendlyfarmer.org/PDFs/Phase%20IIRevisedMay09.pdf Accessed Feb. 13, 2020.

Gerling, H.S., M.G. Willoughby, A. Schoepf, C. Tannas, and K. Tannas. 1996. A Guide to Using Native Plants on Disturbed Lands. Alberta Agriculture, Food, and Rural Development and Alberta Environmental Protection, Edmonton, AB.

Lee-Mäder, E., B. Borders, and A. Minnerath. 2013. Establishing Pollinator Meadows from Seed. The Xerces Society for Invertebrate Conservation, Portland, OR. https://tinyurl.com/Establishing-Pollinator-Meadow. Accessed Feb. 13, 2020.

Manitoba Agriculture. 2018. Farm Machinery Custom and Rental Rate Guide (2018/2019) in Manitoba. https://tinyurl.com/MB-Farm-Machinery-Rates. Accessed Feb. 24, 2019.

[MBSWR] Minnesota Board of Soil and Water Resources. 2016. What's Working: Vegetation Establishment and Maintenance. Restoration Monitoring and Evaluations. Factsheet. [Accessed Jan. 16, 2019; document is no longer available at https://bwsr.state.mn.us/vegetation-establishment-and-management]

Morgan, J.P. 2019a. Native Seed Harvesting 101. Page 85 *in* Proceedings of the 2019 Prairie Conservation and Endangered Species Conference, February 2019, Winnipeg, MB. *Edited by* D. Danyluk. Critical Wildlife Habitat Program, Winnipeg, MB.

Morgan, J.P. 2019b. GMO Prairies: The Importance of Seed Source in Prairie Restoration. Pages 154–157 *in* Proceedings of the 2019 Prairie Conservation and Endangered Species Conference, February 2019, Winnipeg, MB. *Edited by* D. Danyluk. Critical Wildlife Habitat Program, Winnipeg, MB.

Morgan, J.P., D.R. Collicut, and J.D. Thompson. 1995. Restoring Canada's Native Prairies: A practical manual. Prairie Habitats Inc., Argyle, MB. Also available at: www.naturenorth.com/RCNP/RCNP.pdf

Robson, D.B. 2014. Identification of plant species for crop pollinator habitat enhancement in the northern Prairies. Journal of Pollination Ecology 14(21): 218–234.

Smreciu, A., H. Sinton, D. Walker, and J. Bietz. 2002. Establishing Native Plant Communities. Alberta Agriculture, Food and Rural Development, Edmonton, AB.

[USDA] United States Department of Agriculture. No Date. Native Prairie: Establishment & Management of Native Prairie. https://tinyurl.com/USDA-Native-Prairie. Accessed Jan. 16, 2019.

Vaughan, M., E. Lee-Mäder, J.K. Cruz, J. Goldenetz-Dollar, J., J. Hopwood, B. Borders, S.F. Jordan, E. Krafft, and S. Morris. 2012 (rev. 2015). Pollinator Meadow Installation Guide and Checklist: Upper Midwest. The Xerces Society for Invertebrate Conservation, Portland, OR. https://xerces.org/publications/higs/upper-midwest-pollinator-meadow. Accessed Feb. 13, 2020.

Wojcik, V., L. Morandin, L., and K. Law. 2017. Selecting Plants for Pollinators: A Guide for Gardeners, Farmers, and Land Managers in the Aspen Parkland Ecoregion. North American Pollinator Protection Campaign and Pollinator Partnership Canada. https://tinyurl.com/Pollinators-Aspen-Parkland [see also http://pollinator.org/guides]. Accessed Oct. 17, 2018.

SESSION 10: BIG-PICTURE PLANNING

Session Moderator – Ken De Smet, Manitoba Sustainable Development

Managing for Diversity on Manitoba Habitat Heritage Corporation Lands

Tom Moran and Kasie McLaughlin

Manitoba Habitat Heritage Corporation; Email: tmoran@mhhc.mb.ca

Abstract – For decades, the Manitoba Habitat Heritage Corporation (MHHC) has been managing for diversity on its lands under fee-simple ownership. The focus has been working with neighbours and using agricultural practices to achieve the wildlife habitat outcomes. There is agricultural use on the properties that finds the balance and enhances wildlife habitat in a working landscape.

This presentation and poster provide insight into the long road that got MHHC to where it is today with respect to wildlife land management. By applying some simple and practical strategies and finding the right lessee, MHHC has been successful in producing wildlife habitat while supporting local beef producers.

Valley of Grass: Conservation Efforts in the Grasslands of the Souris River Valley

Lacy Kontzie

Manitoba Habitat Heritage Corporation; Email: lkontzie@mhhc.mb.ca

Abstract – The grassland habitat of the Souris River valley is one of the few contiguous blocks of native habitat within the mixed-grass prairie region of southern Manitoba, and is critical habitat for many species at risk. Due to the continuous threats to this ecosystem, this region is of significant importance to the conservation efforts of the Manitoba Habitat Heritage Corporation (MHHC), in collaboration with the landowners who manage these grasslands.

Manitoba's Conservation Agreements Act was legislated in 1998 to allow conservation agencies, such as MHHC, to work with landowners to protect wildlife habitat on private land. In 2000, the MHHC developed a partnership with Environment and Climate Change Canada through the Habitat Stewardship Program. This partnership provides funding to contribute to the recovery of species at risk and to prevent the decline of other species that rely on prairie grasslands through the protection and securement of native mixed-grass prairie.

This oral and poster presentation demonstrate the importance of this region to prairie conservation in Manitoba, outline the work that has been done to protect and enhance the native rangeland for species at risk, including range health assessments, and elaborate on continuing conservation efforts.

Collaborative Adaptive Rangeland Management: A Case Study in Private Lands Stewardship

Angela M. Dwyer[1], Justin D. Derner[2], Hailey Wilmer[3], María E. Fernández-Giménez[4], David D. Briske[5], David J. Augustine[2], Lauren M. Porensky[2,6], Seth Gallagher[7], Rachel Murph[8], Kim Obele[9], Matt Pollart[10], Terri Schulz[11] and Ted Toombs[12]

[1] Bird Conservancy of the Rockies; Email: angela.dwyer@birdconservancy.org
[2] Plains Area Rangeland Resources and Systems Research Unit, Agricultural Research Service, US Department of Agriculture (USDA);
[3] Northern Plains Climate Hub, USDA;
[4] Department of Forest and Rangeland Stewardship, Colorado State University;
[5] Department of Ecosystem Science and Management, Texas A&M University;
[6] Collaborative Adaptive Rangeland Management (CARM) Stakeholder Group;
[7] National Fish and Wildlife Foundation;
[8] Natural Resource Conservation Service, USDA;
[9] US Forest Service, USDA;
[10] Colorado State Land Board;
[11] The Nature Conservancy;
[12] Environmental Defense Fund and the Crow Valley Livestock Cooperative, Inc.

Abstract – Bird Conservancy of the Rockies in Colorado has been conserving birds and their habitats for over 30 years through an integrative model of science, education, and private land stewardship. Private land stewardship is especially vital to bird conservation, as over 70% of land in the US is privately owned, and grassland birds have declined more than any other guild. Privately owned grasslands in the western US are often working rangelands, and are complex social-ecological systems where multiple management objectives converge. Bird Conservancy participates in the Collaborative Adaptive Rangeland Management (CARM) experiment, a 10-year project (initiated in 2012) that develops collaborative partnerships and data-driven rangeland management approaches through a multi-stakeholder approach.

The goal of CARM is to compare traditional (continuous) livestock grazing with rotational (adaptive) grazing, and measure outcomes with four primary objectives: 1) livestock production, 2) grassland bird conservation, 3) vegetation structure and composition, and 4) collaborative learning. Early collaborative outcomes include increased trust and engagement among stakeholders, as well as increased trust between researchers and non-researchers. An early ecological outcome is increased bird abundance on adaptive grazing sites. We present this example of successful collaborative conservation on private lands, working to achieve multiple objectives through an adaptive grazing management framework.

Coming Together for Recovery of Multiple Species at Risk: Grasslands National Park Works with Neighbours to Achieve Beneficial Grazing

Maggi Sliwinski[1], Nathan Young[1], Kelly Williamson[2] and Jody Larson[1]

[1] Grasslands National Park, Parks Canada Agency; Email: maggi.sliwinski@pc.gc.ca
[2] South of the Divide Conservation Action Program Inc.

Abstract – In 2018, Grasslands National Park (GNP), along with the Saskatchewan Stock Growers Association, announced a partnership to support a large collaborative grazing project to improve habitat for three species at risk: Greater Sage-grouse (*Centrocercus urophasianus*), Chestnut-collared Longspur (*Calcarius ornatus*), and Sprague's Pipit (*Anthus spragueii*). Through this grassbank-type partnership, 17,000 ha of GNP land are grazed by two neighbours who ranch within the proposed boundary of GNP. These neighbours manage their cattle carefully to meet vegetation targets for the three species on both Park land and their adjoining private land. Targets were defined in consultation with species experts and recent literature. Each section of land (i.e., 260 ha) within the project area has a species designation that defines which targets are to be achieved on that section. Targets are measured by a third party, and when targets are met, the ranchers receive a reduced grazing fee (on GNP land), or a financial payout from SSGA (on private land). Through this project, GNP benefits from grazing where it was excluded for twenty years, and the ranchers have access to a large grass resource for beef production. We discuss achievement of the targets over the first two years of the program.

Creating Habitat for Multiple Species at Risk through a Collaborative Grazing Project

Kelly Williamson[1], Maggi Sliwinski[2], Nathan Young[2] and Jody Larson[2]

[1] South of the Divide Conservation Action Program Inc.; Email: easttech@sodcap.com
[2] Grasslands National Park, Parks Canada Agency

Abstract – The South of the Divide Conservation Action Program (SODCAP) Inc., Grasslands National Park (GNP), Saskatchewan Stock Growers Association, and local ranchers are implementing recovery and conservation actions for multiple species at risk in the East Block of GNP through a grassbank-style collaboration. The project area covers 40,000 acres of public and private land, much of which is considered critical habitat for Greater Sage-grouse (*Centrocercus urophasianus*), Sprague's Pipit (*Anthus spragueii*), and Chestnut-collared Longspur (*Calcarius ornatus*). Local ranchers manage grazing on portions of the East Block of GNP and their adjacent private land with a goal of achieving habitat targets for the three species. These habitat targets are measured by SODCAP. This presentation discusses the adaptive management strategies used to achieve increased biodiversity and approaches for creating habitat that shift in time and space as needed for the different species of interest. We also discuss the opportunities and challenges of working with multiple partners.

Important Bird and Biodiversity Areas: A Tool for Conserving Prairie Ecosystems

Andrew R. Couturier[1], Sonya Richmond[1], Christian Artuso[1], Timothy F. Poole[2] and Mike Burrell[3]

[1] Bird Studies Canada; Email: acouturier@birdscanada.org
[2] Nature Manitoba
[3] Ontario Natural Heritage Information Centre

Abstract – Important Bird and Biodiversity Areas (IBAs) represent a proven conservation tool in more than 120 countries worldwide. Originally, IBAs were designated for critical populations of birds, without regard to other biodiversity or ecosystem services. Increasingly, IBAs are being recognized as umbrella sites for conserving wider biodiversity (e.g., fish, plants, mammals, etc.) and as focal points for stewardship activities. Thousands of IBAs worldwide are also now considered Key Biodiversity Areas.

To help in directing appropriate conservation actions at specific sites, and to understand the degree of biodiversity capture at IBAs, we undertook an analysis of the overlap of biodiversity records with Canadian IBAs, using data from NatureServe Canada and the network of Conservation Data Centres across the country. Preliminary results indicate that, at a national scale, IBAs harbour a high percentage of species listed by COSEWIC despite the fact that some 70% of IBAs have little or no overlap with protected areas. Stewardship of sites by volunteers and NGO groups is, therefore, critically important to ensuring the persistence of biodiversity and ecosystem services, especially within the settled landscapes of the south. We highlight several examples where local groups are working at IBAs to conserve prairie ecosystems.

SESSION 11: MULTIPLE SPECIES AT RISK MANAGEMENT

Session Moderator – Chris Friesen, Manitoba Sustainable Development

A Multiple Species at Risk Management, Recovery, and Research Framework in Tall-grass Prairie

Cary D. Hamel[1] and Nicole Firlotte[2]

[1] Nature Conservancy of Canada – Manitoba Region; Email: Cary.Hamel@natureconservancy.ca
[2] Manitoba Sustainable Development

Abstract – The application of active land management 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. Several conservation management techniques are used in Manitoba's prairies and aspen parklands to promote the maintenance of a diversity of habitats and successional stages, as well as the rare and endangered species these habitats support, to achieve long-term maintenance of biodiversity.

Here we present a practical tool for supporting conservation land management decisions 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; and that formalize the identification of key knowledge gaps and ongoing monitoring of both the effectiveness of management actions and of species and their habitats.

MULTISAR – Species at Risk Partnerships on Agricultural Lands (SARPAL)

Brad Downey[1], Craig DeMaere[2], Fawn Jackson[3], Katheryn Taylor[4], Kelsey Cartwright[5], Monica Hadarits[6] and Rich Smith[7]

[1] Alberta Conservation Association; Email: Brad.Downey@ab-conservation.com
[2] Alberta Environment and Parks
[3] Canadian Cattlemen's Association
[4] Prairie Conservation Forum
[5] Cows and Fish
[6] Canadian Roundtable for Sustainable Beef
[7] Alberta Beef Producers

Abstract – The MULTISAR program is a grassroots project initiated in 2002 in southeastern Alberta (Milk River Watershed) and has since grown to encompass the South Saskatchewan Watershed, thanks to funding from the Species at Risk Partnerships on Agricultural Lands (SARPAL) starting in 2015. These funds have allowed the program to collaborate with producers on an additional 123,876 acres benefiting 80 producers, with producers on another 70,000 acres expressing interest for 2019–2020.

MULTISAR (Multiple Species, Multiple Agencies, and Multiple Resources) is a collaboration of NGOs, government, and cattle groups working together to assist producers with species at risk habitat in a way that is mutually beneficial. The project focuses on knowledge sharing, the completion of habitat assessments, development of voluntary Habitat Conservation Strategies (HCS), and subsequent implementation and monitoring of beneficial management practices. A Habitat Conservation Strategy includes an assessment of the natural resources, such as plant communities, range health, wildlife biodiversity, and riparian health on the property. In addition to the baseline assessment, the HCS provides recommendations for maintaining or enhancing these resources.

Species at Risk Partnerships on Agricultural Lands (SARPAL): Voluntary Management Changes and the Economics of Alternate Livestock Water Sources on Ranches in Alberta's Grassland Natural Region

Kelsey Cartwright[1], Brad Downey[2], Katheryn Taylor[3], Fawn Jackson[4], Rich Smith[5] and Monica Hadarits[6]

[1] Cows and Fish; Email: kcartwright@cowsandfish.org
[2] Alberta Conservation Association
[3] Prairie Conservation Forum
[4] Canadian Roundtable for Sustainable Beef
[5] Alberta Beef Producers
[6] Canadian Cattlemen's Association

Abstract – The Cows and Fish program began in 1992, when a group of scientists and ranchers in Alberta recognized the need for riparian area awareness and management resources. Over the past 26 years, thousands of riparian health inventories have been conducted by Cows and Fish along streams, rivers, lakes, and wetlands across the province. Species at Risk Partnerships on Agricultural Lands (SARPAL) funding will have enabled riparian work on a total of about 200,000 acres of ranchland when the 5-year collaboration between Cows and Fish, the Canadian Cattlemen's Association, 80 producers, and other MULTISAR affiliates ends in 2020. Riparian health results on SARPAL properties are included with range health and wildlife data in a MULTISAR Habitat Conservation Strategy. The project also supports implementation of voluntary habitat enhancements and management recommendations to protect water sources and species at risk habitat. Northern Leopard Frog (*Lithobates pipiens*), Plains Spadefoot Toad (*Spea bombifrons*), and Westslope Cutthroat Trout (*Oncorhynchus clarki lewisi*) populations, as well as various terrestrial species at risk and migratory birds, are benefitting from on-the-ground conservation projects while maintaining viable cattle operations, which is a primary goal of the SARPAL program.

In Defence of Wildlife: Approaches to Species at Risk Management on CFB Suffield

Amy Moores

CFB Suffield, Department of National Defence**;** Email: amy.moores@forces.gc.ca

Abstract – Military training and species at risk conservation can be compatible on a landscape. Both the diversity and density of protected species can be higher on military bases when compared with other protected areas as a result of a heterogeneous disturbance regime. Disturbance to species at risk, both sensory and habitat, is inherent on a military base. Primary sources of military disturbance on army bases are fire and off-road vehicle maneuvering, which impact vegetation and soil.

Canadian Forces Base (CFB) Suffield is the largest army military training establishment in Canada, and is comprised primarily of contiguous native prairie habitat, with 21 species at risk known to breed on the base while coexisting with activities related to military training. At CFB Suffield, species at risk management strategies are implemented on species-specific and ecosystem levels. Examples of species at risk interactions with military training are presented for Barn Swallow (*Hirundo rustica*), Bank Swallow (*Riparia riparia*), and Ferruginous Hawk (*Buteo regalis*). Potential issues and approaches to management are outlined, as well as involvement from CFB Suffield with creation of nesting habitat for Burrowing Owl (*Athene cunicularia*).

Developing Predictive Models for the Occurrence of Four Grassland Bird Species in Alberta: Horned Lark, McCown's Longspur, Western Meadowlark, and Sprague's Pipit

Julie P. Landry-DeBoer[1], Paul F. Jones[1], Brad A. Downey[1], Brandy L. Downey[2], Katheryn T. Taylor[3], Craig G. DeMaere[2] and Amanda J. Miller[2]

[1] Alberta Conservation Association; Email : julie.landry-deboer@ab-conservation.com
[2] Alberta Environment and Parks
[3] Prairie Conservation Forum

Abstract – Many grassland birds are experiencing population declines across the Canadian prairies, with some listed as Threatened by the federal Species at Risk Act, such as Sprague's Pipit (*Anthus spragueii)*. Understanding the habitat requirements for grassland birds may guide their future conservation. Within pre-determined areas in the mixed-grass and dry mixed-grass regions of southern Alberta, we utilized grassland bird point-count data and range health data to examine the habitat requirements for four native bird species: Horned Lark (*Eremophila alpestris*), McCown's Longspur *(Rhynchophanes mccownii*), Western Meadowlark (*Sturnella neglecta*), and Sprague's Pipit (*Anthus spragueii*). Using Akaike's information criterion, we evaluated which of three hypotheses best explained the occurrence of the four bird species: 1) habitat structure, 2) habitat community, or 3) habitat disturbance. A suite of *a priori* models was developed for each hypothesis and consisted of variables determined from vegetation transects, range health assessments, and GIS analysis. We discuss the top models for predicting occurrences of these grassland birds and their conservation implications.

SESSION 12: BIOLOGICAL EFFECTS OF MANAGEMENT

Session Moderator – Jason Kelly, Manitoba Sustainable Development

Influence of Management Strategy on Insects that Provide Ecological Services in the Tall-grass Prairie Ecosystem

Reid Miller

Department of Entomology, University of Manitoba; Email: millerrb@myumanitoba.ca

Abstract – The tall-grass prairie ecosystem occupies less than 0.05% of its former range in Manitoba. Current management strategies designed to mimic historical disturbances include prescribed fires and cattle grazing. The effects that these strategies have on invertebrate communities that depend on tall-grass prairie, along with the associated ecological functions that they provide, are insufficiently studied. For my study, the diversity and abundance of insect pollinators and decomposers will be analyzed to elucidate the effects that current management policies are having on these beneficial insect guilds in the tall-grass prairie ecosystem.

To study the effect that fire and grazing are having on the diversity and abundance of pollinators and decomposers in a tall-grass prairie ecosystem, sites were chosen representing three treatments: 1) burned, 2) grazed, and 3) no disturbance. Native bees were captured using bee bowls and blue vane traps and saprophagous beetles were captured using baited pitfall traps. The level of decomposition was measured in the three treatments by weighing dung before and after time exposed to insects in the field. Here I report on some preliminary bee and beetle abundance and diversity results, as well as landscape characteristic data.

Responses to Weather and Land Management Gleaned from 20 Years of Monitoring of Two Rare Tall-grass Prairie Orchids in Manitoba

Barbara I. Bleho[1], Christie L. Borkowsky[2], Cary D. Hamel[3], Nicola Koper[4] and Melissa A. Grantham[3]

[1] Golder Associates Ltd.; Email: bleho.barbara@gmail.com
[2] Critical Wildlife Habitat Program
[3] Nature Conservancy of Canada – Manitoba Region
[4] Natural Resources Institute, University of Manitoba

Abstract – Small White Lady's-slipper (*Cypripedium candidum*) and Western Prairie Fringed-orchid (*Platanthera praeclara*) are rare orchids largely restricted to remnant wet to mesic tall-grass prairie. Both species are listed as Endangered in Manitoba and Canada, yet our understanding of how these orchids respond to environmental conditions and land management is limited, hindering conservation and recovery efforts. We used 20 years of monitoring data to evaluate the responses of Small White Lady's-slipper and Western Prairie Fringed-orchid populations to weather and land management at the Manitoba Tall Grass Prairie Preserve.

Temperature appears to proximately regulate Small White Lady's-slipper growth and flowering, with warm springs favored, whereas precipitation appears to have a weak lag effect. Snow cover may moderate winter ground temperature and provide water in spring. Some grazing appears to benefit the species, presumably by reducing competition and shading, but frequent grazing may increase the risk of direct damage. Fire data were inadequate for the Small White Lady's-slipper analysis. Western Prairie Fringed-orchids appear to benefit most from a combination of warm temperatures in the previous growing season followed by cool snowy but short winters and wet springs. Periodic burning (e.g., every 2 to 3 years) may benefit fringed-orchids, whereas frequent grazing may be detrimental.

Climate and Grazing Effects on Root Biomass in Manitoba, Saskatchewan, and Alberta Grasslands

Diego Steinaker[1], Scott Wilson[2], Bradley Pinno[3], Edward Bork[4], Shannon White[5] and James Cahill, Jr.[5]

[1] Saskatchewan Prairie Conservation Action Plan; Email: pcap@sasktel.net
[2] Department of Biology, University of Regina
[3] Department of Renewable Resources, University of Alberta
[4] Department of Agricultural, Food & Nutritional Sciences, University of Alberta
[5] Department of Biological Sciences, University of Alberta

Abstract – Root mass comprises a large component of carbon cycling in temperate grasslands and is influenced by climate and grazing. In this experiment we tested whether varying defoliation intensity can mitigate the effects of reduced precipitation (using rainout shelters) and 2°C higher temperature (using open-topped chambers) on root biomass. We used minirhizotron images and specific root-length measures to estimate root biomass changes in the top 40 cm of soil of three grasslands in Alberta, Saskatchewan, and Manitoba. In general, we found that the negative effects of drought or warming on root mass were increased by greater defoliation intensity.

Our results suggest that managing grazing intensity could play an important role in maintaining root mass and associated ecosystem services, such as below-ground carbon sequestration, under future climates. Under 2°C warming, for instance, root mass at the Alberta site increased by 17% by reducing grazing from severe to moderate intensity, and by an additional 13% by resting from grazing. Considering that below-ground biomass in these grasslands is 1,000–1,800 g/m^2 (equivalent to 500–900 g/m^2 of carbon), an additional 0.8 to 1.4 t/ha of carbon might be stored by reducing defoliation intensity on heavily grazed rangelands.

Bison as Ecosystem Engineers in the Aspen Parkland

Peter Tarleton[1] and Eric Lamb[2]

[1] Parks Canada Agency and University of Saskatchewan; Email: peter.tarleton@usask.ca
[2] Department of Plant Sciences, University of Saskatchewan

Abstract – The aspen parkland is threatened by many factors including the loss of natural disturbance processes such as fire and herbivory. Bison, as the dominant large herbivore, are suspected to have played an important role in maintaining and structuring the plant community by preventing shrub encroachment into open grassland. In this study we examined the effect of bison on plant communities across the forest–grassland ecotone in Riding Mountain National Park in Manitoba. We found that over a single year, bison reduced sward heights but did not alter the composition of grassland communities, with the possible exception of an important interaction with the invasive Kentucky Bluegrass (*Poa pratensis*). However, the long-term (>80 year) presence of bison was associated with greater species richness, reduced litter accumulation, and a distinct community composition compared to areas without bison. We also found that the influence of bison on the shrub community at the forest–grassland edge is limited. Bison occurred at very low densities in areas with dense, tall shrub understories, and thus cannot be a major factor in limiting shrub growth and survival. Shrub stem mortality due to fire may be a necessary precursor to bison in mitigating woody encroachment in the aspen parkland.

Anthropogenic Landscape Effects on Wild Bee Diversity in Southern Manitoba

Emily J. Hanuschuk

Department of Entomology, University of Manitoba; Email: hanusche@myumanitoba.ca

Abstract – Wild bee diversity and the effects of anthropogenic change on bee communities remains poorly understood in southern Manitoba. This study looks to compare species richness, abundance, and diversity of wild bees between disturbed and semi-natural landscapes across southern Manitoba. Sixteen paired sites with high and low levels of anthropogenic disturbance were sampled for bees from May to August 2018. Bees were collected using blue vane traps, coloured bee bowls, and air nets. Only specimens from net collections have been processed so far, and preliminary results on these specimens are presented. This study is being conducted in collaboration with Agriculture and Agri-Food Canada as part of a larger ongoing study on native pollinator potential in Manitoba.

Retaining Prairie Ponds to Offset Agricultural Impacts on Aerial Insectivores: An Assessment of Tree Swallow Foraging Habitat

Andrew S. Elgin[1], Robert G. Clark[2] and Christy Morrissey[3]

[1] Department of Biology, University of Saskatchewan; Email: andrew.elgin@usask.ca
[2] Prairie & Northern Wildlife Research Centre, Environment & Climate Change Canada
[3] School of Environment and Sustainability, University of Saskatchewan

Abstract – Patches of non-crop habitat in agroecosystems may benefit bird and insect populations by serving as shelter, breeding areas, or foraging habitat. Prairie ponds may function as such critical habitat on landscapes dominated by cropland. Aerial insectivorous birds, especially Tree Swallows (*Tachycineta bicolor*), often forage over open water to capture emergent aquatic insect prey. However, it is unclear whether prairie ponds are selected by swallows relative to other habitat types, especially in areas with differing composition of dominant land cover.

Using miniature GPS tags, we tracked 24 adult breeding female Tree Swallows to evaluate whether ponds were selected as foraging habitat at sites dominated by tame grass, croplands, or mixed habitats in south-central Saskatchewan. We used sweep-net sampling to assess the abundance of aquatic and terrestrial insects in different habitat types on each site. Tree Swallows primarily selected ponds as foraging areas (~30% of GPS fixes), with differences between sites, and generally avoided cropland areas. We confirmed that upland habitats in croplands have the lowest insect abundance, while wetlands and grassy margins had higher abundance. This study underscores the importance of protection and restoration of prairie ponds in agricultural landscapes to mitigate aerial insectivore declines.

SESSION 13: PUBLIC ENGAGEMENT – PART II

Session Moderator – Caitlin Mroz, Saskatchewan Prairie Conservation Action Plan

Reconnecting Language, Land, and People: Place Names of posâkanacik aski (Touchwood Hills) Plains Cree and Saulteaux Communities, Central Saskatchewan

Andrew M. Miller

Department of Indigenous Language, Arts and Culture, First Nations University of Canada;
Email: amiller@firstnationsuniversity.ca

Abstract – This talk presents ongoing community-based research on Indigenous toponyms (place names) being undertaken by First Nations University of Canada and four Cree and Saulteaux First Nations of the Touchwood Hills in central Saskatchewan prairie-parkland ecosystem. Toponyms often incorporate salient plant and animal species, reflecting the history, cosmovision, and land-use values of a society of a specific time. Our research reveals First Nations' histories, understandings, and relationships to environments in a region transformed over the past 150 years by intensive agriculture and livestock production.

Through interviews and examination of records in local museum and provincial archives, we report on local faunal changes including the extirpation of Whooping Crane (*Grus americana*) and buffalo, and increases in elk, wolves, beaver, and dog ticks. Traditional knowledge of plant phenology and animal behavior provide signals for livelihood activities linking harvest of plant and animal resources. Place names provide an entry point for discussion of changing land uses, environmental changes, and identify physical spaces where the work of reconciliation between Aboriginal and settler societies can occur.

Diversity in Engagement: Toward Stewardship of Manitoba's Important Bird and Biodiversity Areas

Timothy F. Poole[1], Lynnea A. Parker[1] and Christian Artuso[2]

[1] Nature Manitoba; Email: iba@naturemanitoba.ca
[2] Bird Studies Canada

Abstract – Important Bird and Biodiversity Areas (IBAs) are places of international significance for the conservation of birds and their associated habitats. IBAs are a practical response to the many conservation challenges facing birds around the world, each site being selected from globally standardized criteria. There are currently 35 IBAs in Manitoba, three of which are in the mixed-grass prairies of southwestern Manitoba.

The Manitoba IBA Program was established in 2012 to engage volunteers and communities in and around IBAs. The Manitoba Grassland Bird Initiative was created as a conduit for outreach and advocacy in the mixed-grass prairie IBAs, but has since evolved, becoming part of a larger partnership with several other organizations, to more directly engage with the local pasture managers. Program volunteers are encouraged to participate in locating species at risk, partake in IBA-wide counts, and, more recently, in monitoring upland shorebird trends via the International Shorebird Survey. The program also provides direct outreach with Indigenous and non-Indigenous communities, delivering workshops on grassland bird conservation and monitoring.

We discuss some of the challenges and lessons learned in transitioning from citizen science to fostering stewardship activities, and in engaging local communities, organizations, and individuals in species and site conservation.

Alberta Environmental Farm Plan Species at Risk Tool

François Blouin[1], **Paul Watson**[2], Robin Bloom[3], Jeff Harder[2], John Wilmshurst[4] and David Johns[5]

[1] Private Consultant
[2] Alberta Environmental Farm Plan, Agricultural Research and Extension Council of Alberta;
Email: efp@areca.ab.ca
[3] Canadian Wildlife Service, Environment and Climate Change Canada
[4] ProofreadCanada
[5] Alberta Environment and Parks

Abstract – The Alberta Environmental Farm Plan (AEFP) program of the Agricultural Research and Extension Council of Alberta (ARECA) has developed a decision-support tool for the management of multiple species at risk on lands owned or managed by agricultural producers. It uses federal, provincial, regional, and publicly available databases, habitat models, and range maps, as well as input from the user, to infer occurrence of species at risk on any given quarter section of land. The purposes of the tool are: 1) to provide awareness of which species at risk might be present on a ranch or farm and what their needs are, 2) to offer simple actions that can be taken to conserve or improve species at risk and their habitat, and 3) to provide further resources (funding, expertise, information) to support producers in the implementation of these actions. This online tool is expected to reach between 10,000 and 25,000 farmers and ranchers over the next decade.

Introduction

The Alberta Environmental Farm Plan (AEFP) is a voluntary, whole farm, self-assessment tool that helps agricultural producers systematically identify the environmental strengths of, and risks to, their operation and develop an action plan to mitigate those risks. It was developed to help the agriculture and agri-food sector achieve environmental sustainability in the areas of soil, water, air, and biodiversity, and increase competitiveness in global markets (AAFC 2009).

There is growing demand by consumers that agricultural production be sustainable. The AEFP program is working toward adapting the plan to meet or exceed international sustainable sourcing standards so that it can be used by agricultural producers to demonstrate sustainability. A benchmark study showed the AEFP lacked content on the protection of rare and endangered species and enhancement of biodiversity (Control Union 2015). Funding was available through the federal Species at Risk Partnerships on Agricultural Lands (SARPAL) program and the AEFP program to develop an online Species at Risk Tool (SAR-Tool) to introduce species at risk to producers in a confidential and non-threatening way.

Methods

Area of Interest

The SAR-Tool is intended for implementation in the Agricultural Region of Alberta, which encompasses the entire Grassland and Parkland, and part of the Boreal, Natural Regions (Figure 1). Much of this land is either privately owned for crop and livestock production or public land under various dispositions, primarily grazing leases (Government of Alberta 2007).

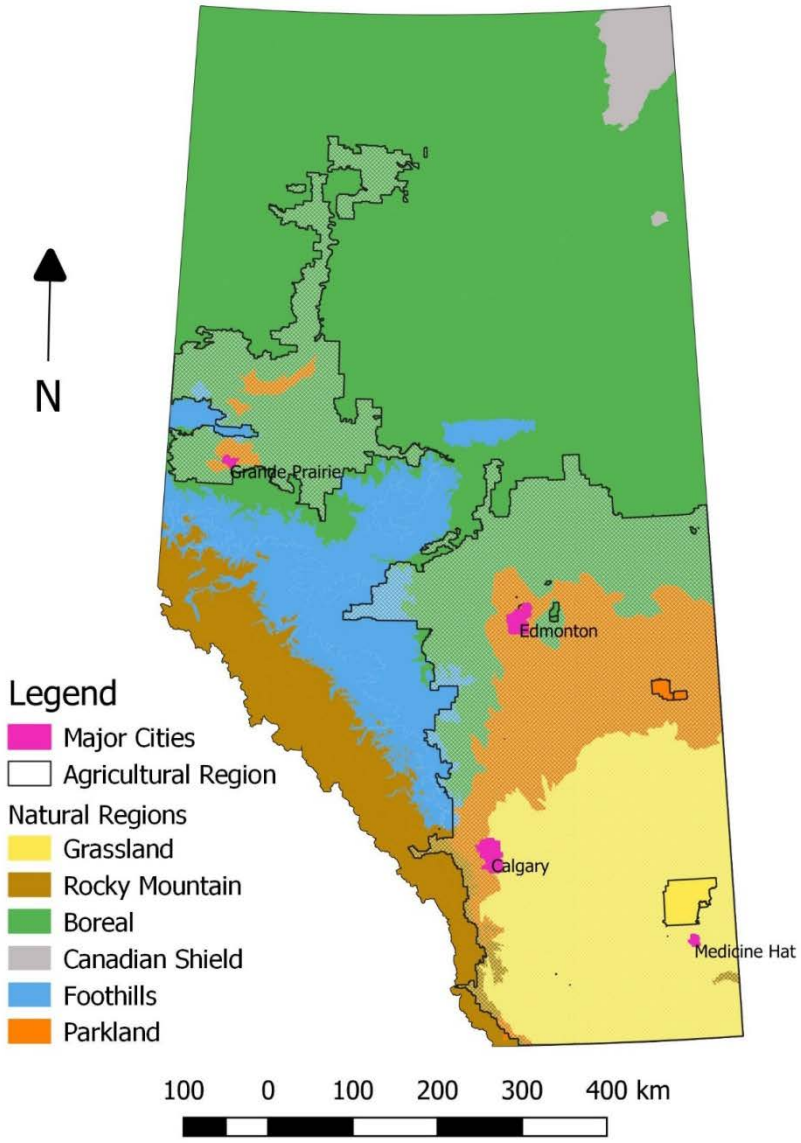

FIGURE 1. Agricultural and Natural Regions of Alberta, Canada (derived from: Alberta Agriculture and Forestry 2005, Natural Regions Committee 2006).

Selection and Ranking of Species at Risk

Species at risk were defined as species whose conservation status had been assessed and were designated provincially as Endangered or Threatened under Alberta's *Wildlife Act* or of Special Concern by the Alberta Endangered Species Conservation Committee (Government of Alberta 2016), or listed federally in Schedule 1 of the *Species at Risk Act* (SARA) (Government of Canada 2017) as of April 2017. The scientific and common names of species follow the nomenclature under SARA. To harmonize taxonomic identifiers among datasets, NatureServe's element code

(or ELCODE) was used (Alberta Parks 2018). A *Species Rank* was assigned to each species at risk according to their formal designation under the Alberta *Wildlife Act*, SARA, or their subnational (provincial) conservation status rank (ACIMS 2018; see Figure 2): highest for Endangered and lowest for Special Concern.

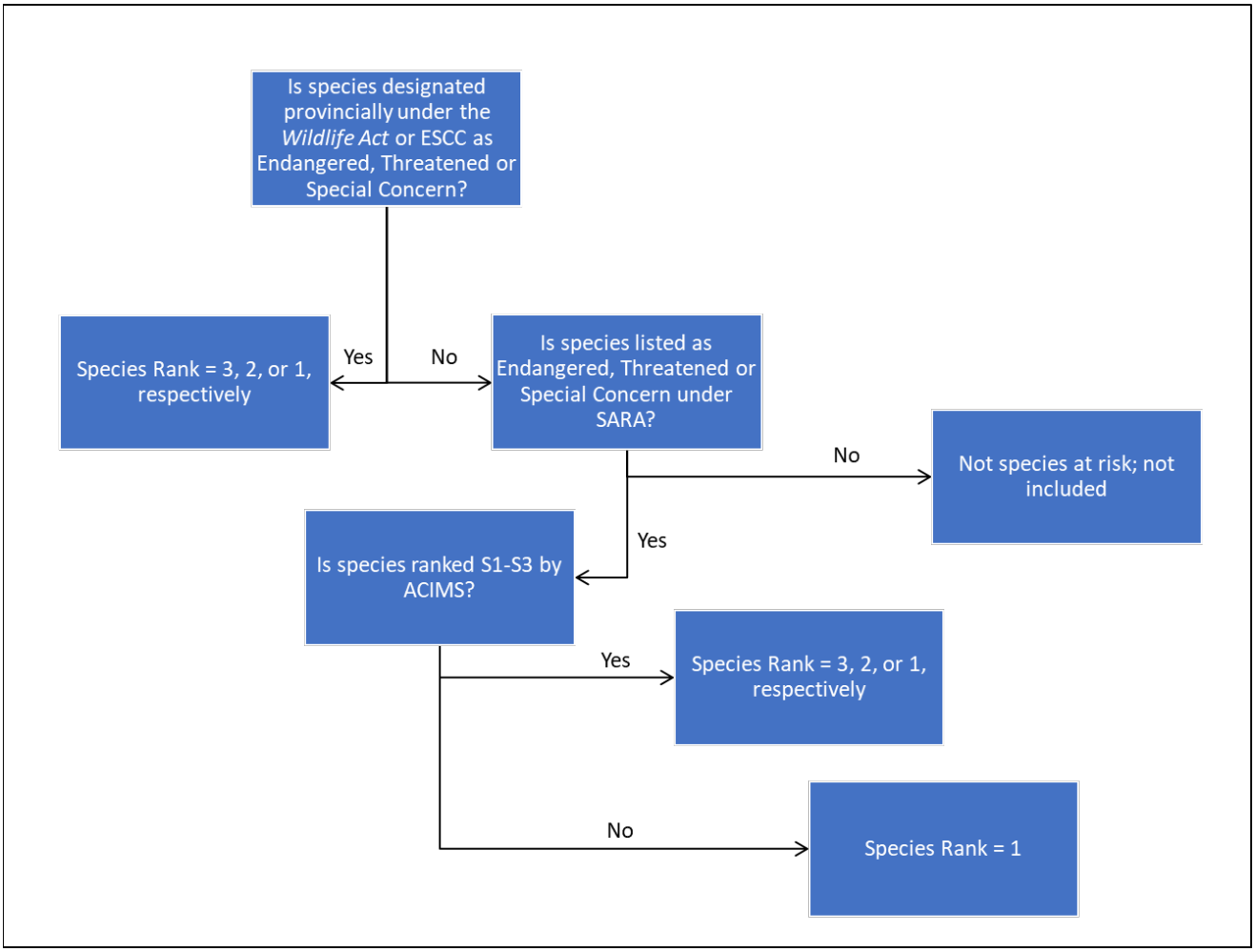

FIGURE 2. Decision process for selecting species at risk and establishing Species Ranks. ESCC is Alberta's Endangered Species Conservation Committee. ACIMS is the Alberta Conservation Information Management System.

We developed four Species Rank modifiers to further distinguish and prioritize species of otherwise equal rank known or inferred to occur in the same land parcel (Table 1). Modifiers were assessed by a minimum of three experts using a Delphi method (Linstone and Turoff 1975). We used the modal value when there was disagreement between scores. When the two scores were tied, we used the assessment of the main author. We added the four modifier scores together for each species, divided them by 10 and added them to the Species Rank to create the *Modified Species Rank* (see Supplementary Material on page 123).

TABLE 1. Species Rank Modifiers.

Modifier	Definition	Modifier Score*	
		2	1
1) Geographic Distribution (Range)	Narrow ranging: extent of occurrence (EO) estimated to < 5000 km^2 (IUCN criteria B1 for Endangered category; IUCN 2012); wide ranging: EO ≥ 5000 km^2	Narrow ranging	Wide ranging
2) Habitat Features	Strong association with "structures" or "features" that differ from the main habitat matrix (e.g., caves, cliffs, backwaters)	Yes	No
3) Area Sensitivity	The probability of species occurrence increases with patch size; below a threshold patch size of otherwise suitable habitat, the species doesn't tend to occur (see Davis 2004)	Yes	No
4) Level of Ecological Tolerance	Requirement for environmental factors/conditions (pH, temperature, acidity, moisture, etc.) that are limited	Yes	No

* Modifiers were assigned a score of 2 when the criterion largely applied to the species and 1 when the criterion weakly applied or did not apply.

Development and Compatibility of Beneficial Management Practices

Beneficial management practices (BMPs) for species at risk were derived from secondary sources (e.g., ECCC n.d.; USGS 2002; RCS 2016), other scientific and gray literature, and consultation with experts. To improve their understanding and provide justification for their application, all BMPs were structured as follows:

1) Desired outcome (goal of the BMP);
2) One of the ways to do it (management activity to implement or avoid, implying that there may be other ways to achieve the same desired outcome);
3) Where (in what habitat or habitat feature to apply the activity);
4) When (to apply it); and
5) Why (justification supporting the BMP, empirically derived or based on expert opinion).

A list of 84 BMPs were derived for the 35 species at risk. Species were associated with all BMPs expected to provide them with direct benefits to their conservation and recovery (Table 2).

We compared 3486 BMP pairs against one another to assess their compatibility (yes/no). BMP pairs were considered compatible when: 1) the activities from the two BMPs targeted different habitats or habitat features within the same management unit [e.g., a wetland versus a grassland], or 2) they affected the same habitats but in a way that was mutually beneficial or neutral; and 3) the interspecific interactions between the species targeted by one BMP and those targeted by the other BMP were either neutral or beneficial.

BMP Ranking and Barriers to Adoption

BMPs were ranked according to their perceived benefit to the target species. A *BMP Rank* from 1 to 3 (low, medium, high) was assigned to each BMP based on the expected impact on the population. In addition, each BMP received a score based on three parameters related to perceived barriers to implementation of BMPs by producers: 1) Cost (of implementation: low, medium, high); 2) Time (spent: low, medium, high); and 3) Economics (cost to farm operation: low, medium, high). The average of the three was the BMP *Adoption Likelihood* (Table 2).

Data Sources

We used recent (Jan. 1, 2008 to Dec. 31, 2017) data from multiple sources to identify or infer species occurrence at the quarter-section level. These included provincial databases (such as the Fisheries and Wildlife Management Information System [FWMIS]), eBird data, habitat models, critical habitat maps, and range maps. For animal species that overwinter outside of Alberta, we used records with observations made between April 1 and September 1 of any one year.

Data Processing

Species at risk data were assigned a (naïve) *Confidence Index* (CI) (which varies between 0 and 1) that the species at risk or suitable species at risk habitat exists in the land parcel of interest. Species occurrence records were buffered to a precision (or precision proxy) value using a GIS and assigned a CI according to that level of precision (Table 3). For Resource Selection Function (RSF) or Habitat Suitability Index (HSI) models, the CI was drawn directly from the normalized (0–1) model indices representing values proportional to the probability of use of the land parcel (the resource unit) by a species, or to its carrying capacity (USFWS 1981; Boyce *et al*. 2002). Designated *critical habitat*, per federal recovery strategies, was assigned a CI of 1 regardless of how critical habitat was derived. Range maps were assigned the lowest CI of 0.1 as they offer no inference about habitat quality. All buffered species records and their associated CI value were summarized at the quarter-section level, which corresponds to the basic management unit for agricultural producers in Alberta. Where species occurrence in a quarter section was inferred from multiple sources, the record with the highest CI was used.

Improving the Confidence Index

While the assigned CI of individual species at risk can be as high as 1 in some quarter sections where they are known or inferred to occur, in many cases it is lower and can be as low as 0.1 (Table 3). We developed an interactive section for habitat selection in the SAR-Tool. Species were pre-assigned to one or multiple habitat types (e.g., native grassland, cropland, etc.) and/or habitat features (e.g., tree/shrub, ephemeral wetland, etc.) depending on their specific habitat requirements. User selection of habitat types/features that apply to their quarter section of interest reduces, in most cases, the “naïve” species list for the quarter. With a few exceptions, all the species that are sub-selected through the habitat selection process have their revised CI (or *Informed CI*) doubled, up to a maximum of 1. The remaining species have their Informed CI adjusted to 0.

TABLE 2. Two examples of Beneficial Management Practices (BMPs) showing structure, content, target species at risk, BMP Ranks, and the three Barriers to Adoption scores that make up the Adoption Likelihood (see text for details).

Target Species†	BMP ID	BMP Description	BMP Rank*	Barriers to Adoption*			Adoption Likelihood
				Cost	Time	Eco-nomics	
Baird's Sparrow, Burrowing Owl, Chestnut-collared Longspur, Common Nighthawk, Long-billed Curlew, McCown's Longspur, Short-eared Owl, Sprague's Pipit, Swift Fox	7	**Desired Outcome**: Prairie patches one quarter (160 acres, 65 hectares) or preferably more in size with less than 20% shrub or tree cover. **Where:** In uplands where reducing shrub and tree encroachment is needed for range improvement. **One way to do it**: Remove encroaching trees and shrubs using targeted grazing, mowing, cutting, or pulling that will not damage grass. Do not remove sagebrush shrubs without consulting with a biologist as many prairie species use them. **When:** Mowing and pulling should be done after the grassland bird breeding season (after August 15). **Why:** Many prairie species have evolved with large expanses of open grassland without shrubs or trees.	2	2	2	3	2.33
Burrowing Owl, Long-billed Curlew, Piping Plover, Greater Sage-grouse, Short-eared Owl	8	**Desired Outcome**: Reduced predation on, or competition with, species at risk. **One way to do it**: Remove abandoned buildings, unused utility poles, shelterbelts and debris piles that don't house bats, Swift Foxes, Common Nighthawks, or swallows. **Where:** Within 1 mile (1.6 km) of species at risk habitat. **When:** Remove during fall and winter (Sept 22 – Jan 31). **Why:** Native prairie species that are at risk have to compete with or evade species that have adapted to humans. Removing artificial habitats when appropriate can help the original prairie species thrive.	3	2	2	2	2.00

* 1 = low, 2 = medium, 3 = high. † See Supplementary Material (page 123) for scientific names.

TABLE 3. Confidence Index (CI) assignment and required GIS processing of management units (quarter sections) based on data source and related precision.

Source	Precision*	CI	GIS Processing
FWMIS† Observations (point data)	≤ 800 m	1	Applied CI to observation quarter
FWMIS Observations (point data)	≤ 800 m	0.8	Applied CI to quarters surrounding observation quarter
FWMIS Observations (point data)	> 800 m and ≤ 1600 m	0.8	Buffered location to "Precision" value, selected all the quarter sections that touched the buffered area and assigned CI
FWMIS Observations (point data)	> 1600 m and ≤ 3200 m	0.6	Buffered location to "Precision" value, selected all the quarter sections that touched the buffered area and assigned CI
FWMIS Observations (point data)	> 3200 m and ≤ 6400 m	0.4	Buffered location to "Precision" value, selected all the quarter sections that touched the buffered area and assigned CI
FWMIS Observations (point data)	> 6400 m	0.2	Buffered location to "Precision" value, selected all the quarter sections that touched the buffered area and assigned CI
eBird Observations (point data) (Stationary Counts/Random Counts/ Travelling Counts/IBA Canada Protocols/ Rusty Blackbird Blitz/Area Counts)	≤ 800 m	1	Buffered location to "Precision" value, selected all the quarter sections that touched the buffered area and assigned CI
eBird Observations (point data) (Stationary Counts/Random Counts/ Travelling Counts/IBA Canada Protocols/ Rusty Blackbird Blitz/Area Counts)	> 800 m and ≤ 1600 m	0.8	Buffered location to "Precision" value, selected all the quarter sections that touched the buffered area and assigned CI
eBird Observations (point data) (Stationary Counts/Random Counts/ Travelling Counts/IBA Canada Protocols/ Rusty Blackbird Blitz/Area Counts)	> 1600 m and ≤ 3200 m	0.6	Buffered location to "Precision" value, selected all the quarter sections that touched the buffered area and assigned CI
eBird Observations (point data) (Stationary Counts/Random Counts/ Travelling Counts/IBA Canada Protocols/ Rusty Blackbird Blitz/Area Counts)	> 3200 m and ≤ 6400 m	0.4	Buffered location to "Precision" value, selected all the quarter sections that touched the buffered area and assigned CI

Source	Precision*	CI	GIS Processing
eBird Observations (point data) (Stationary Counts/Random Counts/ Travelling Counts/IBA Canada Protocols/ Rusty Blackbird Blitz/Area Counts)	> 6400 m	0.2	Buffered location to "Precision" value, selected all the quarter sections that touched the buffered area and assign CI
eBird Observations (point data) (Casual/Historical Observations)	6400 m	0.2	Buffered location to "Precision" value, selected all the quarter sections that touched the buffered area and assigned CI
Resource Selection Function Models / Habitat Suitability Index Models (raster data)	Variable	0–1	Clipped model (raster) to species' range. Normalized pixel values from 0 to 1. Grouped pixels into 5-10 bins of equal intervals. Converted to polygon and intersected with quarter section layer. Applied highest CI to quarter.
Critical Habitat Maps (polygon data)	Variable	1	Applied CI to all quarters that intersected CH polygons
Range Maps (polygon data)	Undefined	0.1	Applied CI to quarters that touched the range map polygon(s)

* For eBird Data, a precision value was not available. Parameters associated with the specific sampling protocols were used to create a proxy for Precision. "Effort Distance" was used for Stationary Counts/ Random Counts/ Travelling Counts/IBA Canada protocol/Rusty Blackbird Blitz (RBB). For Stationary Counts, "Effort Distance" (not provided) was assumed to be 0 and the Precision was assumed to be 800 m. For Exhaustive Area Counts, the "Area" was assumed to be a circle and the circle radius was used as a proxy for Precision. The Important Bird Area (IBA) protocol is designed to cover an entire IBA area. The "Distance Traveled" value is mandatory in eBird but the "Area Searched" value is not, and no IBA records had a value entered for that parameter. It was therefore treated as a Traveling Count. For Traveling Counts/IBA Canada Protocol/Rusty Blackbird Blitz: 1) the observation coordinates could be captured at any location along a transect (although usually captured at the beginning or mid-length of transect) but required at mid-length for RBB and recommended at mid-length for Traveling Counts, and 2) the transects could be in any direction, any shape, a loop, or open. We applied the transect mid-length as the Precision value around the location. For Casual Observations/Historical Observations, no transect length or area were provided. "Localities" of unknown but variable sizes and shapes were provided, including backyards, towns, highways, national parks, etc. Therefore, we applied a Precision of 6.4 km and assigned the lowest Confidence Index above that of a range map.

† FWMIS = Fisheries and Wildlife Management Information System

Selection and Prioritization of Conservation Opportunities

Each BMP was assigned one or multiple habitat types/features. For a BMP to be selected as an opportunity for producers, its associated single or multiple species–habitat combination(s) had to match at least one species–habitat combination generated from the user's legal land description entry and selections of habitat types/features.

Prioritizing BMPs is a multiplicative approach using the various ranks and scores developed: 1) the Modified Species Rank is multiplied by the Informed CI to yield an *Action Priority*; 2) the

Action Priority for all the species that were inferred to occur on the land parcel of interest and that shared the same individual BMPs were added together to yield the *Combined Action Priority* for that BMP; 3) the Combined Action Priority was then multiplied by the BMP Rank to yield the *Conservation Opportunity Priority* (Table 4).

TABLE 4. Conservation Opportunity Priority calculation for species in a hypothetical quarter section with BMP ID #1.

Species ID*	Source†	CI† (naïve)	Modified Species Rank	CI (informed)	Action Priority
Ferruginous Hawk	FWMIS	1	3.6	1	3.6
Burrowing Owl	HSI	0.5	3.5	1	3.5
Chestnut-collared Longspur	FWMIS	0.8	1.7	1	1.7
Prairie Falcon	RSF	0.9	1.6	1	1.6
Baird's Sparrow	FWMIS	0.8	1.6	1	1.6
Prairie Rattlesnake	RSF	0.7	1.6	1	1.6
Sprague's Pipit	RSF	0.5	1.6	1	1.6
Loggerhead Shrike	RSF	0.8	1.5	1	1.5
McCown's Longspur	eBird	0.2	1.6	0.4	0.64
Long-billed Curlew	eBird	0.2	1.5	0.4	0.6
Short-eared Owl	eBird	0.2	1.4	0.4	0.56
Common Nighthawk	eBird	0.2	1.4	0.4	0.56
Barred Owl	Range Map	0.1	1.7	0	0
				Combined Action Priority (= Σ Action Priority):	19.06
				BMP Rank (BMP ID #1):	3
				Conservation Action Priority (COP):	57.18

* FWMIS = Fisheries and Wildlife Management Information System; HSI = Habitat Suitability Index; RSF = Resource Selection Function; CI = Confidence Index.
† see Supplementary Material (page 123) for scientific names.

Results

The AEFP SAR-Tool is a simple and easy-to-use online system and interface. The user enters the legal land description for the quarter section of interest. The online system searches the background database for potential species at risk in that quarter (an initial "naïve" list). A first level of habitat types/features relevant to the initial list of species is then presented to the user with the option of selecting all that apply using radio buttons. The selected habitat types/features trigger additional habitat options nested at the second and third levels if applicable. The species associated with the lowest level of habitat lineages are sub-selected from the initial list and their CIs are adjusted upward or downward, resulting in an "informed" list of species. The species–habitat combinations are matched to the species–habitat combinations associated with the BMPs, and the Conservation Opportunity Priority (COP) values are calculated for the list of matching BMPs (Table 4).

Following this process, the SAR-Tool user is presented with the Conservation Opportunity with the highest COP value along with its target species in the quarter section of interest. The user can decline the COP and is offered easier (i.e., higher Adoption Likelihood; see "*BMP Ranking and Barriers to Adoption*" above) COPs for three iterations.

Once completed, the SAR-Tool generates a PDF report that includes: 1) a disclaimer; 2) the input information entered by the producer; 3) the "informed" list of species at risk inferred to occur on the quarter section of interest, and linked to external sources of additional information about species at risk; 4) Conservation Opportunities associated with those species and the selected habitat types/features; and 5) a list of contacts for additional information and support for implementing Conservation Opportunities.

Conservation Opportunities are organized into "packages" of non-conflicting opportunities; the producer is invited to choose a package and work toward implementing Conservation Opportunities from that package only. Different packages offer various combinations of Conservation Opportunities that have greater or lesser potential of positively affecting one or several species. The Conservation Value of the package can assist the user with deciding between packages.

Discussion

The Species at Risk Tool of the Alberta Environmental Farm Plan provides a unique opportunity for agricultural producers to quickly find out what species at risk may occur on their property based on their location in the province, the habitat(s) present, and the current knowledge of species distribution. It prioritizes Conservation Opportunities in a way that either maximizes the expected benefit to multiple species at risk, or optimizes the likelihood of adopting and implementing them while still offering improvements to species at risk habitat. Implementing Conservation Opportunities is optional and agricultural producers are free to implement as many or as few as they want. However, just going through the SAR-Tool process will increase their knowledge of species at risk and their needs, and of some of the management options that they can implement to potentially assist with recovery and conservation of species at risk.

Acknowledgements – Many individuals and organizations contributed databases, habitat models, assessments, and reviews and suggestions. We would like to acknowledge Cheryl Bradley (Private Consultant), Dan Buell (Eastern Irrigation District), the Cornell Lab of Ornithology, Brenda Dale (Private Consultant), Brad Downey (MULTISAR; Alberta Conservation Association), Ron McNeil (LandWise Inc.), Peg Strankman (Private Consultant), Katheryn Taylor (MULTISAR; Prairie Conservation Forum); from Alberta Environment and Parks: Lonnie Bilyk, Gordon Court, Brandy Downey, Pat Fargey, Cindy Kemper, Marge Meijer, Sandi Robertson, Mike Russell, Dragomir Vujnovic, and Lisa Wilkinson; from Environment and Climate Change Canada: Lynne Burns, Medea Curteanu, Stephen Davis, Andrew Didiuk, Diana Ghikas, Candace Neufeld, and Troy Wellicome; along with the many researchers and volunteers who enabled the creation of species databases and models and the landowners who facilitated their work. Funding was provided by the Government of Alberta through the Growing Forward 2 (GF2) and Canadian Agricultural Partnership (CAP) program and the Government of Canada through the GF2 and CAP (Agriculture and Agri-Foods Canada) and SARPAL programs (Environment and Climate Change Canada).

Literature Cited

[AAFC] Agriculture and Agri-Food Canada. 2009. Environment Programs. Agriculture and Agri-Food Canada, Government of Canada. https://tinyurl.com/AAFC-Environment-Programs. Accessed December 5, 2018.

[ACIMS] Alberta Conservation Information Management System. 2018. Species Conservation Ranks. Alberta Parks, Government of Alberta. https://tinyurl.com/ACIMS-Species-Ranks. Accessed December 7, 2018.

Alberta Agriculture and Forestry. 2005. Agricultural Land Resource Atlas of Alberta - Organic Matter Content of Cultivated Soils of the Agricultural Area of Alberta. Government of Alberta. https://www.alberta.ca/organic-matter-content-of-cultivated-soils.aspx. Accessed October 2018.

Alberta Parks. 2018. Element Description – Species. Alberta Parks, Government of Alberta. https://tinyurl.com/AB-Parks-Element-Description. Accessed December 7, 2018.

Boyce, M.S., P.R. Vernier, S.E. Nielsen, and F.K.A. Schmiegelow. 2002. Evaluating resource selection functions. *Ecological Modeling* 157: 281–300.

Control Union. 2015. The Alberta Environmental Farm Plan Benchmarking Project. Control Union, Vancouver, BC. Unpublished report available at https://tinyurl.com/AEFP-Benchmarking-Report. Accessed December 5, 2018.

Davis, S.K. 2004. Area sensitivity in grassland passerines: effects of patch size, patch shape, and vegetation structure on bird abundance and occurrence in southern Saskatchewan. *The Auk* 121: 1130–1145.

[ECCC] Environment Canada and Climate Change. n.d. State of Knowledge Project: Species at Risk Conservation for Prairie Land Managers. Unpublished draft document.

Government of Alberta. 2007. Understanding Land Use in Alberta. Alberta Environment and Parks, Government of Alberta. https://tinyurl.com/Alberta-Land-Use-2007. Accessed December 7, 2018.

Government of Alberta. 2016. Species Assessed by the Conservation Committee: Alberta Species at Risk. Government of Alberta. https://tinyurl.com/Alberta-Species-Assessed. Accessed December 7, 2018.

Government of Canada. 2017. A to Z species index. Species at risk public registry, Government of Canada. https://wildlife-species.canada.ca/species-risk-registry/sar/index/default_e.cfm. Accessed April 15, 2017.

Linstone, H.A., and M. Turoff. 1975. The Delphi Method: Techniques and Applications. Addison-Wesley, Reading, MA.

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. https://www.albertaparks.ca/media/2942026/nrsrcomplete_may_06.pdf. Accessed May 2017.

[RCS] Rangeland Conservation Service Ltd. 2016. Beneficial Management Practices for the Milk River and South Saskatchewan River Watersheds, Alberta (2016 Update): A Component of the Multiple Species at Risk (MULTISAR) Conservation Strategy. Unpublished report prepared for MULTISAR. Airdrie, Alberta, Canada.

[USFWS] United States Fish and Wildlife Service. 1981. Standards for the development of habitat suitability index models (103 ESM). Division of Ecological Services, US Fish and Wildlife Service. Department of the Interior. Washington, DC.

[USGS] United States Geological Survey. 2002. Effects of Management Practices on Grassland Birds. Internet Centre for Wildlife Damage Management, DigitalCommons, University of Nebraska – Lincoln. http://digitalcommons.unl.edu/usgsnpwrc/index.3.html. Accessed Sept. 2016 – Nov. 2017.

SUPPLEMENTARY MATERIAL. List of SAR-Tool target species at risk, their Species Rank, Rank Modifiers (see Table 1) and the resulting Modified Species Rank.

Common Name	Scientific Name	Species Rank	Rank Modifiers				Modified Species Rank
			Range	Habitat	Area Sens.	Ecol. Toler.	
Baird's Sparrow	*Centronyx bairdii*	1	1	2	2	1	**1.6**
Barred Owl	*Strix varia*	1	1	2	2	2	**1.7**
Burrowing Owl	*Athene cunicularia*	3	1	2	1	1	**3.5**
Chestnut-collared Longspur	*Calcarius ornatus*	1	1	2	2	2	**1.7**
Common Nighthawk	*Chordeiles minor*	1	1	1	1	1	**1.4**
Eastern Yellow-bellied Racer	*Coluber constrictor flaviventris*	3	2	2	1	2	**3.7**
Ferruginous Hawk	*Buteo regalis*	3	1	2	1	2	**3.6**
Great Plains Toad	*Anaxyrus cognatus*	1	1	2	1	2	**1.6**
Grizzly Bear	*Ursus arctos*	2	1	1	2	1	**2.5**
Little Brown Myotis	*Myotis lucifugus*	1	1	2	1	2	**1.6**
Loggerhead Shrike	*Lanius ludovicianus*	1	1	2	1	1	**1.5**
Long-Billed Curlew	*Numenius americanus*	1	1	2	1	1	**1.5**
McCown's Longspur	*Rhynchophanes mccownii*	1	1	2	1	2	**1.6**
Mountain Plover	*Charadrius montanus*	3	2	2	1	2	**3.7**
Northern Leopard Frog	*Lithobates pipiens*	2	1	2	1	2	**2.6**
Northern Myotis	*Myotis septentrionalis*	2	1	2	1	2	**2.6**
Ord's Kangaroo Rat	*Dipodomys ordii*	3	2	2	1	2	**3.7**
Peregrine Falcon	*Falco peregrinus*	2	1	2	1	1	**2.5**
Piping Plover	*Charadrius melodus*	3	1	2	1	2	**3.6**
Prairie Falcon	*Falco mexicanus*	1	1	2	1	2	**1.6**
Prairie Rattlesnake	*Crotalis viridis*	1	1	2	1	2	**1.6**
Greater Sage-grouse	*Centrocercus urophasianus*	3	2	2	2	2	**3.8**
Sage Thrasher	*Oreoscoptes montanus*	1	2	2	2	2	**1.8**
Short-eared Owl	*Asio flammeus*	1	1	1	1	1	**1.4**
Short-horned Lizard	*Phrynosoma hernandesi*	3	2	2	1	2	**3.7**
Sprague's Pipit	*Anthus spragueii*	1	1	2	2	1	**1.6**
Swift Fox	*Vulpes velox*	3	2	2	2	2	**3.8**
Trumpeter Swan	*Cygnus buccinator*	1	1	2	1	2	**1.6**
Western Grebe	*Aechmophorus occidentalis*	2	1	2	1	2	**2.6**
Western Harvest Mouse	*Reithrodontomys megalotis dychei*	3	2	1	1	1	**3.5**
Western Silvery Minnow	*Hybognathus argyritis*	2	1	2	1	2	**2.6**
Western Small-footed Bat	*Myotis ciliolabrum*	1	1	2	1	2	**1.6**
Western Spiderwort	*Tradescantia occidentalis*	3	1	2	2	2	**3.7**
White-winged Scoter	*Melanitta fusca*	1	1	1	2	2	**1.6**
Yellow Rail	*Coturnicops noveboracensis*	1	1	2	1	2	**1.6**

SESSION 14: PUBLIC PASTURES

Session Moderator – Cam Meuckon, Manitoba Sustainable Development

Preserving Publicly Owned Grasslands

Lorne Scott, Trevor Herriot, Joanne Havelock, Kristen Martin and **Branimir Gjetvaj**

Public Pastures – Public Interest; Email: public4pastures@gmail.com

Abstract – Since 2012, Public Pastures – Public Interest (PPPI) has worked to retain publicly owned grasslands in Saskatchewan, sparked by the closure of the Prairie Farm Rehabilitation Administration program and land transfer to the province. The 1.8 million acres in 62 community pastures have not been sold to date; most are on 15-year leases managed by private corporations of pasture patrons. Pending negotiations with the province, three southwestern pastures will become a federal conservation grazing reserve.

Following the Saskatchewan Pasture Program's demise, announced in 2017, pastures will have 15-year leases with patron corporations. Other parcels of provincial Crown grassland continue to be offered for sale. PPPI is calling for a full government-led inventory of native grasslands in public and private hands. Due to the reduced federal and provincial extension programming, and the loss of federal and provincial pasture management systems, we are drawing attention to the need to fill gaps in rangeland management technical capacity.

Recently, PPPI critiqued a proposed wind turbine development on publicly owned grasslands in a migratory bird pathway, contributed to siting guidelines for provincial wind energy projects, and provided input for other wind energy projects. We are also working to increase public awareness and interaction with grassland landscapes to increase public support for their protection.

Spy Hill-Ellice Community Pasture: An Agricultural Oasis for Prairie Species at Risk

Zane Fredbjornson[1] and **Christian Artuso**[2]

[1] Association of Manitoba Community Pastures; Email: amcp@pastures.ca
[2] Bird Studies Canada; Email: christian.artuso@canada.ca

Abstract – Zane Fredbjornson has managed the Spy Hill-Ellice Community Pasture for seven years; this is his second time managing the pasture. He discusses the management challenges of marrying day-to-day agricultural operations with achieving biodiversity and ecological integrity objectives. Although this site is distant from the areas of southwestern Manitoba that are perceived as "core" for grassland bird populations, the density of listed grassland species, notably Sprague's Pipit (*Anthus spragueii*), Chestnut-collared Longspur (*Calcarius ornatus*) and Baird's Sparrow (*Centronyx bairdii*), at this community pasture and the neighbouring Ellice-Archie pasture is arguably the highest in Manitoba. These two pastures (combined) have therefore been proposed as an Important Bird Area. Three years of avian point-count data attest to the excellent management of these grasslands.

The Prairie Commons Project

Katie Doke Sawatzky[1] and Joseph Piwowar[2]

[1] School of Journalism, University of Regina and Public Pastures – Public Interest;
Email: katiesawatzky@gmail.com
[2] Department of Geography, University of Regina

Abstract – The Prairie Commons Project (located at www.prairiecommons.ca) is a multimedia website that completes the requirements of my graduate degree in journalism at the University of Regina (graduated October 2018). Motivated by the fact that temperate grasslands are now the most endangered and least protected ecozone on the planet, the Prairie Commons Project (published Oct. 1, 2018) is a journalistic investigation, told through different media, of how much native prairie or grassland is currently left in Saskatchewan and its current and historical ecological and social benefits.

The Project features stories that encompass three perspectives – a spiritual home, a public resource, and a conservation priority – in order to show how diverse people and communities in Saskatchewan value prairie for different reasons and how some try to conserve it despite government decisions and policies. The goal of the Project is not only to raise awareness about the state of native prairie in Saskatchewan and its current threats, but also to highlight the collaborative nature of grassroots conservation work going on in the province. I attended meetings held by Public Pastures – Public Interest as part of my research and their work is part of this movement, as are farmers, ranchers, and conservationists across southern Saskatchewan.

SESSION 15: INSECT CONSERVATION

Session Moderator – Sarah Semmler, Living Prairie Museum

Missourians for Monarchs: A Model for Collaboration and Engagement of Diverse Audiences to Develop a Framework for Successful Implementation of Monarch Habitat in Missouri

Brent Vandeloecht

Missouri Department of Conservation Agricultural Liaison; Email: brent.vandeloecht@mdc.mo.gov

Abstract – The state of Missouri participated in a national pilot as part of a National Fish and Wildlife grant to host a summit and develop the first state Monarch (*Danaus plexippus*) strategy meeting in the US. The results of that effort have been used as a model across the Monarch range to help develop other state plans. The Missouri summit had 47 attendees representing 32 different diverse organizations including state/federal agencies, agriculture, education, and non-profit organizations. The Monarch State Summit led to the creation of a formal Missouri Collaborative Organization, now called "Missourians for Monarchs", who developed a statewide strategy/plan based on priorities identified by partners at the summit.

The Missouri plan contains six priorities including: Habitat Conservation; Enhancements and Restoration; Collaboration and Partnerships; Outreach and Education; Monitoring and Research; and Capacity, Governance, and Funding. Several priority actions have been or are being implemented including hiring a statewide coordinator, identifying and engaging new partners, developing a website, and developing best management practices and outreach materials. An annual review of the plan is held to consider any updates or research that could assist with meeting objectives of the plan. The Missouri plan has a 20-year objective of creating 385,000 acres of new, quality Monarch habitat. A quality acre of habitat is defined by having 200 stems of milkweed per acre plus diverse nectaring species that bloom periodically throughout the year to support migrating Monarchs.

Effects of Non-ionizing Electromagnetic Pollution on Invertebrates, Including Pollinators such as Honey Bees: What We Know, What We Don't Know, and What We Need to Know

Margaret Friesen[1] and Magda Havas[2]

[1] Independent Researcher, Winnipeg, MB; Email: friesenm.ehs@gmail.com
[2] Trent School of the Environment, Trent University

Abstract – Invertebrates, including pollinators such as honey bees, can be adversely affected by non-ionizing electromagnetic radiation (EMR). Sources contributing to common environmental EMR exposures include antennae (cell phone, broadcast, and radar), communications satellites, and power lines. Adverse biochemical changes and disorientation have been reported for honey bees and other invertebrates. Field studies have reported changes in abundance and composition of "key pollinator groups" (wild bees, hoverflies, bee flies, beetles, and wasps) that have been attributed to emissions from telecommunications towers. We take a close look at the biological effects on invertebrates of EMR reported in the scientific literature and a general look at evidence from studies on plants, birds, humans, and other animals (domestic, laboratory, wild). We discuss possible implications of excessive electromagnetic pollution on ecosystems and identify knowledge gaps and what we need to know before more electromagnetic pollution is added to the environment, especially in the form of 5G.

Introduction

Invertebrates (animals without backbones) are major components of most ecosystems. Insects are key to the integrity of many ecosystems in many roles including as pollinators. Honey bees play a role in pollination of domestic as well as wild plants and are often used as bio-indicator species and as a "model" to examine environmental problems. The global decline of pollinators is of grave concern and efforts are being made to identify the reasons (Potts *et al.* 2010; Sánchez-Bayo and Wyckhuys 2019). One factor not widely considered is the possible role of anthropogenic electromagnetic radiation (EMR).

Electromagnetic fields (EMFs) are invisible electric and magnetic fields of force. All living organisms have evolved in Earth's natural EMFs and depend on them to live. Natural sources include Earth's static magnetic field, and static electricity, including differences in charges among clouds and the earth that can lead to lightning. Electromagnetic radiation (EMR) originates when fields change.

Anthropogenic (human-made, artificial) EMR sources are sometimes referred to as electromagnetic pollution or electrosmog. The main frequency ranges of interest in this article are: 1) extremely low frequencies (ELF) of 50/60 to 90 Hz that emanate from sources such as power lines and building wiring; and 2) radiofrequency radiation (RFR) of 700 MHz to 6 GHz, commonly used for devices such as cell phones, radio and television, and their supporting infrastructure, e.g., cell towers, antennae on buildings, and orbiting communications satellites. Also discussed are frequencies currently being developed and deployed above 6 GHz for 5G (5th Generation) for faster and more pervasive connectivity, including the "Internet of Things".

There are no Canadian guidelines for non-ionizing EMR exposures for non-human organisms, including wildlife. Health Canada's safety guidelines, *Safety Code 6* (Health Canada 2015), set limits for human exposure to RFR (3 kHz to 300 GHz). In the commonly used frequencies, these guidelines are based only on thermal effects, i.e., if there is no heating, it is assumed that there is no harm. For "far field" exposures such as cell towers and Wi-Fi access points, the *Safety Code 6* power density safety limits are, depending on frequency, between 2 and 10 W/m^2 [at least 1,000,000,000,000 (= 10^{12}) x natural levels (Bandara and Carpenter 2018)]. For "near field" exposure, such as cell phones, the upper limit of the permissible Specific Absorption Rate (SAR) is set at 1.6 W/kg for the head, neck, and trunk.

What We Know

Relatively few EMR studies have been conducted on invertebrates. A 2011 report commissioned by the Indian Ministry of Environment and Forest found that of 919 publications identified in a comprehensive review of biological effects of RFR exposure, 81% (742) were on humans, about 3% (30) were on birds, and <1% (7) were on bees. "Other animals" made up about 12% (111), and <1% (8) were on plants (Expert Committee 2011). The majority of the studies in each of the categories showed impacts.

Invertebrates – Honey Bees

We conducted a comprehensive search for original (primary) peer-reviewed research studies on EMR (ELF and RFR) and honey bees using "EMF Portal", an online database of scientific studies on the effects of electromagnetic fields, created by Aachen University, Germany (EMF Portal 2019), as well as internet searches. Identified publications were further examined for relevant studies. A total of 26 studies were identified from 1976 to the end of January 2019. Research methods and descriptions varied widely in quality. No studies were conducted in Canada or by Canadian scientists. Some studies that found effects were noted as being conducted under "non-thermal" conditions.

Seven of the eight ELF frequency studies reported effects (Table 1). One paper concluded: "*The results suggest that 50 Hz ELF EMFs emitted from powerlines may represent a prominent environmental stressor for honey bees, with the potential to impact on their cognitive and motor abilities, which could in turn reduce their ability to pollinate crops.*" (Shepherd *et al.* 2018). For RFR studies, 13 of 18 (72%) showed effects (Table 2). Exposure conditions ranged from ambient levels (two studies) to very high levels.

Invertebrates - Other insects

Potential adverse effects have been reported in other invertebrates (Cucurachi *et al.* 2013), including fruit flies (Sagioglou *et al.* 2016) and ants (Cammaerts and Johansson 2013). A major field study on insect pollinators (excluding honey bees) was conducted on two islands in the Mediterranean with cell towers (Lázaro *et al.* 2016). Abundance and composition of beetles, wasps, and hoverflies were negatively affected, and underground-nesting wild bees and bee flies were positively affected. The authors conclude: "*… these changes …associated with electromagnetic smog may have important ecological and economic impacts on the pollination service that could significantly affect the maintenance of wild plant diversity, crop production and human welfare*."

TABLE 1. Publications studying extremely low frequency fields (ELFs) and honey bees.

Study: authors and year	Country of authors	Effects*
1. Altmann and Warnke (1976)	Germany	Yes
2. Altmann and Warnke (1987)	Germany	Yes
3. Bindokas *et al.* (1988)	US	Yes
4. Greenberg *et al.* (1981a)	US	Yes
5. Greenberg *et al.* (1981b)	US	Yes
6. Kirschvink *et al.* (1997)	US	Yes
7. Shepherd *et al.* (2018)	UK, Brazil	Yes
8. Wyszkowska *et al.* (2019)	Poland	No

* Effects included disturbed flying behaviour, metabolism abnormalities, queen loss, and decreased overwintering survival.

TABLE 2. Publications studying radiofrequency radiation (RFR) and honey bees.

Study: authors and year	Country of authors	Effects*
1. Dalio (2015)	India	Yes
2. el Halabi *et al.* (2013)	Lebanon	Yes
3. Favre (2017)	Switzerland	Yes
4. Favre (2011)	Switzerland	Yes
5. Gary and Westerdahl (1981)	US	No
6. Harst *et al.* (2006)	Germany	Yes
7. Kimmel *et al.* (2007)	Germany	Yes
8. Kumar *et al.* (2013)	India	Yes
9. Kumar *et al.* (2011)	India	Yes
10. Mall and Kumar (2014)	India	No
11. Mixson *et al.* (2009)	US	No
12. Odemer and Odemer (2019)	Germany	Yes
13. Patel *et al.* (2016)	India	No
14. Pattazhy (2012)	India	Yes
15. Sahib (2011)	India	Yes
16. Sharma and Kumar (2010)	India	Yes
17. Taye *et al.* (2017)	India	Yes
18. Westerdahl and Gary (1981)	US	No

* Effects included production of higher frequency sounds; induction of piper signal (announces the swarming process or is a signal of a disturbed colony); disruption of navigational skills of foragers; increased aggressiveness; reduction of numbers of returning foragers and in some cases, none returning (colony collapse). Other adverse effects included decreased colony strength, hatching success, queen egg-laying, honey storing ability, and pollen reserves.

An EKLIPSE project (a research initiative on biodiversity and ecosystem services, supported by the European Union Horizon 2020 research and innovation program) recently took an in-depth look at 39 peer-reviewed studies of effects of EMR exposure on invertebrates as part of a wider study on wildlife and exposure to EMR (Goudeseune *et al.* 2018). The EKLIPSE webinar presentation in January 2018 (Tscheulin and Vanbergen 2018) reported evidence that EMR provides environmental cues, can affect behaviour and reproduction, and poses a potential risk to some physiological mechanisms in invertebrates. Levels of confidence in the evidence were outlined in the webinar and in an EKLIPSE report (Malkemper *et al.* 2018) (Figure 1).

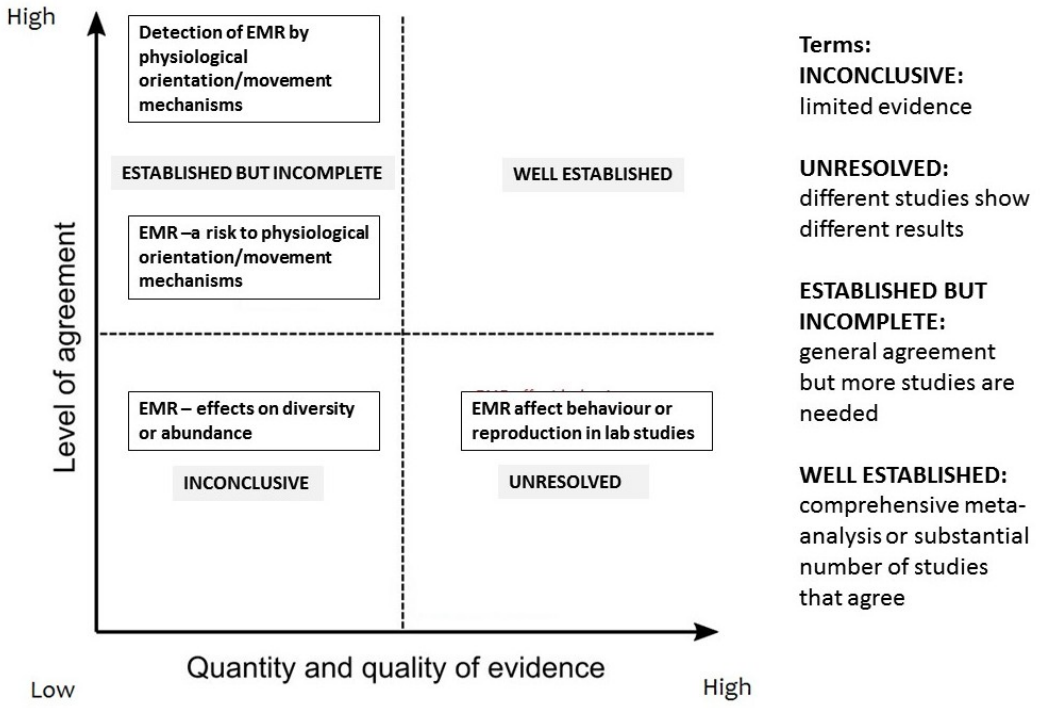

FIGURE 1. Levels of confidence of statements on invertebrates. Modified from EKLIPSE report (Malkemper *et al.* 2018).

Plants

A review by Halgamuge *et al.* (2017) identified 45 peer-reviewed publications (1996–2016), many conducted at non-thermal levels, where 90% showed physiological or morphological effects from exposure to RFR. Sensitivity varied with frequencies. Pea, tomato, and mungbean were very sensitive. In a partially replicated study, peas exposed to Wi-Fi frequencies had diminished growth compared with the controls after 30 days (Havas and Symington 2016). A study on trees concluded: "*EMR from mobile masts are harmful to trees*" (Waldmann-Selsam *et al.* 2016).

Vertebrates - Birds

Disorientation of some bird species due to exposure to ambient (non-thermal) RFR levels have been documented in a number of bird studies, most notably in the well-controlled, double-blinded work on European robins by a German research team (Engels *et al.* 2014). Weak

broadband fields disrupted the birds' magnetic compass orientation whereas relatively strong narrowband fields did not (Schwarze *et al.* 2016).

Domestic Animals

ELFs at low levels have been reported to affect behaviour in large mammals (Burda *et al.* 2009), and circadian rhythms and blood biochemistry in dairy cows (Stelletta *et al.* 2007).

Laboratory mammal studies

There are more than 1,000 studies showing potentially adverse effects at well below *Safety Code 6* levels. Recently, a $30 million US study, conducted at frequencies commonly used in 2G and 3G cell phones, found "*clear evidence of carcinogenic activity*" in male rats (National Toxicology Program 2018). We examined 20 laboratory mammal studies conducted at Wi-Fi frequencies of 2400 to 2450 MHz that reported DNA damage, oxidative stress, and other potentially adverse effects at and well below the *Safety Code 6* SAR level (Figure 2).

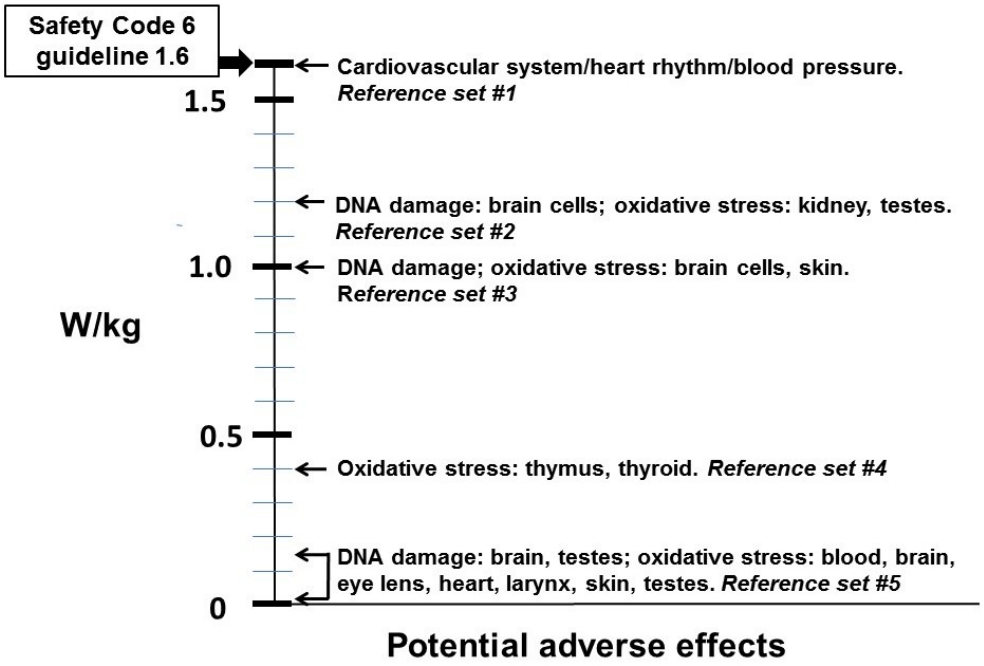

FIGURE 2. Potential harmful biological effects reported for Wi-Fi exposure in 22 studies with the corresponding Specific Absorption Rate (SAR) level indicated with arrows. Health *Canada's Safety Code 6* SAR safety guideline is 1.6 W/kg (head, neck, and trunk). References for the respective sets are:

Reference set #1: Saili *et al.* (2015)
Reference set #2: Lai and Singh (1996); Özorak *et al.* (2013)
Reference set #3: Ceyhan *et al.* (2012); Eser *et al.* (2013); Paulraj and Behari (2006)
Reference set #4: Misa Agustiño *et al.* (2012); Misa-Agustiño *et al.* (2015)
Reference set #5: Atasoy *et al.* (2013); Aynali *et al.* (2013); Deshmukh *et al.* (2013); Deshmukh *et al.* (2015); Gürler *et al.* (2014); Kesari *et al.* (2010); Meena *et al.* (2014); Nazıroğlu *et al.* (2012); Oksay *et al.* (2014); Shahin *et al.* (2014); Shahin *et al.* (2013); Tök *et al.* (2014)

Vertebrates - Humans

The International Agency for Research on Cancer of the World Health Organization (IARC-WHO) classified ELF magnetic fields as a Group 2B *possible* human carcinogen in 2001 (IARC 2002) and RFR (includes Wi-Fi frequencies) in 2011 (Baan *et al.* 2011). This latter classification was based mainly on human epidemiological studies showing an elevated risk of brain tumours (gliomas). Canadian data shows a doubling of risk for gliomas for those using cell phones for more than 558 lifetime hours (Momoli *et al.* 2017). More recent studies support upgrading the classification to a *probable* or *known* human carcinogen (the same classification group as asbestos and tobacco) (Coureau *et al.* 2014; Miller *et al.* 2018; Peleg *et al.* 2018).

Proposed mechanisms

Underlying mechanisms for the various effects have been proposed: 1) magnetic compass (orientation) is affected (Engels *et al.* 2014); 2) increased oxidative stress (therefore more susceptible to disease and other insults) (Reuter *et al.* 2010; Yakymenko *et al.* 2016); and 3) activation of voltage-gated calcium channels (Pall 2016).

5G (5th Generation: 6 GHz and higher frequencies)

Very few studies on any taxa have been conducted using higher frequencies in the millimeter-wave 5G range. These frequencies are of particular concern because the wavelengths are in the same range as some invertebrate body sizes and structures such as antennae. In insect modelling studies, all insect models absorbed from 3 to 370% more radiofrequency power at and above 6 GHz frequencies than at lower frequencies (Thielens *et al.* 2018). The proposed infrastructure will be dense with mini-antennae (microcells) required every 100 to 300 meters (FCC 2016a). Public health issues and environmental implications are discussed in Russell (2018).

RFR emissions from orbiting satellites

According to the United Nations Office for Outer Space, currently there are over 7,000 "objects" orbiting Earth (United Nations 2018), with numbers expected to increase. Many of these satellites are transmitting or receiving RFR signals. SpaceX alone has made applications to the US Federal Communications Commission (FCC) to position more than 300 satellites over the next few years (FCC 2016b)[1]. With emissions from orbiting satellites, there will no longer be "unexposed" groups of living organisms that can serve as controls in research field studies.

What We Don't Know

There are substantial gaps in knowledge regarding biological effects on ecosystems of the frequencies and modulations now commonly in use. In addition, there is little known about non-linear effects and "windows" of vulnerability (Marino *et al.* 2000; Sage 2015; Sagioglou *et al.* 2016) as well as synergistic effects (combined, co-exposures) (Kostoff and Lau 2013).

The following points to address knowledge gaps are largely taken from the EKLIPSE project (Goudeseune *et al.* 2018):

1) Develop standardization/methodologies/protocols to design better future studies and the ability to compare research results;
2) Set up more field and ecological studies, along with better corresponding laboratory studies;
3) Initiate research on more technologies;
4) Study the impacts of EMR at different biological organizations/levels;
5) Collect data on confounding/interfering factors and how multiple frequencies interact;
6) Develop more and better collaborations, especially interdisciplinary teams;
7) Include observations and knowledge from local people and consider citizen-science approaches.

What We Need to Know

We need a fuller understanding of the impacts of EMR on invertebrates specifically and how EMR effects could impact ecosystems in general. This includes knowledge regarding the frequencies and modulations already deployed and ahead of, or at least alongside, wide deployment of new technologies such as 5G.

In Canada we need:

1) Biologically based EMR exposure guidelines for wildlife based on thermal and, in particular, non-thermal biological effects;
2) Research as outlined by the EKLIPSE report; and
3) Adequate funding of independent scientists to conduct research.

A final consideration is that scientists who are conducting ongoing and future biological and ecological research, particularly field studies, should be supported with expert advice and equipment, so they can use the opportunity to include EMR measurements in research protocols.

_____

[1] According to an October 15, 2019 article (https://spacenews.com/spacex-submits-paperwork-for-30000-more-starlink-satellites/), "SpaceX…filed paperwork in recent weeks for up to 30,000 additional Starlink satellites on top of the 12,000 already approved by the US Federal Communications Commission."

Literature Cited

Altmann, G., and U. Warnke. 1976. [Metabolism of bees (*Apis mellifera* L.) in 90Hz high-tension field] Der Stoffwechsel von Bienen (*Apis mellifica* L.) im 50-Hz-Hochspannungsfeld. *Zeitschrift für Angewandte Entomologie* 80: 267–271.

Altmann, G., and U. Warnke. 1987. [Thermography of honeybee colonies in winter influenced by high-voltage electric fields] Thermographie der Honigbienen-Wintertraube unter Einfluß von Hochspannungswechselfeldern. *Journal of Applied Entomology* 104: 69–73.

Atasoy, H.I., M.Y. Gunal, P. Atasoy, S. Elgun, and G. Bugdayci. 2013. Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices. *Journal of Pediatric Urology* 9: 223–229.

Aynali, G., M. Nazıroğlu, Ö. Çelik, M. Doğan, M. Yarıktaş, and H. Yasan. 2013. Modulation of wireless (2.45 GHz)-induced oxidative toxicity in laryngotracheal mucosa of rat by melatonin. *European Archives of Oto-Rhino-Laryngology* 270: 1695–1700.

Baan, R., Y. Grosse, B. Lauby-Secretan, F. El Ghissassi, V. Bouvard, L. Benbrahim-Tallaa, N. Guha, F. Islami, L. Galichet, and K. Straif. 2011. Carcinogenicity of radiofrequency electromagnetic fields. *The Lancet Oncology* 12: 624–626.

Bandara, P., and D.O. Carpenter. 2018. Comment: Planetary electromagnetic pollution: it is time to assess its impact. *The Lancet Planetary Health* 2: 512–514.

Bindokas, V.P., J.R. Gauger, and B. Greenberg. 1988. Mechanism of biological effects observed in honey bees (*Apis mellifera* L.) hived under extra-high-voltage transmission lines: implications derived from bee exposure to simulated intense electric fields and shocks. *Bioelectromagnetics* 9: 285–301.

Burda, H., S. Begall, J. Cervený, J. Neef, and P. Nemec. 2009. Extremely low-frequency electromagnetic fields disrupt magnetic alignment of ruminants. *Proceedings of the National Academy of Sciences* 106: 5708–5713.

Cammaerts, M.-C., and O. Johansson. 2013. Ants can be used as bio-indicators to reveal biological effects of electromagnetic waves from some wireless apparatus. *Electromagnetic Biology and Medicine* 33: 282–288.

Ceyhan, A.M., V.B. Akkaya, Ş.C. Güleçol, B.M. Ceyhan, F. Özgüner, and W. Chen. 2012. Protective effects of β-glucan against oxidative injury induced by 2.45-GHz electromagnetic radiation in the skin tissue of rats. *Archives of Dermatological Research* 304: 521–527.

Coureau, G., G. Bouvier, P. Lebailly, P. Fabbro-Peray, A. Gruber, K. Leffondre, J.-S. Guillamo, H. Loiseau, S. Mathoulin-Pélissier, R. Salamon, and I. Baldi. 2014. Mobile phone use and brain tumours in the CERENAT case-control study. *Occupational and Environmental Medicine* 71: 514–522.

Cucurachi, S., W.L.M. Tamis, M.G. Vijver, W.J.G.M. Peijnenburg, J.F.B. Bolte, and G.R. de Snoo. 2013. A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF). *Environment International* 51: 116–140.

Dalio, J.S. 2015. Effect of Electromagnetic (cell phone) radiations on *Apis mellifera*. *Journal of Research in Agriculture and Animal Science* 2: 6–10.

Deshmukh, P.S., K. Megha, B.D. Banerjee, R.S. Ahmed, S. Chandna, M.P. Abegaonkar, and A.K. Tripathi. 2013. Detection of Low Level Microwave Radiation Induced Deoxyribonucleic Acid Damage Vis-à-vis Genotoxicity in Brain of Fischer Rats. *Toxicology International* 20: 19–24.

Deshmukh, P.S., N. Nasare, K. Megha, B.D. Banerjee, R.S. Ahmed, D. Singh, M.P. Abegaonkar, A.K. Tripathi, and P.K. Mediratta. 2015. Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation. *International Journal of Toxicology* 34: 284–290.

el Halabi, N., R. Achkar, and G. Haidar. 2013. The Effect of Cell Phone Radiations on the Life Cycle of Honeybees. Pages 529–536 *in* Eurocon 2013, Zagreb, Croatia. IEEE (Institute of Electrical and Electronics Engineers), Piscataway, New Jersey.

EMF Portal. 2019. https://www.emf-portal.org/en. Accessed January 30, 2019.

Engels, S., N.-L. Schneider, N. Lefeldt, C.M. Hein, M. Zapka, A. Michalik, D. Elbers, A. Kittel, P.J. Hore, and H. Mouritsen. 2014. Anthropogenic electromagnetic noise disrupts magnetic compass orientation in a migratory bird. *Nature* 509: 353–356.

Eser, O., A. Songur, C. Aktas, E. Karavelioglu, V. Caglar, F. Aylak, F. Ozguner, and M. Kanter. 2013. The effect of electromagnetic radiation on the rat brain: an experimental study. Turkish Neurosurgery 23: 707–715.

Expert Committee, Ministry of Environment and Forest, India. 2011. Report on possible impacts of communication towers on wildlife including birds and bees. India Environmental Portal. http://www.indiaenvironmentportal.org.in/ Accessed January 30, 2019.

Favre, D. 2011. Mobile phone-induced honeybee worker piping. *Apidologie* 42: 270–279.

Favre, D. 2017. Disturbing honeybees' behavior with electromagnetic waves: a methodology. *Journal of Behavior* 2: 1010.

FCC. 2016a. The FCC's 5G FAST Plan. Federal Communications Commission 2016-09-15T06:51:41–04:00. https://www.fcc.gov/5G. Accessed January 30, 2019.

FCC. 2016b. Significant Satellite Rulemakings. Federal Communications Commission https://www.fcc.gov/significant-satellite-rulemakings. Accessed January 30, 2019.

Gary, N.E., and B.B. Westerdahl. 1981. Flight, orientation, and homing abilities of honeybees following exposure to 2.45-GHz CW microwaves. *Bioelectromagnetics* 2: 71–75.

Goudeseune, L., E. Balian, and J. Ventocilla. 2018. The impacts of artificial electromagnetic radiation on wildlife (flora and fauna). Report of the web conference. A report of the EKLIPSE project. Horizon 2020 European Union Funding for Research & Innovation. https://tinyurl.com/EKLIPSE-report. Accessed January 30, 2019.

Greenberg, B., V.P. Bindokas, M.J. Frazier, and J.R. Gauger. 1981a. Response of Honey Bees, *Apis mellifera* L., to High-Voltage Transmission Lines. *Environmental Entomology* 10: 600–610.

Greenberg, B., V.P. Bindokas, and J.R. Gauger. 1981b. Biological effects of a 765-kV transmission line: Exposures and thresholds in honeybee colonies. *Bioelectromagnetics* 2: 315–328.

Gürler, H.Ş., B. Bilgici, A.K. Akar, L. Tomak, and A. Bedir. 2014. Increased DNA oxidation (8-OHdG) and protein oxidation (AOPP) by low level electromagnetic field (2.45 GHz) in rat brain and protective effect of garlic. *International Journal of Radiation Biology* 90: 892–896.

Halgamuge, M.N. 2017. Review: Weak radiofrequency radiation exposure from mobile phone radiation on plants. *Electromagnetic Biology and Medicine* 36: 213–235.

Harst, W., J. Kuhn, and H. Stever. 2006. Can electromagnetic exposure cause a change in behaviour? Studying possible non-thermal influences on honeybees. An approach within the framework of educational informatics. *Acta Systemica – International Journal of the IIAS (International Institute for Advanced Studies in Systems Research and Cybernetics)* 6(1): 1–6. https://tinyurl.com/IIAS-Electromagnetic-exposure. Accessed January 30, 2019.

Havas, M., and M.S. Symington. 2016. Effects of Wi-Fi Radiation on Germination and Growth of Broccoli, Pea, Red Clover and Garden Cress Seedlings: A Partial Replication Study. *Current Chemical Biology* 10: 65–73.

Health Canada - Safety Code 6. 2015. Limits of human exposure to radiofrequency electromagnetic energy in the frequency range from 3 KHz to 300 GHz. https://tinyurl.com/RFR-Safety-Code-6. Accessed January 30, 2019.

[IARC] International Agency for Research on Cancer. 2002. Non-Ionizing Radiation, Part 1: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields. IARC Monographs on the evaluation of carcinogenic risks to humans, Volume 80. 445 pages. Lyon, France.

Kesari, K.K., J. Behari, and S. Kumar. 2010. Mutagenic response of 2.45 GHz radiation exposure on rat brain. *International Journal of Radiation Biology* 86: 334–343.

Kimmel, S., J. Kuhn, W. Harst, and H. Stever. 2007. Electromagnetic radiation: influences on honeybees (*Apis mellifera*). IIAS International Conference on Systems Research, Informations and Cybernetics (InterSymp 2006), Baden-Baden, Germany. https://tinyurl.com/EMR-influences-on-honeybees. Accessed January 30, 2019.

Kirschvink, J., S. Padmanabha, C. Boyce, and J. Oglesby. 1997. Measurement of the threshold sensitivity of honeybees to weak, extremely low-frequency magnetic fields. *Journal of Experimental Biology* 200: 1363–1368.

Kostoff, R.N., and C.G.Y. Lau. 2013. Combined biological and health effects of electromagnetic fields and other agents in the published literature. *Technological Forecasting and Social Change* 80: 1331–1349.

Kumar, N.R., S. Sangwan, and P. Badotra. 2011. Exposure to cell phone radiations produces biochemical changes in worker honey bees. *Toxicology International* 18: 70–72.

Kumar, N.R., N. Rana, and P. Kalia. 2013. Biochemical changes in haemolymph of *Apis mellifera* L. drone under the influence of cell phone radiations. *Journal of Applied and Natural Science* 5: 139–141.

Lai, H., and N.P. Singh. 1996. Single- and double-strand DNA breaks in rat brain cells after acute exposure to radiofrequency electromagnetic radiation. *International Journal of Radiation Biology* 69: 513–521.

Lázaro, A., A. Chroni, T. Tscheulin, J. Devalez, C. Matsoukas, and T. Petanidou. 2016. Electromagnetic radiation of mobile telecommunication antennas affects the abundance and composition of wild pollinators. *Journal of Insect Conservation* 20: 315–324.

Malkemper, E.P., T. Tscheulin, A.J. VanBergen, A. Vian, E. Balian, and L. Goudeseune. 2018. The impacts of artificial Electromagnetic Radiation on wildlife (flora and fauna). Current knowledge overview: a background document to the web conference. A report of the EKLIPSE project. Horizon 2020 European Union Funding For Research & Innovation. https://tinyurl.com/EKLIPSE-current-knowledge. Accessed January 30, 2019.

Mall, P., and Y. Kumar. 2014. Effect of electromagnetic radiations on brooding, honey production and foraging behavior of European honeybees (*Apis mellifera* L.) *African Journal of Agricultural Research* 9: 1078-1085.

Marino, A.A., R.M. Wolcott, R. Chervenak, F. Jourd'Heuil, E. Nilsen, and C. Frilot. 2000. Nonlinear response of the immune system to power-frequency magnetic fields. *American Journal of Physiology – Regulatory, Integrative and Comparative Physiology* 279: R761–768.

Meena, R., K. Kumari, J. Kumar, P. Rajamani, H.N. Verma, and K.K. Kesari. 2014. Therapeutic approaches of melatonin in microwave radiations-induced oxidative stress-mediated toxicity on male fertility pattern of Wistar rats. *Electromagnetic Biology and Medicine* 33: 81–91.

Miller, A.B., L.L. Morgan, I. Udasin, and D.L. Davis. 2018. Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102). *Environmental Research* 167: 673–683.

Misa-Agustiño, M.J., J.M. Leiro, M.T. Jorge Mora, J.A. Rodríguez-González, F.J. Jorge Barreiro, F.J. Ares-Pena, and E. López-Martín. 2012. Electromagnetic fields at 2.45 GHz trigger changes in heat shock proteins 90 and 70 without altering apoptotic activity in rat thyroid gland. *Biology Open* 1: 831–838.

Misa-Agustiño, M.J., J.M. Leiro-Vidal, J.L. Gomez-Amoza, M.T. Jorge-Mora, F.J. Jorge-Barreiro, A.A. Salas-Sánchez, F.J. Ares-Pena, and E. López-Martín. 2015. EMF radiation at 2450MHz triggers changes in the morphology and expression of heat shock proteins and glucocorticoid receptors in rat thymus. *Life Sciences* 127: 1–11.

Mixson, T.A., C.I. Abramson, S.L. Nolf, G. Johnson, E. Serrano, and H. Wells. 2009. Effect of GSM cellular phone radiation on the behavior of honey bees (*Apis mellifera*). *Science of Bee Culture* 1: 22–27.

Momoli, F., J. Siemiatycki, M.L. McBride, M.-É. Parent, L. Richardson, D. Bedard, R. Platt, M. Vrijheid, E. Cardis, and D. Krewski. 2017. Probabilistic Multiple-Bias Modeling Applied to the Canadian Data From the Interphone Study of Mobile Phone Use and Risk of Glioma, Meningioma, Acoustic Neuroma, and Parotid Gland Tumors. *American Journal of Epidemiology* 186: 885–893.

National Toxicology Program, National Institute of Environmental Health Sciences. 2018. Toxicology and carcinogenesis studies in Hsd: Sprague Dawley SD rats exposed to whole-body radio frequency radiation at a frequency (900 MHz) and modulations (GSM and CDMA) used by cell phones. *NTP Technical Report* 595: 384.

Nazıroğlu, M., Ö. Çelik, C. Özgül, B. Çiğ, S. Doğan, R. Bal, N. Gümral, A.B. Rodríguez, and J.A. Pariente. 2012. Melatonin modulates wireless (2.45 GHz)-induced oxidative injury through TRPM2 and voltage gated Ca^{2+} channels in brain and dorsal root ganglion in rat. *Physiology & Behavior* 105: 683–692.

Odemer, R., and F. Odemer. 2019. Effects of radiofrequency electromagnetic radiation (RF-EMF) on honey bee queen development and mating success. Science of the Total Environment 661:553–562.

Oksay, T., M. Naziroğlu, S. Doğan, A. Güzel, N. Gümral, and P.A. Koşar. 2014. Protective effects of melatonin against oxidative injury in rat testis induced by wireless (2.45 GHz) devices. *Andrologia* 46: 65–72.

Özorak, A., M. Nazıroğlu, Ö. Çelik, M. Yüksel, D. Özçelik, M.O. Özkaya, H. Çetin, M.C. Kahya, and S.A. Kose. 2013. Wi-Fi (2.45 GHz)- and mobile phone (900 and 1800 MHz)-induced risks on oxidative stress and elements in kidney and testis of rats during pregnancy and the development of offspring. *Biological Trace Element Research* 156: 221–229.

Pall, M. 2016. Electromagnetic Fields Act Similarly in Plants as in Animals: Probable Activation of Calcium Channels via Their Voltage Sensor. *Current Chemical Biology* 10: 74–82.

Patel, S., S.K. Yadav, and P. Mall. 2016. Influence of Electromagnetic Radiations on *Apis mellifera* L. Colonies. *Agricultural Research Journal* 53: 442–443.

Pattazhy, S. 2012. Electromagnetic radiation (EMR) clashes with honey bees. *Journal of Entomology and Nematology* 4(1): 1–2.

Paulraj, R., and J. Behari. 2006. Single strand DNA breaks in rat brain cells exposed to microwave radiation. *Mutation Research* 596: 76–80.

Peleg, M., O. Nativ, and E.D. Richter. 2018. Radio frequency radiation-related cancer: assessing causation in the occupational/military setting. *Environmental Research* 163: 123–133.

Potts, S.G., J.C. Biesmeijer, C. Kremen, P. Neumann, O. Schweiger, and W.E. Kunin. 2010. Global pollinator declines: trends, impacts and drivers. *Trends in Ecology and Evolution* 25: 345–353.

Reuter, S., S.C. Gupta, M.M. Chaturvedi, and B.B. Aggarwal. 2010. Oxidative stress, inflammation, and cancer: How are they linked? *Free Radical Biology and Medicine* 49: 1603–1616.

Russell, C.L. 2018. 5G wireless telecommunications expansion: Public health and environmental implications. *Environmental Research* 165: 484–495.

Sage, C. 2015. The implications of non-linear biological oscillations on human electrophysiology for electrohypersensitivity (EHS) and multiple chemical sensitivity (MCS). *Reviews on Environmental Health* 30: 293–303.

Sagioglou, N.E., A.K. Manta, I.K. Giannarakis, A.S. Skouroliakou, and L.H. Margaritis. 2016. Apoptotic cell death during Drosophila oogenesis is differentially increased by electromagnetic radiation depending on modulation, intensity and duration of exposure. *Electromagnetic Biology and Medicine* 35: 40–53.

Sahib, S. 2011. Impact of mobile phones on the density of honeybees. *Journal of Horticulture and Forestry* 3: 131-133.

Saili, L., A. Hanini, C. Smirani, I. Azzouz, A. Azzouz, M. Sakly, H. Abdelmelek, and Z. Bouslama. 2015. Effects of acute exposure to WIFI signals (2.45 GHz) on heart variability and blood pressure in Albinos rabbit. *Environmental Toxicology and Pharmacology* 40: 600–605.

Sánchez-Bayo, F., and K.A. Wyckhuys. 2019. Worldwide decline of the entomofauna: A review of its drivers. *Biological Conservation* 232: 8–27.

Schwarze, S., N.-L. Schneider, T. Reichl, D. Dreyer, N. Lefeldt, S. Engels, N. Baker, P.J. Hore, and H. Mouritsen. 2016. Weak broadband electromagnetic fields are more disruptive to magnetic compass orientation in a night-migratory songbird (*Erithacus rubecula*) than strong narrow-band fields. *Frontiers in Behavioural Neuroscience* 10: 55.

Shahin, S., V.P. Singh, R.K. Shukla, A. Dhawan, R.K. Gangwar, S.P. Singh, and C.M. Chaturvedi. 2013. 2.45 GHz microwave irradiation-induced oxidative stress affects implantation or pregnancy in mice, *Mus musculus*. *Applied Biochemistry and Biotechnology* 169: 1727–1751.

Shahin, S., V. Mishra, S.P. Singh, and C.M. Chaturvedi. 2014. 2.45-GHz microwave irradiation adversely affects reproductive function in male mouse, *Mus musculus*, by inducing oxidative and nitrosative stress. *Free Radical Research* 48: 511–525.

Sharma, V.P., and N.R. Kumar. 2010. Changes in honeybee behaviour and biology under the influence of cellphone radiations. *Current Science(Bangalore)* 98: 1376–1378.

Shepherd, S., M.a.P. Lima, E.E. Oliveira, S.M. Sharkh, C.W. Jackson, and P.L. Newland. 2018. Extremely Low Frequency Electromagnetic Fields impair the Cognitive and Motor Abilities of Honey Bees. *Scientific Reports* 8: 7932.

Stelletta, C., P.D. Nardo, F. Santin, G. Basso, G. Piccione, and M. Morgante. 2007. Effects of Exposure to Extremely Low Frequency Electro-magnetic Fields on Circadian Rhythms and Distribution of Some Leukocyte Differentiation Antigens in Dairy Cows. *Biomedical and Environmental Sciences* 20: 164–170.

Taye, R.R., M.K. Deka, A. Rahman, and M. Bathari. 2017. Effect of electromagnetic radiation of cell phone tower on foraging behaviour of Asiatic honey bee, *Apis cerana* F. (Hymenoptera: Apidae). *Journal of Entomology and Zoology Studies* 5: 1527–1529.

Thielens, A., D. Bell, D.B. Mortimore, M.K. Greco, L. Martens, and W. Joseph. 2018. Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz. *Scientific Reports* 8: 3924.

Tök, L., M. Nazıroğlu, S. Doğan, M.C. Kahya, and O. Tök. 2014. Effects of melatonin on Wi-Fi-induced oxidative stress in lens of rats. *Indian Journal of Ophthalmology* 62: 12–15.

Tscheulin, T., and A.J. Vanbergen. 2018. Webinar: Day 3 Session 4 - Introduction on Invertebrates. EKLIPSE Knowledge and Learning Mechanism on Biodiversity & Ecosystem Services. https://tinyurl.com/EKLIPSE-Webinar. Accessed January 30, 2019.

United Nations Office for Outer Space. 2018. UNOOSA Annual Report 2017. http://www.unoosa.org/documents/pdf/annualreport/UNOOSA_Annual_Report_2017.pdf. Accessed January 30, 2019.

Waldmann-Selsam, C., A. Balmori-de la Puente, H. Breunig, and A. Balmori. 2016. Radiofrequency radiation injures trees around mobile phone base stations. *Science of the Total Environment* 572: 554–569.

Westerdahl, B.B., and N.E. Gary. 1981. Longevity and food consumption of microwave-treated (2.45 GHz CW) honeybees in the laboratory. *Bioelectromagnetics* 2: 305–314.

Wyszkowska, J., P. Grodzicki, and M. Szczygiel. 2019. Electromagnetic Fields and Colony Collapse Disorder of the Honeybee. *Przeglad Elektrotechniczny* 95: 137–140.

Yakymenko, I., O. Tsybulin, E. Sidorik, D. Henshel, O. Kyrylenko, and S. Kyrylenko. 2016. Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation. *Electromagnetic Biology and Medicine* 35: 186–202.

Habitat Filtering Affects Plant-Pollinator Interactions in Prairie Ecosystems

Diana Bizecki Robson[1], Cary D. Hamel[2], Rebekah Neufeld[2] and Barbara I. Bleho[3]

[1] Manitoba Museum, Email: drobson@manitobamuseum.ca
[2] Nature Conservancy of Canada – Manitoba Region
[3] Golder Associates Ltd.

Abstract – Bees are more abundant in dry biomes than anthophilous flies, and differences in their ratios may impact plant community composition. However, plant-pollinator compositions of prairie ecosystems varying in moisture and soil types have not been compared. Remnant Canadian prairies were surveyed to document plant-pollinator interactions for at least two consecutive years at five sites. Most pollinators were flies (46%) but long-tongued bees (i.e., bumble bees and leaf-cutter bees) were responsible for the majority of all flower visits on average (42%). However, at one tall-grass prairie site, the majority of visits were by flies. Differences in the proportion of bees and flies, likely due to the type of breeding habitat available, appear to be influencing the types of plants that dominate each site via habitat filtering. Open, regular, and yellow/orange-flowered plants were most frequently visited at tall-grass prairie sites; at fescue and mixed-grass prairie sites, tubular, irregular, and violet/blue-flowered plants were visited more frequently. Flowers at the site with moist, Gleysolic soils were predominantly visited by flower and soldier flies while those at sites with dry, Chernozemic soils were mainly visited by long-tongued bees, bee flies, and parasitic flies.

Introduction

The xeric hypothesis (Michener 1979) is that bees are more common pollinators in temperate xeric habitats than in cool arctic or humid tropical habitats. Both temperature and humidity are thought to be responsible for these differences (Michener 1979; Arroyo *et al.* 1982; Devoto *et al.* 2009). Sargent and Ackerly (2008) hypothesized that the composition of a pollinator community could act as a habitat filter if the absence of certain pollinators prevents the establishment of some plant species. Pellissier *et al*. (2012) state that "changes in the proportion of pollinator functional groups are likely to trigger changes in the structure and composition of natural plant communities" because different pollinators favour different floral traits.

While studying plant pollinator interactions in fescue, mixed- and tall-grass prairies, we noticed that tubular, irregular, and violet/blue flowers seemed to be less common in tall-grass prairie. Further, the dominant pollinators in tall-grass prairie were flies. Using Generalized Linear Mixed Models (GLMM), we decided to assess whether certain pollinator groups and floral structures were indeed different between the prairie types. If trends exist, the dominant pollinators may be an additional factor influencing plant composition. Climate change models are predicting drying of the prairies which could, in time, favour different plant species and pollinators.

Methods

Study Sites

Insect floral visitors were observed and sampled at five study sites in three Ecoregions of the Prairie Ecozone (Ecological Stratification Working Group 1995) in southern Manitoba (Figure 1). There were three tall-grass prairie sites [Birds Hill Provincial Park (BHPP), Living Prairie Museum (LPM), the Manitoba Tall Grass Prairie Preserve (TGPP)], one mixed-grass prairie site at Yellow Quill Prairie Preserve (YQPP), and one fescue prairie site at the Fescue Prairie Preserves (FPP).

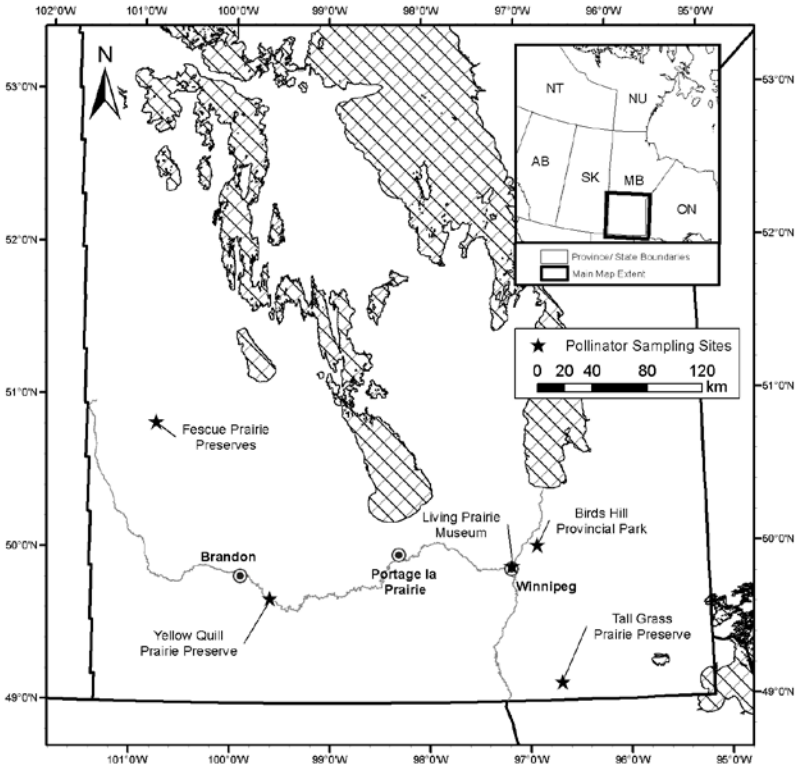

FIGURE 1. Location of the five study sites in southern Manitoba. Copyright © 2001-2018, the Government of Manitoba. All rights reserved. The Government of Manitoba is the owner of copyright in all information contained in the Manitoba Land Initiative, unless otherwise noted.

Plant and Pollinator Surveys

Plant-insect visitor datasets from the tall-grass (Robson 2008, 2010, 2013) and fescue prairie (Robson *et al*. 2017) were compared to a new dataset from the mixed-grass prairie (i.e., YQPP). We established 24 plots (4 m^2) at YQPP, 18 plots (4 m^2) at FPP, 16 plots (2.5 m^2) at BHPP, and 6 plots (5 m^2) each at LPM and TGPP. Vegetation and pollinator surveys were conducted in 2014 and 2015 at FPP for four consecutive days once each month for four months (June to September) for 32 days in total. Surveys at YQPP were conducted for two consecutive days twice each month for four months (May to August in 2017 and June to September in 2016) for 32 days in total. Sampling in BHPP was conducted for 37 non-consecutive days: 13 days in 2008 (August and September), 12 days in 2010 (July and August), and 12 days in 2011 (June and July).

Sampling at LPM and TGPP occurred on two consecutive days twice each month for four months (June to September) in both 2004 and 2005 for a total of 32 days at each site. On each survey day, insect-pollinated plant richness and number of inflorescences in the plots was recorded. Floral visitors were recorded for set periods of time (10 minutes per plot at FPP, YQPP and BHPP, and 30 minutes per plot at LPM and TGPP) each sampling day; total sampling effort at each site ranged from 96 to 128 hours over two to three years. Surveys were conducted between 0930 h and 1700 h, when insect foraging activity is at a maximum.

Data Analysis

To assess plant and insect compositional differences between sites and determine which environmental factors were most influential, we used canonical correlation analysis (CCA) as a method of ordination. CCA is a direct gradient analysis that examines species and environmental data simultaneously (Ter Braak 1986). Environmental variables examined were: average temperature, humidity, and wind speed during the survey periods, as well as elevation, mean annual precipitation, and frost free days (Table 1). We also used GLMMs using the GLIMMIX procedure in SAS v. 9.3 (SAS Institute 2010) to test for differences among prairie types (tall-grass versus mixed-grass versus fescue) in floral attributes (shape, symmetry, colour).

Results

The CCA ordinations showed that humidity and annual precipitation were the variables most strongly correlated with the first axes for both plants (Humidity $r = 0.980$ and Annual precipitation $r = 0.890$) and insects (Humidity $r = 0.954$ and Annual precipitation $r = 0.827$). Temperature was the most strongly correlated with axis 2 for the plants ($r = -0.699$) but elevation ($r = -0.763$) for insects. Specifically, the GLMMs showed that temperature influenced flies and bees positively, but humidity only affected flies and short-tongued bees, and annual precipitation only affected flies.

Overall, long-tongued bees were responsible for 42% of all visits, flies 37%, short-tongued bees 15%, butterflies and moths 4%, wasps and ants 1.5%, and beetles and bugs 0.5%. Although the percentage of long-tongued bee taxa was low at all of the sites (Figure 2), this functional group was responsible for the majority of the visits at three sites: FPP, YQPP and LPM. However, at BHPP and TGPP the majority of the visits were by flies. Further, flower visits by flies were significantly higher in tall-grass prairie (i.e., BHPP, LPM and TGPP sites) than in the other two prairie types which had a similar proportion of visits.

Bumble bees were the dominant bee family at all sites (Figure 3). Mining bees were responsible for more than 20% of all bee visits at the three tall-grass prairie sites but less than 10% at the others. Sweat bees were frequently observed at TGPP but not so much at the other sites.

Fly family composition was also different (Figure 4). Bee flies were most common at the two drier sites (i.e., YQPP and BHPP) but infrequently seen at TGPP. Flower flies were observed at all sites but most frequently at LPM and TGPP. Soldier and other fly families were responsible for about half of all fly visits at TGPP.

TABLE 1. Location, environmental,* and land management information on the five prairie study sites.

Site	Prairie type	Ecoregion	Surficial geology	Soil order	Elevation (m a.s.l.)	Annual precip. (mean mm)	Frost free days (mean #)	Land management during survey years
Fescue Prairie Preserves	Fescue	Boreal Transition	Glacial till, sand/silt	Chernozemic	610	510	96–105	Ungrazed † and unburned
Yellow Quill Prairie Preserve	Mixed-grass	Aspen Parkland	Glaciolacustrine, sand/silt	Chernozemic	409	474	106–115	Grazed and unburned
Birds Hill Provincial Park	Dry tall-grass	Lake Manitoba Plain	Glaciofluvial, gravel/silt/sand	Chernozemic	265	550	116–125	Ungrazed and unburned
Living Prairie Museum	Mesic tall-grass	Lake Manitoba Plain	Glaciofluvial, clay/silt/sand	Vertisolic	239	521	116–125	Ungrazed; two 2004 plots on burned prairie
Tall Grass Prairie Preserve	Wet tall-grass	Lake Manitoba Plain	Glacial till, gravel/clay/silt/sand	Gleysolic	301	581	116–125	Ungrazed and unburned

* Ecological Stratification Working Group (1995), Environment and Climate Change Canada (2018);
† Six of the plots had been grazed the year before the study began (2013).

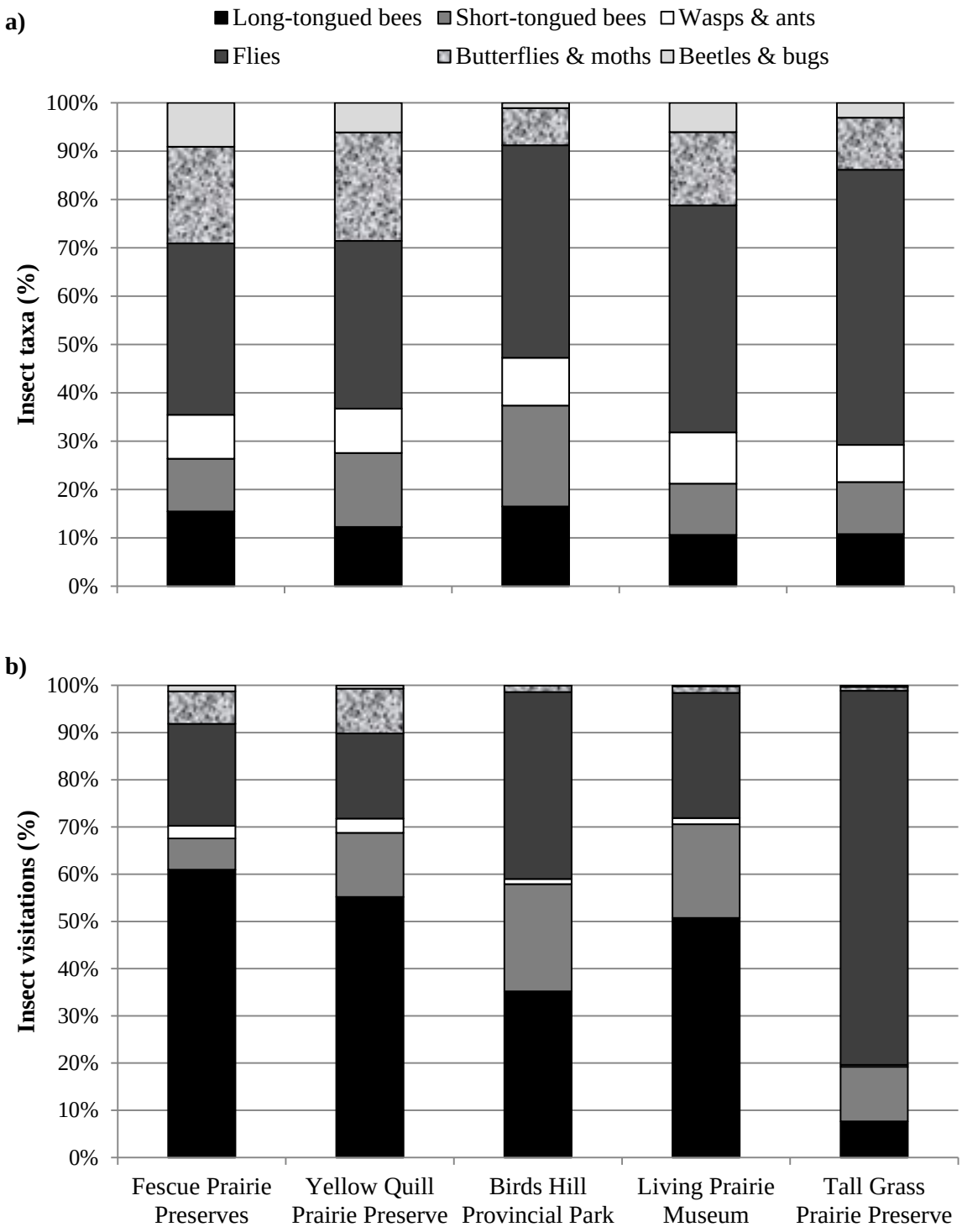

FIGURE 2. Percentage of (a) all taxa, and (b) all visitations in six functional groups of insects at the five study sites. Pearsons χ^2 (20, N = 500) = (a) 31.83 (p = 0.04), and (b) 144.75 (p < 0.0001) indicated these proportions were significantly different.

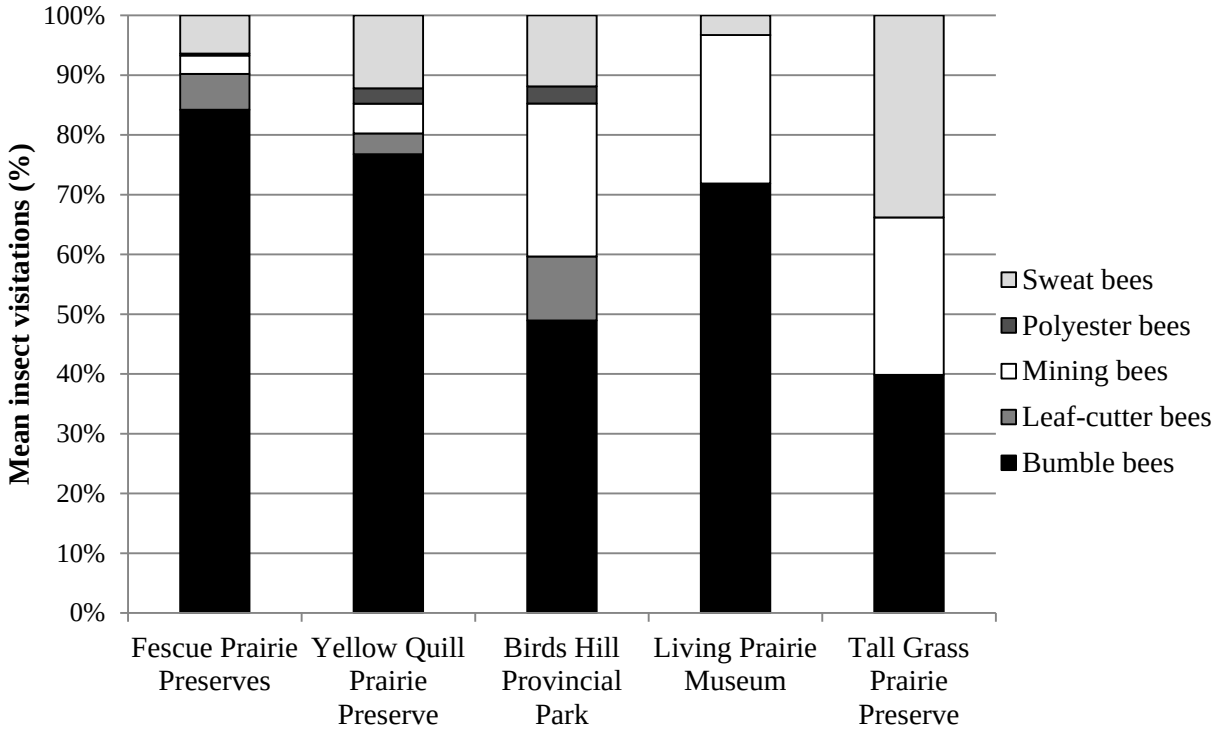

FIGURE 3. Percentage of all bee visitations by long-tongued (bumble bees and leaf-cutter bees) and short-tongued bees (mining, polyester, and sweat bees) at the five study sites.

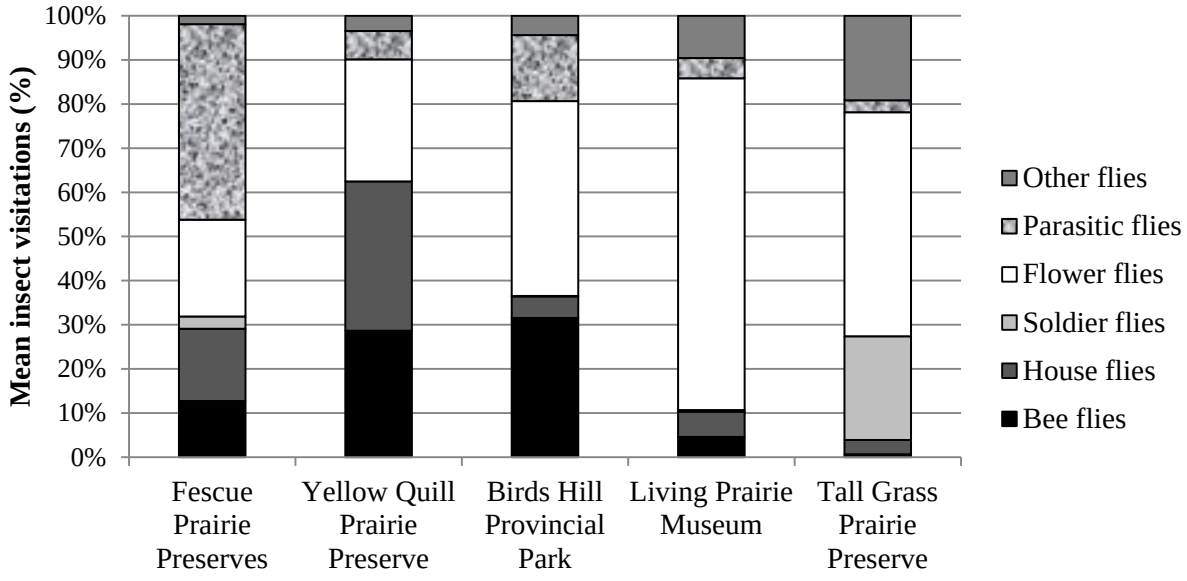

FIGURE 4. Percentage of all visitations by the five dominant families of flies and all other families at the five study sites. Pearsons χ^2 (20, N = 500) = 324.24, $p < 0.0001$ indicated these proportions were significantly different.

The results of GLMMs show that the proportion of inflorescences with open versus tubular flowers, regular versus irregular flowers, and in different colour groups was significantly different ($p < 0.05$) between some of the prairie types (Table 2). The proportions of insect visits to plants of these different types differed significantly among prairie types except with respect to visits to open flowers, which were the same at all sites. Tubular flowers were more common and visited more frequently at the fescue and mixed-grass prairie than at the tall-grass prairie. Irregular flowers were most common and visited most frequently at the mixed-grass prairie. Plants with violet/blue and white flowers were more common at the mixed-grass prairie than at the tall-grass prairie; the fescue prairie had more white flowers but the same number of violet/blue flowers as the tall-grass prairie. Insect visits to violet/blue and white flowers were higher at the fescue and mixed-grass prairie than at the tall-grass prairie. Instead, yellow/orange-flowered plants were more common at the tall-grass prairie, receiving more visits than at the mixed-grass prairie.

Discussion

The province of Manitoba has three distinctive prairie types—fescue, mixed-grass and tall-grass—providing an excellent opportunity to assess how plant-pollinator communities in these ecosystems differ. Our research shows that sites within the same prairie type were not necessarily the most similar in terms of their plant and insect community composition: the three tall-grass prairie sites were more dissimilar than the fescue and mixed-grass prairie sites were to each other.

Of the environmental variables we used in the CCA, humidity and annual precipitation appeared to have the greatest influence on overall plant and insect composition. At sites with high humidity and precipitation, and more standing water due to the high clay content of the soil (i.e., LPM and TGPP), flies were responsible for most flower visits, and at sites with low humidity and precipitation, and less standing water due to coarser soils (i.e., YQPP and FPP), bees (mostly long-tongued) were responsible for most visits, supporting the xeric hypothesis. However, although bees were more common at the mixed-grass and fescue prairie, differences in temperature and moisture do not seem to be the reason. The GLMM showed that bees were not influenced by annual precipitation, and humidity positively affected short-tongued but not long-tongued bees. Instead, long-tongued bees responded to the abundance and type of forage available.

Other researchers have found that flower richness and density strongly influence long-tongued bee visitation (Kevan and Baker 1983; Rathcke 1983; Ebeling *et al.* 2008) and, as Villalobos and Vamosi (2018) suggest, this could outweigh the impact of climate on bee visitation in some regions. With respect to short-tongued bees, Michener (1979) noted that some families (i.e., mining and sweat bees) are tolerant of mesic conditions so our results are not wholly unexpected.

Temperature positively affected all pollinators likely because most are not active at cool temperatures due to thermoregulation limits, and temperatures do not get hot enough in this region to inhibit foraging behaviour (Kevan and Baker 1983; McCall and Primack 1992).

TABLE 2. Mean proportion of inflorescences and insect visits to plants according to flower shape, symmetry, and colour at three prairie types.

Prairie type		Flower shape (%)*		Flower symmetry (%)		Flower colour (%)			
		Open	Tubular	Regular	Irregular	Violet/blue	White	Pink	Yellow/orange
Fescue prairie	Inflorescences	54.6 [a]	45.4 [a]	80.5 [a]	19.5 [a]	34.1 [ab]	29.4 [a]	11.1 [a]	25.5 [a]
Mixed-grass prairie		68.0 [b]	31.7 [b]	72.9 [b]	26.8 [b]	36.7 [a]	38.6 [b]	6.2 [b]	18.1 [b]
Tall-grass prairie†		70.4 [b]	25.2 [c]	77.4 [ab]	18.2 [a]	30.6 [b]	19.2 [c]	12.4 [a]	33.4 [c]
Fescue prairie	Insect visits	41.6	31.1 [a]	56.4 [a]	16.2 [a]	30.9 [a]	15.9 [a]	3.9 [n/a]	21.9 [ab]
Mixed-grass prairie		45.5	19.7 [b]	43.8 [b]	21.5 [b]	26.5 [a]	16.0 [a]	4.3 [n/a]	18.5 [b]
Tall-grass prairie†		48.7	12.6 [c]	53.0 [ab]	8.2 [c]	15.9 [b]	10.1 [b]	7.5 [n/a]	27.7 [a]

* Lowercase letters indicate statistically significant ($p < 0.05$) differences in proportions among sites using Generalized Linear Mixed Models;
† Includes data from Birds Hill Provincial Park, Living Prairie Museum, and Tall Grass Prairie Preserve sites.

Although our results roughly parallel those of Devoto *et al.* (2009) and Kearns (1992), who found that flies dominated the wetter portion of an environmental gradient and bees the drier portion, a clear negative effect of moisture on bees was not observed within the Prairie Ecozone, although it may explain differences between ecozones where climatic difference are greater.

The habitat filtering hypothesis (Sargent and Ackerly 2008) predicts that the dominant pollinators will influence the types of plants in the community by acting "as a sieve that filters which species can establish and persist" (Pellissier *et al.* 2012). Thus we expected that sites where bees were the dominant pollinators would contain more plants they are known to favour in terms of colour, shape, and symmetry than fly-dominated sites. Regarding colour, bee preference for violet/blue flowers and fly preference for yellow flowers has been observed in some studies (McCall and Primack 1992; Lunau and Maier 1995). In our study, we also found differences in the dominant flower colour: violet/blue and white-flowered plants were more abundant at the xeric mixed-grass prairie than at the mesic tall-grass prairie, while yellow/orange-flowered plants were more common at the tall-grass prairie. Further, the plants were not being visited in proportion to their abundances: visits to violet/blue flowers were almost double at the fescue prairie than at the tall-grass prairie, despite no significant difference in flower abundance. The tall-grass prairie had the most visits to yellow/orange flowers. Similarly, irregular flowers were more commonly visited at the drier mixed-grass prairie than at the wetter tall-grass prairie. Tubular plants whose nectar can simply not be accessed by smaller, shorter-tongued insects were also more abundant and visited more frequently at the drier sites.

In summary, the plant and pollinator communities were different with respect to the dominant species, but the fescue and mixed-grass prairie types were more similar to each other compositionally than the tall-grass prairie sites were to each other. The proportion of visits by flies was higher at tall-grass than fescue or mixed-grass prairie and the proportion of long-tongued bee visits was highest at fescue followed by mixed-grass prairie. However, short-tongued bee visits were not different between the sites. Further, tubular, irregular, and violet/blue-coloured flowers, and visits to these flowers, were lower at the prairie type with more flies (tall-grass prairie), as hypothesized. Thus the habitat filtering hypothesis (Sargent and Ackerly 2008), that the dominant pollinators influence the plant community, has some support.

However, whether temperature and moisture are the most influential variables on pollinator composition, as suggested by the xeric hypothesis of Michener (1979), varies among pollinator groups. Temperature affected all bees and flies positively, and although the proportion of fly visits was positively affected by increased humidity and precipitation, short-tongued bees responded positively (not negatively as expected) to humidity, and long-tongued bees were not affected at all. These mixed results suggest that at least within biomes, floral composition may be a more important influence on bees than climate. The xeric hypothesis may only be applicable at larger geographic scales. In the future, changes in climate may shift community composition in favour of bees and the plants they prefer. Habitat fragmentation may prevent the dispersal of appropriate plant species from further south, therefore assisted migration of plants may be needed to ensure healthy Canadian prairies.

Acknowledgements – The full version of this paper was recently published in *Botany* (2019, 97: 204–220; https://doi.org/10.1139/cjb-2018-0134.) Financial support was received from The Manitoba Museum Foundation Inc., Nature Conservancy of Canada (NCC), World Wildlife Fund Canada, Government of Manitoba, and the Science and Technology Internship Program and Virtual Museum of Canada, Government of Canada. Special thanks to Heather Flynn, Robert Wrigley, Sarah Semmler, Reid Miller, and Jason Gibbs for preparation and/or identification of insect specimens. The Government of Manitoba, NCC, the City of Winnipeg and Nature Manitoba graciously allowed us to conduct research on their lands.

Literature Cited

Arroyo, M.T.K., R. Primack, and J. Armesto. 1982. Community studies in pollination ecology in the high temperate Andes of central Chile. I. Pollination mechanisms and altitudinal variation. *American Journal of Botany* 69: 82–97.

Devoto, M., D. Medan, A.R. Roig-Alsina, and N.H. Montaldo. 2009. Patterns of species turnover in plant-pollinator communities along a precipitation gradient in Patagonia (Argentina). *Austral Ecology* 34: 848–857.

Ebeling, A., A.-M. Klein, J. Schumacher, W.W. Weisser, and T. Tscharntke. 2008. How does plant richness affect pollinator richness and temporal stability of flower visits. *Oikos* 117: 1808–1815.

Ecological Stratification Working Group. 1995. A national ecological framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa-Hull, ON.

Environment and Climate Change Canada. 2018. Historical climate data. http://climate.weather.gc.ca/index_e.html. Accessed May 7, 2018.

Kearns, C.A. 1992. Anthophilous fly distribution across an elevation gradient. *American Midland Naturalist* 127: 172–182.

Kevan, P.G., and H.G. Baker. 1983. Insects as flower visitors and pollinators. *Annual Review of Entomology* 28: 407–453.

Lunau, K., and E.J. Maier. 1995. Innate colour preferences of flower visitors. *Journal of Comparative Physiology A*, 177: 1–19.

McCall, C., and R.B. Primack. 1992. Influence of flower characteristics, weather, time of day, and season on insect visitation rates in three plant communities. *American Journal of Botany* 79: 434–442.

Michener, C.D. 1979. Biogeography of the bees. *Annals of the Missouri Botanical Garden* 66: 277–347.

Pellissier, L., N. Alvarez, and A. Guisan. 2012. Pollinators as drivers of plant distribution and assemblage into communities. Pages 392–413 *in* Evolution of Plant-Pollinator Relationships. *Edited by* S. Patiny. Cambridge University Press, Cambridge, UK.

Rathcke, B. 1983. Competition and facilitation among plants for pollination. Pages 305–329 *in* Pollination Biology. *Edited by* L. Real. Academic Press Inc., Montreal, QC.

Robson, D.B. 2008. The structure of the flower-insect visitor system in tall-grass prairie. *Botany* 86: 1266–1278.

Robson, D.B. 2010. A comparison of flower visiting insects to rare *Symphyotrichum sericeum* and common *Solidago nemoralis* (Asteraceae). *Botany* 88: 241–249.

Robson, D.B. 2013. An assessment of the potential for pollination facilitation of a rare plant by common plants: *Symphyotrichum sericeum* (Asteraceae) as a case study. *Botany* 91: 34–42.

Robson, D.B., C. Hamel, and R. Neufeld. 2017. Identification of plant species for pollinator restoration in the northern prairies. *Journal of Pollination Ecology* 21: 98–108.

Sargent, R.D., and D.D. Ackerly. 2008. Plant-pollinator interactions and the assembly of plant communities. *Trends in Ecology and Evolution* 23: 123–130.

SAS Institute. 2010. SAS v. 9.3. Cary, NC.

Ter Braak, C.J.F. 1986. Canonical correspondence analysis: a new eigenvector technique for multivariate direct gradient analysis. *Ecology* 67: 1167–1168.

Villalobos, S., and J.C. Vamosi. 2018. Climate and habitat influences on bee pollinator community structure in Western Canada. *Canadian Journal of Zoology* 96: 1002–1009.

SESSION 16: PRAIRIE BIRD CONSERVATION – PART II

Session Moderator – Tim Poole, Nature Manitoba

Oil and Natural Gas Development Influence Nest-site Selection and Nest Survival of Upland-nesting Waterfowl and Shorebirds

Sarah Ludlow[1] and Stephen Davis[2]

[1] Department of Biology, University of Regina and Nature Conservancy of Canada – Saskatchewan Region; Email: Sarah.Ludlow@natureconservancy.ca

[2] Canadian Wildlife Service, Environment and Climate Change Canada

Abstract – Recent increases in oil and gas development in native grassland may alter the quantity and quality of this globally threatened habitat. Our objectives were to determine: 1) whether nest placement by waterfowl and shorebirds varied with proximity to energy infrastructure; and 2) the extent to which nest survival was influenced by proximity to wells, roads, and trails. Mallard *(Anas platyrhynchos*), Blue-winged Teal (*Spatula discors*), Northern Shoveler (*Spatula clypeata*), and Northern Pintail (*Anas acuta*) tended to nest more frequently near wells. In contrast, more shorebird nests were located farther from wells. Mallards and Blue-winged Teal were also more likely to place their nests near roads. Shorebirds tended to place their nests either close to roads or far from these structures. More Mallard nests were located near trails than expected, but few Blue-winged Teal nests were located near trails. The top-ranked models explaining variation in daily nest survival rates of Northern Shoveler, Mallard, and shorebirds included distance to infrastructure variables, although these relationships were weak. Shovelers appear to benefit from nesting near trails; nest survival increased with proximity to trails. However, trails may act as ecological sinks for shorebirds; they tended to nest near trails but nest survival was reduced in these locations.

Effects of Oil Development on Perceived and Realized Habitat Quality for Three Grassland Songbirds

Paulson G. Des Brisay and Nicola Koper

Natural Resources Institute, University of Manitoba; Email: pauldesbrisay@gmail.com

Abstract – Habitat suitability is defined by both habitat quality and whether species can accurately assess habitat quality. Oil development has altered mixed-grass prairies in southeastern Alberta, potentially impacting both habitat quality and how habitat quality is perceived by imperiled migratory grassland songbirds. We tested whether three passerines that vary in phylogenetic divergence, life histories, and conservation status can accurately assess habitat quality in the presence of anthropogenic development. We monitored nest survival and stress hormones to measure realized habitat quality, and tested for differences in settlement patterns to measure perceived habitat quality at sites impacted by real oil infrastructure, simulated oil well noise, and control sites. Chestnut-collared Longspur (*Calcarius ornatus*) and Baird's Sparrow (*Centronyx bairdii*), two species at risk, were more likely to show signs of stress near disturbances that they did not avoid, suggesting a mismatch in perceived versus realized habitat quality. In contrast, Savannah Sparrow (*Passerculus sandwichensis*), a generalist species, accurately assessed and avoided disturbances that reduced realized habitat quality. Simulated oil well noise did not impact perceived habitat quality for any species, but reduced realized habitat quality for Chestnut-collared Longspur. Mismatches in perceived and realized habitat quality caused by oil development may help explain why some species suffer disproportionately in response to anthropogenic disturbances.

Review of, and Advances in, the Captive Propagation and Conservation of the Burrowing Owl in British Columbia, 1983–2017

Lauren Meads[1], Aimee Mitchell[2] and Mike Mackintosh[1]

[1] The Burrowing Owl Conservation Society of BC; Email: lmeads81@gmail.com
[2] Athene Ecological

The Burrowing Owl (*Athene cunicularia*) is a species at risk in Canada and was extirpated from BC in the 1980s. In an attempt to reestablish a population in BC, a group of volunteers, which later became the Burrowing Owl Conservation Society of BC, instituted a reintroduction program involving three captive breeding facilities, creation of artificial nesting burrows, and the release and monitoring of captive-raised birds annually since 1990. Approximately 100 owls are bred each year for release in the grasslands of the Thompson-Nicola and South Okanagan of BC. Over 800 burrows have been placed on privately owned ranch lands, provincial land, and non-government conservation properties. Release techniques have been developed that have increased adult survival rates by 50% and have increased numbers of wild-hatched offspring to fledging by 50%. Increased production has resulted in an increase in the number of birds returning to nest in subsequent years, resulting in a 50% increase from five years ago.

However, the goal of achieving a self-sustaining population has not yet been reached. While habitat quality and availability in BC appear not to be major limiting factors, and survival to fledging appears good, over-wintering and migration survival is lower than anticipated. The Burrowing Owl Conservation Society of BC intends to continue to work closely with colleagues in areas in which the BC owls have wintered, and to work to elucidate migration pathways. It is anticipated that if survival during migration and wintering can be improved, a self-sufficient breeding population in BC may still be achievable.

The Manitoba Burrowing Owl Recovery Program: Working to Help Recover Burrowing Owl Populations in Southwestern Manitoba

Alexandra L.M. Froese

Manitoba Burrowing Owl Recovery Program; Email: mbburrowingowls@gmail.com

Burrowing Owl (*Athene cunicularia*) populations have shown steady and steep declines across western Canada in the last 50 years. Many interrelated factors are thought to be responsible for the rapid decline of this species. A breeding ecology study was initiated in Manitoba to identify existing and emerging threats for wild pairs, and to assess a modified reintroduction technique using food supplements to promote nesting success, recruitment, and survival of captive-released first-year Burrowing Owl pairs to augment wild populations. Breeding, foraging, and behavioural data of captive-released and wild Burrowing Owls were recorded and compared from 2010 to 2012. After the completion of the study, the Manitoba Burrowing Owl Recovery Program (MBORP) was established and implemented several of the 2010–2012 methodologies for reintroduction. Since 2013, MBORP has focused on three recovery goals: 1) reintroduction to promote a self-sustaining population of Burrowing Owls in southwestern Manitoba; 2) research to understand limiting factors for both wild and captive-release owls; and 3) education through habitat improvement by engaging landowners in grassland conservation. A summary of program activities is discussed.

SESSION 17: HABITAT ENHANCEMENT

Session Moderator – Tom Moran, Manitoba Habitat Heritage Corporation

Restoring Dry Mixed-grass Native Grasslands: Silver Sage Conservation Site

Brad Downey and Julie Landry-DeBoer

Alberta Conservation Association; Email: brad.downey@ab-conservation.com

Abstract – The Silver Sage Conservation Site is a 2,418-acre property located in southeastern Alberta that has had 1,200 acres restored to native grass over the past eight years to benefit wildlife habitat and provide additional opportunities for grazing for local producers. Reseeding by local landowners has taken place during the fall and spring, mostly with broadcast seeding, with 250 acres being direct seeded in 2018. Changes in community composition, health, and forb plantings were tracked over the eight-year process. Modifications were implemented to later reseeds, including selective seeding of more costly grass seeds like Needle-and-thread (*Hesperostipa comata*) and shrubs like Silver Sagebrush (*Artemisia cana*) to reduce costs. Wildlife assessments were completed each year to document changes in the wildlife community over time. Wildlife observed on the property once reseeds were established include Sprague's Pipit (*Anthus spragueii*), Baird's Sparrow (*Centronyx bairdii*), and Chestnut-collared Longspur (*Calcarius ornatus*).

A Stitch in Time Saves Nine: Using Habitat Enhancement as a Tool to Help Prevent Extirpation of Greater Sage-grouse from Grasslands National Park

Laura Gardiner[1], Maggi Sliwinski[1], Samantha Fischer[1], Autumn Watkinson[2], Sarah Wilkinson[2], Shelley Pruss[2,3], Anne Naeth[2] and Stefano Liccioli[1]

[1] Grasslands National Park, Parks Canada Agency; Email: laura.gardiner@pc.gc.ca
[2] Department of Renewable Resources, University of Alberta
[3] Natural Resources Conservation Branch, Parks Canada Agency

Abstract – The Greater Sage-grouse (*Centrocercus urophasianus*) is an endangered species in Canada that relies on the mixed-grass prairie ecoregion. Grasslands National Park (GNP) is home to the last breeding populations of Greater Sage-grouse in Saskatchewan. Crucial components of this species' nesting and brood-rearing habitat include cover, density, and height of Silver Sagebrush (*Artemisia cana*), and cover and diversity of forbs. Habitat management that optimizes these vegetation attributes is a key action for the recovery of this species. Habitat assessments conducted across GNP indicated that vegetation attributes in priority sites were below optimal; thus, habitat enhancement was initiated to help prevent extirpation of Greater Sage-grouse from GNP.

We used a landscape approach to select sites for two enhancement strategies. First, we planted 11,856 Silver Sagebrush plugs over 6.5 ha with 51 volunteers and 864.5 volunteer hours. Two-year survival was estimated at 26%, indicating that 3,082 plugs may have survived to date. Second, we hand-broadcasted sagebrush and native forb seeds at an average density of 0.2 seeds/m^2 over an additional 68.6 ha. Future directions include investigating the role of prescribed fire in habitat enhancement programs, experimental restoration of hayfields, and investigating Greater Sage-grouse habitat use to inform selection of enhancement sites.

GMO Prairies: The Importance of Seed Source in Prairie Restorations

John P. Morgan

Prairie Habitats Inc.; Email: john01@xplornet.com

Abstract – Little thought or effort often goes into selecting the origins of the seeds we use in restoring prairies. The actual species are usually chosen carefully. Where they originated, however, is commonly ignored. Using a literature review, conservation biology principles, and four decades of field experience, the author examines the importance of identifying seed origins in restoration projects. Without attention to seed origins, we risk destroying the very ecosystem we are attempting to restore. We also risk creating plant communities that are far cries from what they once were. We may be creating highly modified "GMO prairies", with little resemblance to the real thing, irretrievably losing genetic diversity along the way.

The interest in restoring our declining native prairie grasslands in Canada is at an all-time high. Books, courses, websites, conferences like this one, blogs, vlogs, Facebook groups, and chat rooms abound. If I had died in 1987, and been reincarnated 32 years later as a new seedling Big Bluestem on a restored prairie in Manitoba's Red River Valley, I would not have believed I had come back on the same planet. It is beyond wonderful to see native prairie restoration has finally become main stream.

Many at this conference have seeded native species on a restoration project, or would like to. Most of us prefer native species. Some of us have a boss who likes native species too. Does your boss know what species are native to the area you are working on? Or do they rely on you for that information? Does the accountant who set your budget like natives too? Do you know where the native species you specified for your last project came from? Not what company bagged it, put a species label on it, and sold it to you. The *real origin* of that seed lot. Was it from your municipality, county, region, or province? If so, what soil type or habitat was it originally collected from? Does that match the conditions where you seeded it? Did it come from another province or from the US? Who collected the parent stock and for what purpose? Was there any selection or selective breeding involved?

Before planting native species, it is crucial to know the answers to as many of these questions as possible. Only then can we make an informed choice about whether the seed we plan to use is suitable both ecologically and ethically. Otherwise, we could be planting cheap, genetically similar seed with little resemblance to local wild populations. It contributes almost nothing to the conservation of the very ecosystem we are trying so hard to restore. In essence, we are creating a "GMO prairie."

It surprises many to know that these are not easy questions to answer or even investigate. There is a big international market in "native seed." But *all* seeds are native *somewhere*. The origins of most of our commonly available native grasses are from the collection efforts of agricultural research to select and "improve" species for faster germination, higher forage yields, quicker growth, better tolerance of problem soils, and other factors. Many cultivars or cultivated varieties have been developed. Well-known examples are:

- Mandan Canada Wild Rye
- Revenue Slender Wheatgrass
- Walsh Western Wheatgrass
- Lodorm Green Needle Grass
- NDG4 Big Bluestem
- Elbee Northern Wheatgrass

Many of these cultivars were developed from a relatively few individuals selected for a particular agricultural purpose. While these cultivars have a certain genetic makeup of that species, they were never intended to be representative of the wide variation found among the various populations of that species across its range. Cultivar seed-production plots are inspected regularly, and any natural diversity that occurs is removed.

Much of the original diversity of our native prairies has been lost since European settlement of North America. We lose significant portions of the ever-decreasing remainder each year. Contributing to that diversity loss by planting the cheapest seed commonly available without thought of its origin is simply wrong.

Biological diversity is so basic to prairie restoration that it hardly bears mentioning. But lately I have seen a regression toward what I thought had been settled four decades ago when we first started restoring prairies. Native species have become a buzzword, often without understanding the real meaning and importance of the word “native”. Instead of conserving biodiversity, some GMO native plantings are contributing to its decline.

Real native species in any given area are adapted to that location. The particular combination of soils, moisture, slope, elevation, exposure, drainage, and climate that has evolved at that site or in that region has selected plants that are uniquely adapted to that area. An ecologically useful prairie restoration maintains that diversity. It also gives the restored prairie a chance to continue growing and evolving into the future as conditions inevitably change. This means local adaptation is of primary importance if the planting is to have maximum chances of long-term success.

Every potential prairie restoration in western Canada is within an hour’s drive of at least one high-quality native prairie remnant. It may not match the site perfectly, but it will reflect many or most of the conditions unique to that area. Canadian technology exists that facilitates low impact, sustainable use of prairie remnant seed in ample supply to meet most restoration needs.

The very best way of ensuring long-term restoration success of our endangered prairies, and the species that depend on them, is to take advantage of the diversity Mother Nature has provided. Thousands of years of local evolution have created adaptations we barely understand, but they are crucial to species survival in a rapidly changing world. We destroy this diversity at our peril. Eliminating this heterogeneity with low-diversity restoration plantings is counterintuitive at best. At worst, it hastens the decline of an ecosystem already facing serious decline.

Suggested Reading

Apfelbaum, S.I., and A. Haney. 2010. Restoring Ecological Health to Your Land. Society for Ecological Restoration/Island Press, Washington, DC.

Morgan, J.P., D.R. Collicutt, and J.D. Thompson. 1995. Restoring Canada's Native Prairies – A Practical Manual. Prairie Habitats Inc., Argyle, MB. Also available at: www.naturenorth.com/RCNP/RCNP.pdf

Muir, J.P., W.D. Pitman, F.S. Smith, J. Lloyd-Reilly, and R.A. Shadow. 2019. Challenges to developing native legume seed supplies: the Texas experience as a case study. *Native Plants Journal* 19(3): 224–238.

Schaaf, H.M., and G.A. Rogler. 1960. Selecting green needlegrass for low-dormancy seed. *Agronomy Journal* 52: 704–707.

Sinton-Gerling, H. (ed.) 2000. Native Plant Revegetation Guidelines for Alberta. Alberta Native Plant Working Group. Agriculture, Food and Rural Development and Alberta Environment, Edmonton, AB.

Jones, T.A., and D.B. Wark. 2010. Notice of Release of Fowler Germplasm Green Needlegrass. *Native Plants Journal* 11(2): 103–106.

Harvesting a multi-species Little Bluestem (*Schizachyrium scoparium*) prairie in southwestern Manitoba.

Photo by John P. Morgan, Prairie Habitats Inc.

Botanist Laura Reeves harvesting a diverse tall-grass prairie mix, Gardenton, Manitoba.

Photo by John P. Morgan, Prairie Habitats Inc.

The author collecting seeds from goldenrods and asters near Gardenton, Manitoba.

Photo by Laura Reeves.

A 122-species native prairie mix collected within 16 km of the Nature Conservancy of Canada's Monarch Restoration Project, Gardenton, Manitoba, broadcast-seeded with a Land Pride Broadcaster.

Photo by John P. Morgan, Prairie Habitats Inc.

From Black to Green to Gold: Repairing the Prairie Apiary

Kyla Tulloch

Department of Landscape Architecture, University of Manitoba; Email: kyla_tulloch@hotmail.com

Abstract – Based on my Master of Landscape Architecture practicum (2017), *From Black to Green to Gold: Alternative Land Use Strategies for Abandoned and Decommissioned Oil Well Sites in Southeast Saskatchewan*, the following approach seeks to restore a pollinator-based productive landscape, advocating for large-scale change through small-scale interventions.

Southeast Saskatchewan's landscape is a highly modified pothole prairie where pollinators face multiple challenges: habitat fragmentation, remaining habitat degradation, and negative impacts from pesticides and herbicides. Many native bee species cannot, biologically, traverse the vast matrices of monoculture annual crops to reach new sites for forage and nesting. To facilitate pollinator movement, repurposing gravel-based decommissioned oil well sites and access roads will provide necessary patches amongst the agricultural matrix. I propose the addition of natural and artificial nesting sites for bees in the form of "bee towers", built where pump jacks once stood. A detailed revegetation schedule for the remainder of the site re-establishes native prairie grasses and wildflowers to remediate the site while providing forage and nesting habitats. To create and manage these sites, a partnership of landowners and multiple conservation agencies is proposed to ensure financial incentives, revegetation, wildlife conservation, and ecosystem services are all represented.

Background

This presentation is a synopsis of the design component of *From Black to Green to Gold: Alternative Land Use Strategies for Abandoned and Decommissioned Oil Well Sites in Southeast Saskatchewan*, a University of Manitoba Master of Landscape Architecture practicum by Kyla Tulloch (2017).

The practicum project documents the background of agricultural prairie land use and oil and gas extraction processes in southeast Saskatchewan. Heavy physical and chemical control has transformed much of the nutrient-rich native prairie grasslands to monoculture matrices of human-based food production crops, interspersed with oil and gas extraction infrastructure (Tulloch 2017). This research, combined with the author's background as a farmer's daughter, led to the conclusion that although farmland appears "productive" to the human eye, it is primarily useful to just one species: us.

Goals and Objectives

The goal of the design component of this practicum was to explore alternatives for a "productive" landscape, shifting away from anthropogenic land use. What, then, exists, and what needs to exist, for an alternatively productive landscape? And who are the contributors? As the title suggests, pollinator species – in particular native bee species – became the target that both answers and raises more questions.

To create a productive alternative landscape, three objectives were established to inform the design:

1) implementing the necessities for native bee populations to survive – what already exists in the agricultural prairie landscape, and what needs to exist, to encourage appropriate ecological requirements for native bee populations to survive;
2) creating a visual representation of the redefined productive landscape: symbolic but functional structural elements;
3) ensuring the boundaries of private land ownership and use present on the landscape were well respected.

Contemporary Conditions

"The prairie grasslands of Canada are home to at least 387 bee species" representing "one of the most diverse and important areas supporting bee diversity in the country" (Sheffield *et al.* 2014, p. 427). On a global scale, bee species are a part of the keystone process of pollination, and the "species upon which the persistence of a large number of other species depends: they are essential to the reproductive cycles of most flowering plants, and thus to the ecosystem itself, supporting plant populations that other animal and bird species rely on for food and shelter" (Xerces 2003, p. 4). However, "it is with particular alarm that scientists from nearly every continent have been documenting dramatic declines in [pollinator] populations in recent decades" (ibid.). In southeast Saskatchewan, crops only bloom for a short time; "while [bees] can gorge on nectar during blooming, they starve once the blossoms die off" (Chapman 2013).

The persistence of bee populations, then, survives the present day agricultural landscape in leftover pieces of land. Small areas remain undisturbed long enough for bees to nest, roadside flowers bloom long enough to provide the necessary pollen (Creswell 2016), and there are still farmyards, uncultivated areas (typically the pothole wetlands), and ditches along roads. However, the Xerces Society (2003) highlights the three greatest contributors to ongoing population decline: habitat degradation, habitat fragmentation, and pesticide poisoning.

One further condition exists, a distinct component of the agricultural portions of the prairies: spatial structure. Figure 1 illustrates Saskatchewan's historic grid structure that may not have useful patches within the sheer expanse of fields for bees to live, forage, or rest. "Native pollinators are ... limited by flight distance (200 feet to 1 mile) and cannot access all plants in large fields unless nesting habitat and forage plants are strategically located" (Holm 2014, p. 38).

Fortunately, an organizational remedy for bees may already be present within agricultural fields. When evaluating southeast Saskatchewan's landscape, the oil well sites and their accompanying access roads regularly interrupt the span of a field. For example, in Figure 2, each dot represents an existing oil well. If these sites were to be repurposed upon the decommissioning of oil wells in the future, the semi-scattered locations could offer useful patches within the agricultural matrix.

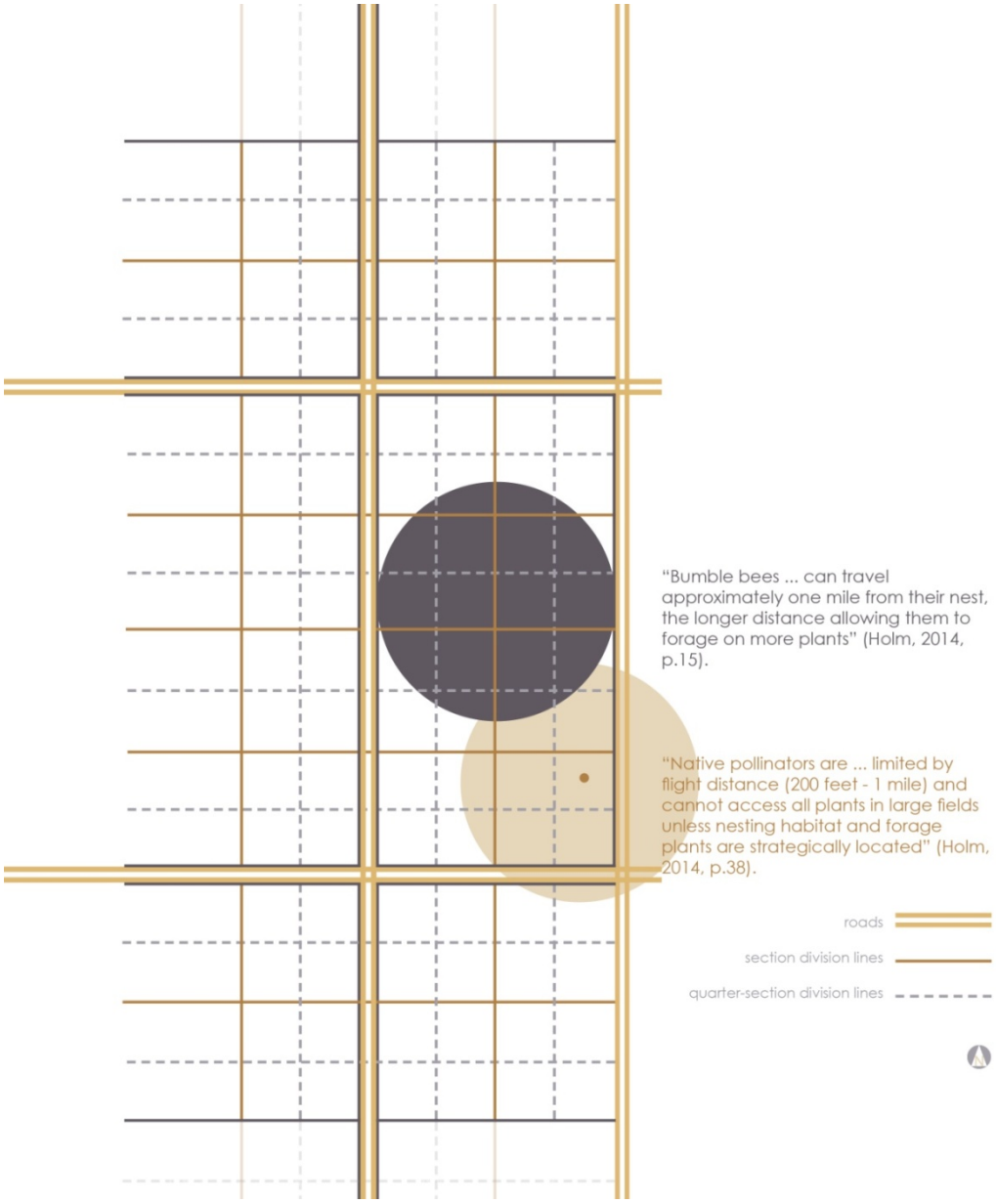

FIGURE 1. Flight distances amongst bee species vary considerably. Adapted from Figure 3.1.04 in Tulloch (2017).

Design Strategy

Based on the above evaluation, a design strategy was developed to repurpose the oil well sites for native bees. This strategy follows three recommendations:

1) supplying the appropriate homes for native bee species to nest in, through the implementation of Bee Towers;
2) modifying the legal method by which oil companies address the disturbed oil well sites and access roads to best provide for bees; and
3) managing long-term conservation and management needs.

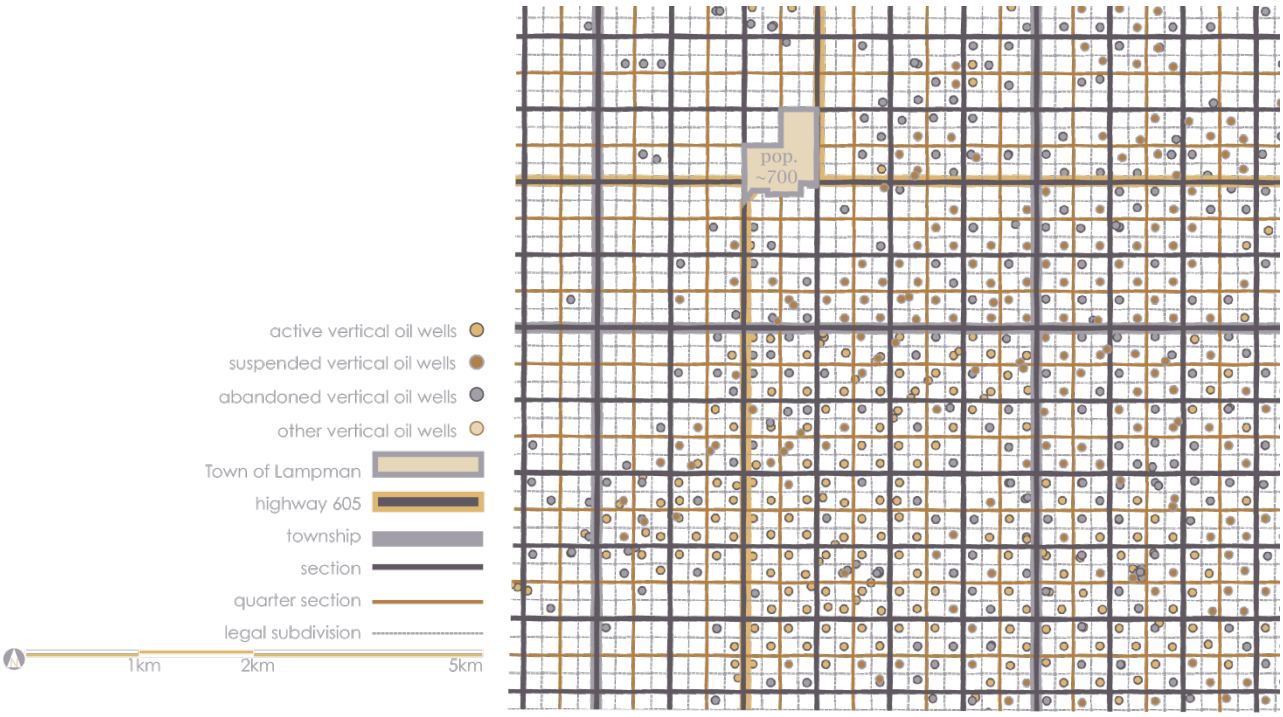

FIGURE 2. Oil well sites punctuate the landscape in high quantities. Adapted from Figure 1.2.25 in Tulloch (2017); originally adapted from Government of Saskatchewan (2017).

The first recommendation of the design strategy addresses bee homes in the form of Bee Towers. Approximately 70% of native bees – sweat bees and many solitary bees – are ground-nesting (Xerces 2003), requiring partially vegetated sites, well-drained soils, and nearby forage for food and nesting materials. If conditions are right, a cubic foot of mediocre soil can contain hundreds of bees (Vaughan *et al.* 2007). Wood-nesting bees nest in hollow stems and reeds, soft wood, and insect holes in dead trees, requiring warm, dry, and safe locations for their brood cells (Holm 2014). In an already sparsely treed landscape, wood-nesting bees are losing valuable nesting sites or are unable to reach them. The proposed Bee Towers, located on (future) decommissioned oil well pads, can remedy this gap by providing specific bee nesting homes. The towers, as shown in Figure 3, will create solid, immovable structures when installed similarly to power poles. In the spirit of reuse and sustainability, they could be built from recycled steel transmission pipelines cut in half lengthwise. Varying from a half metre to 1.2 metres in diameter (Canadian Energy Pipeline Association 2015), these pipelines can comfortably host interior structures, such as artificial bee homes.

To appeal to wood-nesting native bee species and satisfy budgetary constraints, the artificial bee homes could be constructed using inexpensive and easily sourced materials, such as untreated wood blocks, logs, and hollow stems. As seen in Figure 4, the wood blocks or logs require smoothly drilled holes with dead ends, while hollow stems or reeds can be bundled and secured (Holm 2014). As mason and leafcutter bees use these holes as nesting sites, they will seal the open ends hole by hole (Xerces 2003), furthering the visual representation of positive, productive use of these sites. These pieces can then be installed within the protection of the Bee Towers, as shown in Figure 5. The number and organization of the homes could be varied,

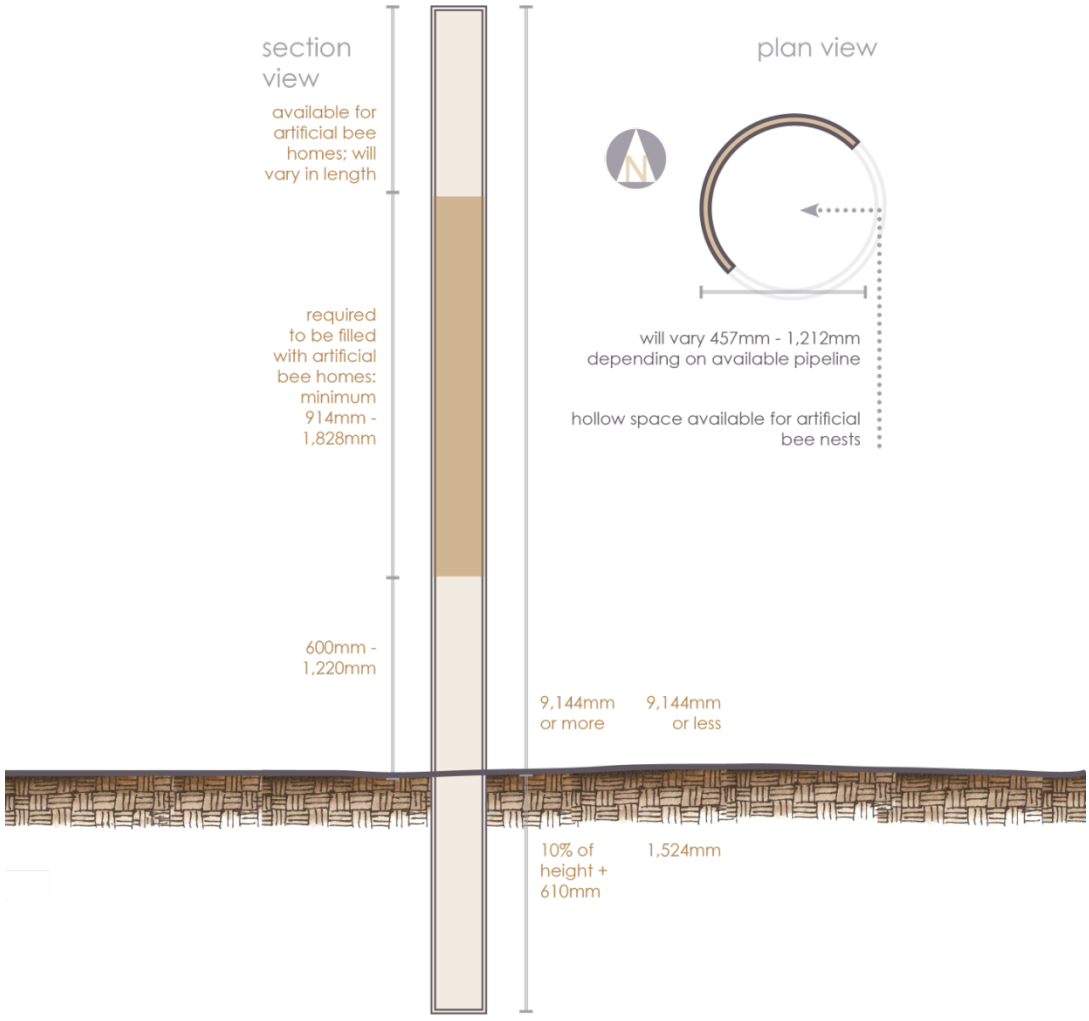

FIGURE 3. Structured installation of Bee Towers. Adapted from Figure 3.1.10 in Tulloch (2017).

constructed in bulk modular fashion, quickly installed, and replaced as necessary. The most effective organization for the individual components regarding height, density, and ongoing maintenance, would require apiarian expertise.

As this project takes place in the future, after oil wells are decommissioned, the proposed strategy will visually commemorate the removed infrastructure, reminding the viewer that although we *can* hide the impact of human-based land use, it cannot be truly erased from the landscape itself. Therefore, the Bee Towers will be organized to reflect the form of the previous pump jacks. The heights of the various towers will reflect the varying heights of the pump jacks, and structured to create density where the thick supports of the pump jack once were, all within the original footprint. The pipelines, turned vertical from their original, below-ground horizontality, allude to further elements of the oil industry, much of it typically unseen but now exposed and raised high.

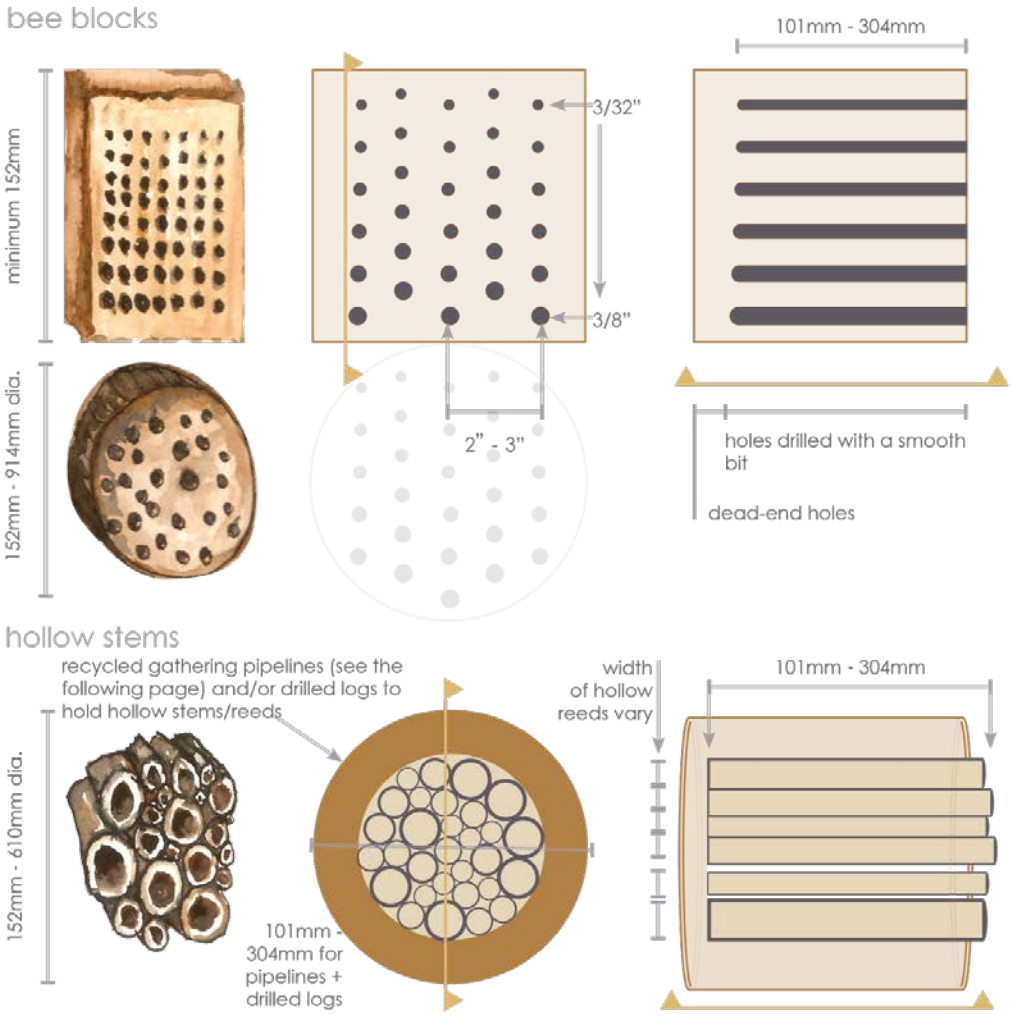

FIGURE 4. Artificial bee home requirements. Adapted from Figure 3.1.09 in Tulloch (2017); information originally adapted from p. 34 in Holm (2014).

The second recommendation of the design strategy references forage-related requirements; although the Bee Towers will provide homes for native bees, the absence of food and additional nest-building supplies will prove them ineffective. Therefore, this strategy recommends the modification of existing operations to provide habitat for bees. In current operations, government-mandated requirements outline necessary remediation, restoration, and revegetation standards in the Government of Saskatchewan *Oil and Gas Conservation Regulations, 2012* (Government 2015b)*, Detailed Site Assessment Requirements* (Government 2015a)*,* and *Saskatchewan Upstream Petroleum Sites Remediation Guidelines* (SPIGEC 2009). Remediation, as a step, should be continued as it will contribute to bee habitats: "the goal of remediation is not to remove every grain of contaminated soil but to achieve a safe level of remediation which protects human and environmental health" (SPIGEC 2009, p. 4).

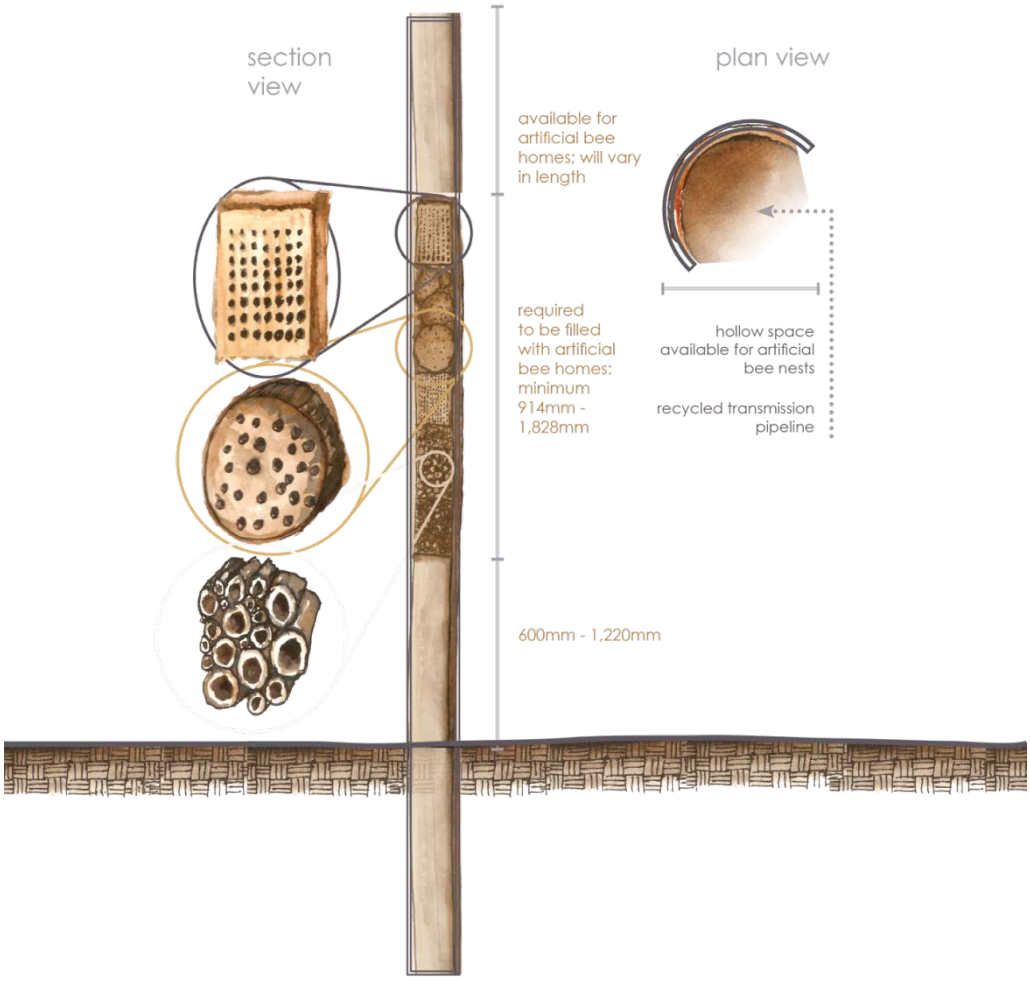

FIGURE 5. Bee Towers filled with artificial bee homes. Adapted from Figure 3.1.11 in Tulloch (2017).

The steps after remediation, however effective for oil well companies to address the disturbance from oil well sites, do not provide for bees. Reclamation, rehabilitation, and restoration all stress returning the site to its previous conditions with human use as the primary objectives. However, with a shift in land management objectives, the responsibility of the oil companies would remain the same, except that revegetation results would be a prairie-like composition of plant species: "native and/or restored grasslands could serve as important reservoirs of native pollinators for future crop pollination needs" (Sheffield *et al.* 2014, p. 430).

Thus, the revegetation requirements would be modified to provide the greatest assistance to the largest varieties of native bees. The Xerces Society (2003, p. 79) states: "Native plants are usually the best choice to attract native pollinators not only because they evolved together, but also because the plants are well adapted to your local growing conditions, soils, and climate, and can thrive with minimum attention." As bees forage from wildflowers at different times – some species are active all season, while some are active for only a couple of weeks (Xerces 2003) – this revegetation strategy strives to appeal to the greatest range of foraging types and to ensure long-term establishment. Therefore, the native plant species have been chosen with

specific objectives in mind: their restoration abilities; those native to moist mixed grasslands; a mix of native wildflower species that ensure continuous blooming from beginning to end of active seasons; and native wildflowers that notably appeal to bees. Species that are quick-to-establish and those dominating on maturity are both included; even if some species fail, the varieties can survive as a whole.

Figure 6 represents the blooming schedule for wildflower species that adhere to at least one of the specified plant objectives just listed. The grey indicates the timing to collect seeds, encouraging a sustainable source of native, locally adapted seed supply. Although wildflowers will be the greatest contributors to bee foraging, native grassland cannot be wildflowers alone. As such, native grassland species used in restoration efforts are also a part of the revegetation strategy.

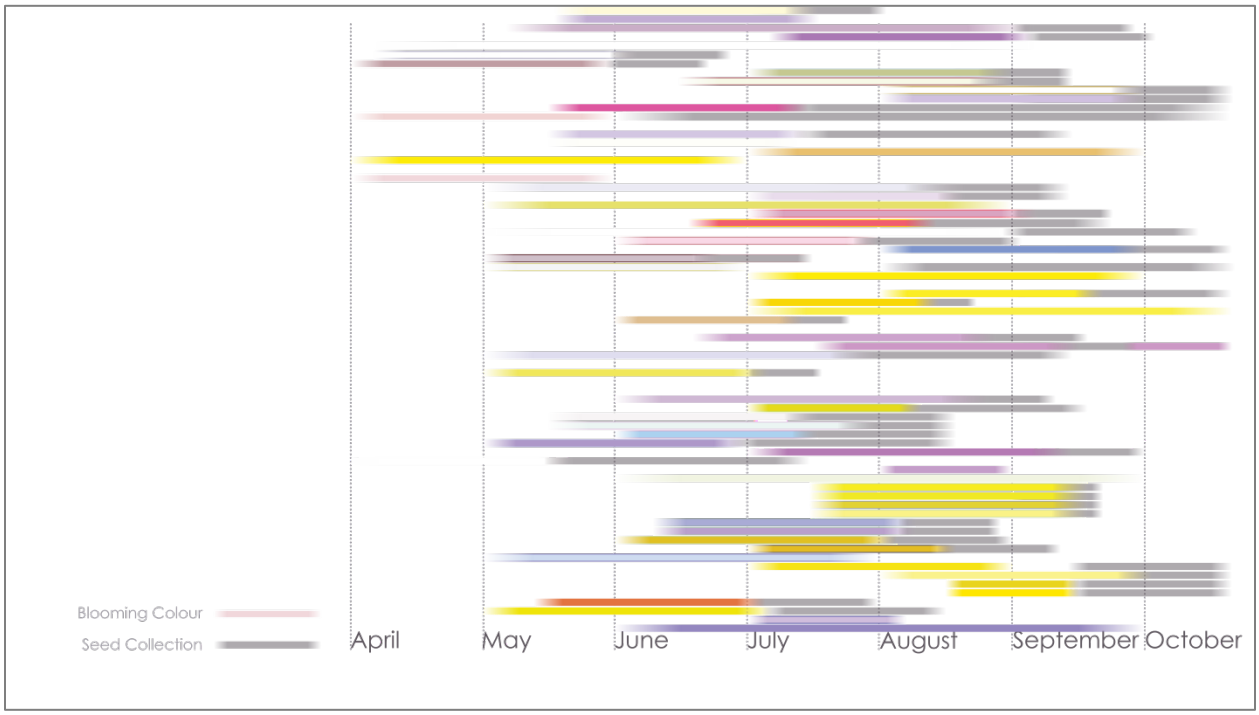

FIGURE 6. Wildflower species bloom and seed collection times. Adapted from Figure 3.2.18 in Tulloch (2017); information originally compiled from Holm (2014) and the following sources: Evergreen (2014), Morgan *et al.* (1995), Prairie Frontier (2017).

The third recommendation of the design strategy recognizes the need for management. Without long-term management, the addition of bee homes and specialized revegetation is a wasted venture. The oil companies can only be expected to revegetate and maintain the landscape until it reaches the required level of establishment. Once the native prairie is re-established, whose responsibility is it? Here, it is key to return to one of the initial project objectives: that private land ownership is respected. The design strategy is limited to the oil well sites and the access roads: the landowners and users are not expected to contribute time and/or money to the proposed design. To appeal to landowners and guarantee protection of the sites, initiatives already established by conservation organizations may be applied, such as

multiple conservation easement and compensation programs that will pay land owners to leave areas uncultivated. The availability and variety of such programs indicate current interest in such endeavours.

Design Strategy – Applied

The goal, objectives, and design strategies will now be theoretically applied to a section of land in southeast Saskatchewan, as seen in Figure 7. Despite the variations in sites and the individual analyses that would be required, there is often an overlap in site conditions. Oil well sites typically span 25 to 40 metres with an attached access road; these access roads often edge or cut through uncultivated areas. Typically, once the access roads and oil well sites are remediated, the merging of access road, oil well site, and adjacent uncultivated area creates a substantial space in which to install the Bee Towers and implement the revegetation strategy, as drawn in Figure 8. “Connecting or enlarging fragmented landscapes by reintroducing native plants can increase the survivability of pollinators and reduce the pressures associated with invasive species and competition” (Holm 2014, p. 42).

The individual oil well sites must be evaluated to review their potential for the proposed design strategy. Using satellite imagery and information provided by Ducks Unlimited Canada, uncultivated areas are identified within the field and compared to the oil well sites and access roads. In Figure 9, the connectivity for native bees and nearby uncultivated areas is evaluated; the circles represent bee flight distances at concentric intervals of 100 metres in diameter. Many of the uncultivated areas, resulting from the pothole prairie landscape, are to remain untouched as they provide valuable resources for native bees in their present state. Where the oil well sites and access roads edge or cut through these areas, they will be treated with the design strategy.

As Figure 10 indicates, if there are few to no trees nearby, the addition of native trees on the peripheries of the oil well sites could be considered for wind protection, additional habitat, and nesting location and supply. When implemented, the revegetation strategy will initially create corridors of grasses and wildflowers that differ in colour, texture, and function from the surrounding monoculture crops. Over time, the spread of native wildflowers and grasses into the now merged uncultivated areas is desirable.

In some sections, there will be atypical oil well sites and access roads. As shown in Figure 11, larger-than-average oil well sites at approximately 100 by 100 metres may exist, providing an opportunity to treat the site beyond the revegetation strategy. However, this expectation is, and would be, well beyond the requirements of oil companies. The companies must still remediate the site, but then a conservation organization might evaluate multiple sites over a larger area as a spatially and ecologically diverse system of habitats. In some cases, an access road is not located along or within uncultivated areas; in these situations, the roads cause unjust disruptions for land users. Each length of access road must then be evaluated to determine the necessity of including it in the design strategy. If, as seen in Figure 12, the patches of revegetated oil well sites are still usably close for native bee species, then the road should be removed and reclaimed for the land user following current requirements for oil companies to address disturbance.

FIGURE 7. Oil wells and access roads on a section in southeast Saskatchewan. Adapted from Figure 3.3.02 in Tulloch (2017); information originally adapted from Google Earth 7.1 (2017); wetland polygons adapted from Ducks Unlimited Canada (2017).

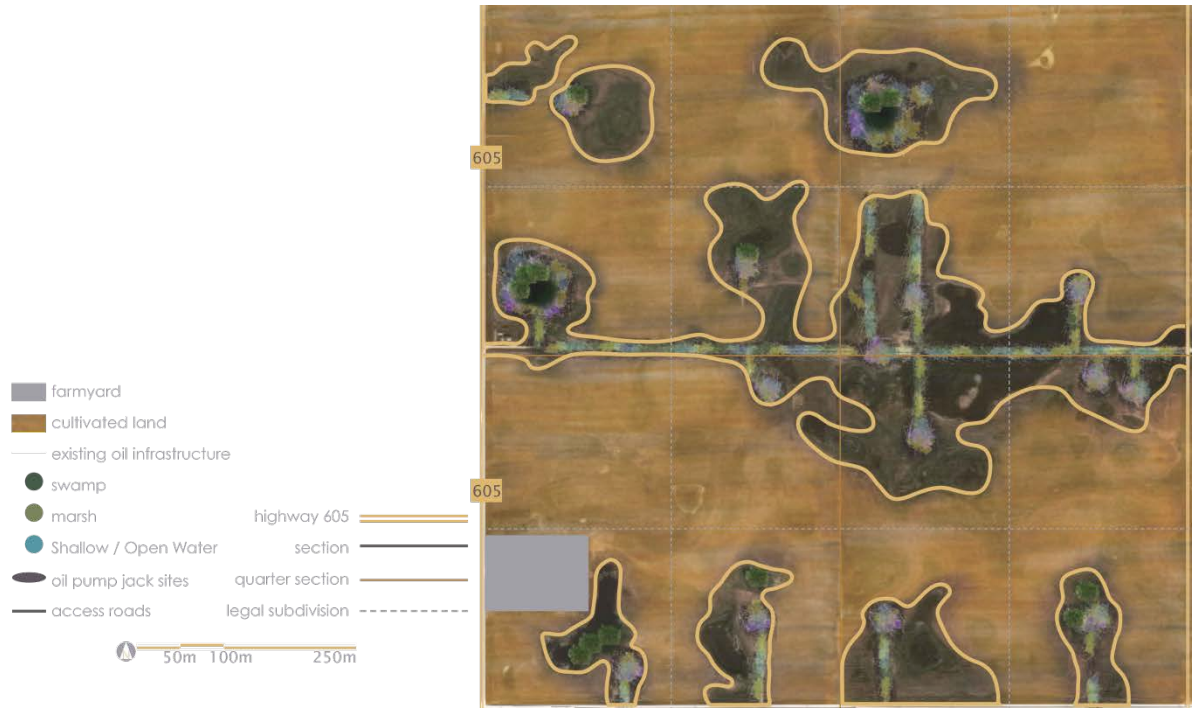

FIGURE 8. Access roads and oil well sites merged with adjacent uncultivated areas. Adapted from Figure 3.3.04 in Tulloch (2017); information originally adapted from Google Earth 7.1 (2017).

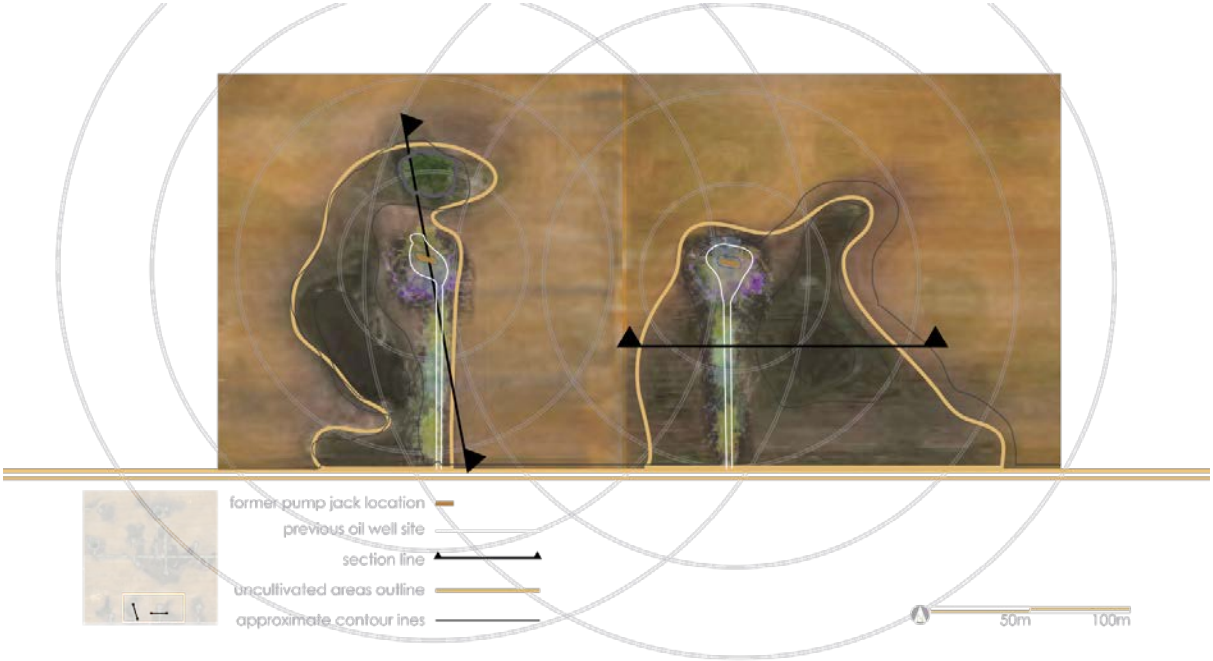

FIGURE 9. Typical oil well sites with applied design strategy. Adapted from Figure 3.3.06 in Tulloch (2017).

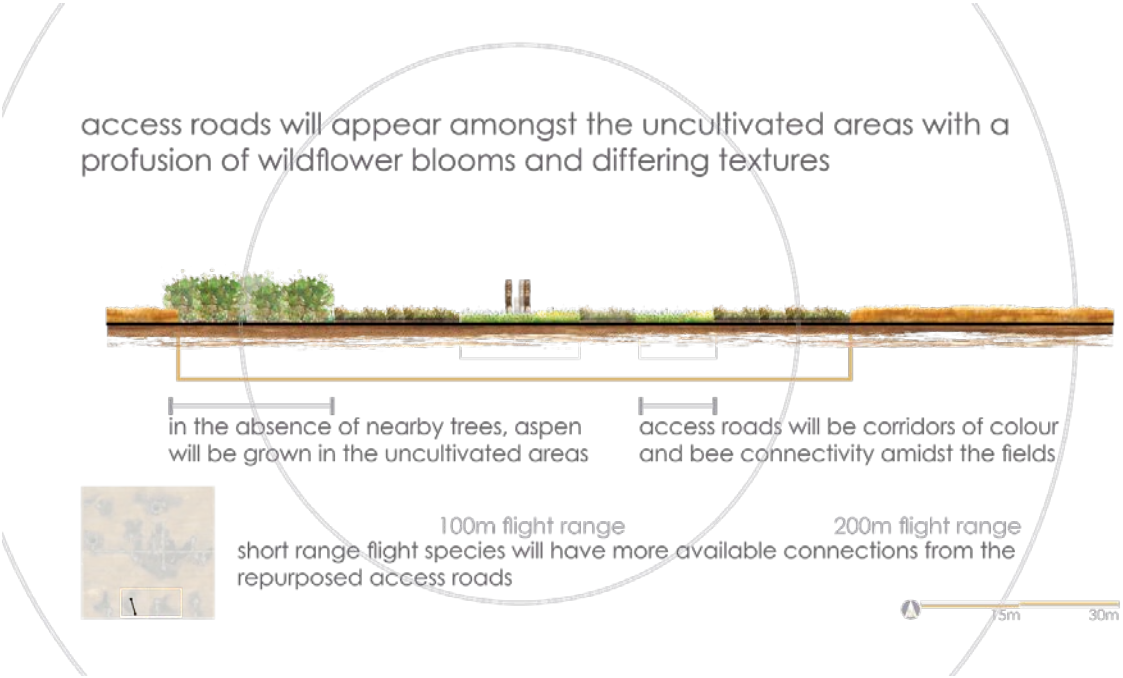

FIGURE 10. Elevation of typical oil well sites. Adapted from Figure 3.3.08 in Tulloch (2017).

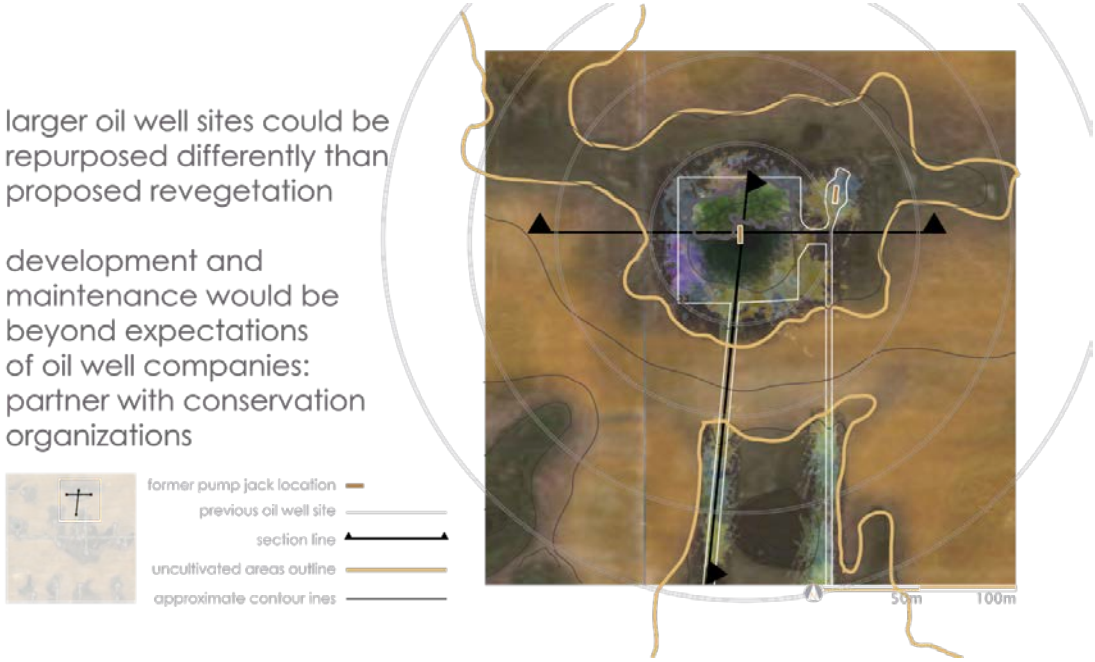

FIGURE 11. Atypical oil well sites with applied design strategy. Adapted from Figure 3.3.09 in Tulloch (2017).

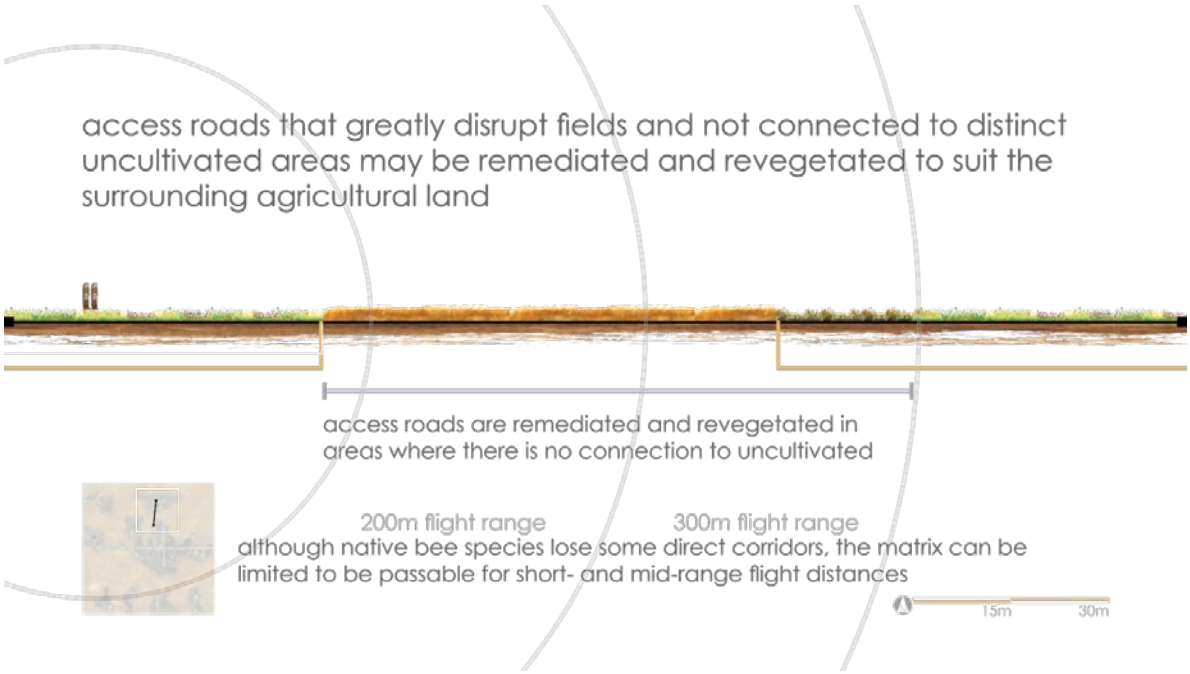

FIGURE 12. Elevation of atypical oil well sites. Adapted from Figure 3.3.10 in Tulloch (2017).

Conclusion

With this strategy applied to the larger landscape, there will be a new landscape to read and interpret, a semiotic shift and a new productivity. The design strategy is split between providing habitat for bees, recognizing the requirements of land ownership and usage, and creating large enough patches to be worthwhile for conservation organizations to invest in to create a functional, newly productive landscape. The form of the Bee Towers combined with the distinct revegetation strategy will visually document the effect that anthropogenic use once had on the landscape. The grasses and wildflowers will create strips of colour and texture that not only differ from the visually monochromatic crops, but supply "linear patches of habitat likely [to] provide a corridor along which bees and other beneficial insects can migrate more quickly through the agricultural landscape" (Vaughan *et al.* 2007, p. 15). These installations are intended to be continually developed and grown successively. The uncultivated areas gain a new life, compensating farmers for a land-use strategy that acknowledges their needs and contributions to the health of the greater landscape, without placing the financial burden on them. The oil companies continue to treat oil well sites, but with a revised method. The bees are provided with living conditions that will promote population maintenance and, preferably, growth. The impact of anthropogenic land use is not erased, but repurposed, acknowledging our history while providing for our future.

FIGURE 13. A productive landscape. Adapted from Figure 3.4.05 in Tulloch (2017).

Literature Cited

Canadian Energy Pipeline Association. 2015. *The different types of pipelines in Canada*. https://www.cepa.com/wp-content/uploads/2016/11/CEPA-PipeLinesInfographic-2015_final1.pdf. Accessed May 15, 2017.

Chapman, S. 2013. Fight of the Bumblebee. *The Walrus*, March 2013. https://thewalrus.ca/fight-of-the-bumblebee/. Accessed June 7, 2017.

Creswell, J.E. 2016. The impacts of agrochemical pesticides on bees in intensively cultivated farmland. Pages 155–179 *in Pollination services to agriculture: sustaining and enhancing a key ecosystem service. Edited by* B. Gemmill-Herren. Routledge, London and New York.

Ducks Unlimited Canada. 2017. Wetlands:16-004-06-W-2. [Geographic Information Systems] Swamp, Marsh, and Shallow / Open Water data layers. Regina, SK.

Evergreen Native Plant Database. 2014. https://nativeplants.evergreen.ca/. Accessed 8 May 2017.

Google Earth 7.1. 2017. 2012 satellite imagery 49°17'40.81"N, 102°45'17.29"W, elevation 588. https://www.google.com/earth/index.html. Accessed March 8, 2017.

Government of Saskatchewan. 2015a. *Detailed Site Assessment Requirements*. Government of Saskatchewan - Publications Centre. http://www.publications.gov.sk.ca/details.cfm?p=76265. Accessed April 12, 2017.

Government of Saskatchewan. 2015b. *Oil and Gas Conservation Regulations, 2012*. Government of Saskatchewan - Publications Centre. http://www.publications.gov.sk.ca/details.cfm?p=745. Accessed February 22, 2017.

Government of Saskatchewan. 2017. Townships, Active oil wells, Suspended oil wells, Abandoned oil wells data layers. Government of Saskatchewan Infomaps originally accessed February 21, 2017. This information is now available at the Saskatchewan Mining and Petroleum GeoAtlas https://gisappl.saskatchewan.ca/Html5Ext/index.html?viewer=GeoAtlas

Holm, H. 2014. *Pollinators of native plants: attract, observe and identify pollinators and beneficial insects with native plants*. Pollination Press LLC, Minnetonka, MN.

Morgan, J.P., D.R. Collicutt, and J.D. Thompson. 1995. *Restoring Canada's native prairies: a practical manual*. Prairie Habitats, Argyle, MB. www.naturenorth.com/RCNP/RCNP.pdf. Accessed May 2, 2017.

Prairie Frontier. 2017. Wildflower native cultural guide. Prairie Frontier Wildflower and Prairie Grass Seed, Waukesha, WI. http://www.prairiefrontier.com/pages/natvpgs/nativeabc.html. Accessed May 2, 2017.

[SPIGEC] Saskatchewan Petroleum Industry / Government Environmental Committee. 2009. *Saskatchewan Upstream Petroleum Sites Remediation Guidelines*. www.publications.gov.sk.ca/redirect.cfm?p=75538&i=84469. Accessed March 23, 2017.

Sheffield, C., S.D. Frier, and S. Dumesh. 2014. The bees (Hymenoptera: Apoidea, Apiformes) of the prairies ecozone with comparisons to other grasslands of Canada. Pages 427–467 *in* Arthropods of Canadian Grasslands (Volume 4). *Edited by* D. J. Giberson, and H. A. Cárcamo. Biological Survey of Canada.

Tulloch, K. 2017. *From black to green to gold: alternative land use strategies for abandoned and decommissioned oil well sites in southeast Saskatchewan*. Master of Landscape Architecture practicum. University of Manitoba, Winnipeg, MB.

Vaughan, M., M. Shepherd, C. Kremen, and S.H. Black. 2007. *Farming for bees: guidelines for providing native bee habitat on farms.* The Xerces Society for Invertebrate Conservation, Portland, OR.

Xerces Society, The. 2003. *Pollinator conservation handbook: a guide to understanding, protecting, and providing habitat for native pollinator insects*. The Xerces Society for Invertebrate Conservation, Portland, OR.

SESSION 18: ADAPTIVE MANAGEMENT PLANNING WITH OPEN STANDARDS

Session Moderator – Cary D. Hamel, Nature Conservancy of Canada – Manitoba Region

The Open Standards for the Practice of Conservation – A Brief Overview

Cary D. Hamel

Nature Conservancy of Canada – Manitoba Region; Email: Cary.Hamel@natureconservancy.ca

Abstract – The Conservation Measures Partnership has worked over the past fifteen years to combine principles and best practices in adaptive management and results-based management from conservation and other fields to create the *Open Standards for the Practice of Conservation*. The Open Standards bring together common concepts, approaches, and terminology in conservation project design, management, and monitoring in order to help practitioners improve the practice of conservation. This presentation aims to introduce the basic components of this adaptive management framework, which is increasingly being adopted by conservation planners and practitioners in prairie Canada. It will also point to the numerous training resources that have been made available by the Open Standards community.

Open Standards: Benefits to NCC Conservation Planning in Saskatchewan

Ryan Dudragne and Matthew Braun

Nature Conservancy of Canada – Saskatchewan Region; Email: Ryan.Dudragne@natureconservancy.ca

Abstract – The Nature Conservancy of Canada (NCC) has embraced the use of Open Standards to guide activities at the ecoregional scale. In the past four years, NCC-SK has completed seven regional planning documents called Natural Area Conservation Plans using the Open Standards model. Several of these plans have involved outside partners, which has had tangible and intangible benefits. Each iteration of the planning process has been adapted to participants in the planning workshops, core team members, and the particular challenges and desired biodiversity outcomes of each planning area.

As we learn more about this powerful tool we get better at using it. Regional NCC staff charged with operations in the Saskatchewan Region have begun using the Open Standards process for other exercises where the need to prioritize activities based on objectively assessed threats is crucial, and the benefit of integrating broader perspectives is clear. These include forest management and restoration projects, bison herd management, and property management. As we continue to use Open Standards to engage with the broader community of people who also share a connection to our working landscapes, we find more people interested in adopting the process to adapt and advance their planning processes.

Open Standards for the Practice of Conservation as a Framework for Integrated, Landscape-scale Conservation Planning

Rebekah Neufeld, **Christine Chilton** and Cary D. Hamel

Nature Conservancy of Canada – Manitoba Region; Email: Rebekah.Neufeld@natureconservancy.ca; Christine.Chilton@natureconservancy.ca

Abstract – The Nature Conservancy of Canada uses focused, strategic, and adaptive landscape-scale conservation plans to guide the protection of areas of exceptional biodiversity. Through these plans we identify desired conservation results, and develop, prioritize, and implement activities that will lead to these results, track their progress, and adapt based on what we have learned. The Open Standards for the Practice of Conservation is a process built on adaptation principles that supports the creation of effective, measurable, and goal-oriented conservation action. This framework facilitates the full integration of biodiversity values, socio-economics, and social values in the planning process, and encourages the incorporation of a wide range of perspectives and worldviews.

This framework was used to develop and climate-change-adapt the third iteration of our Riding Mountain Natural Area Conservation Plan, and pilot the development of a community-relations strategy to support its implementation. The result is a plan that is based upon a shared, collaborative approach to conservation with strategies that facilitate ongoing adaptation, and demonstrably improved the measurable goals and objectives for both conservation and community relations, as compared to previous planning approaches.

Open Standards: A Partnership Approach to Conservation Planning in the Saskatoon Region

Renny W. Grilz and Eryn Tomlinson

Meewasin Valley Authority; Email: rgrilz@meewasin.com

Abstract – Meewasin and Nature Conservancy of Canada – Saskatchewan Region (NCC-SK) partnered on a joint conservation planning exercise in the Saskatoon region in 2016–17. Using the conservation planning tool Open Standards, both agencies worked together to identify key conservation targets and assess the threats impacting these targets in the region. Key stakeholders were engaged and consulted in the planning process. The project resulted in Meewasin developing a Valley-wide Resource Management Plan and NCC-SK updating their Saskatoon Prairie Natural Area Conservation Plan.

The Open Standards process was a new conservation planning tool for Meewasin. The tool has been incorporated into Meewasin's planning process for not only its landscape-scale planning but also for site-specific management planning. This presentation discusses the joint conservation planning project between Meewasin and NCC-SK, how Open Standards was used during the process, and how Open Standards has been further incorporated into Meewasin's planning process.

POSTER ABSTRACTS AND PAPERS

Management Planning for a Plains Bison Conservation Herd

Mike Burak

Nature Conservancy of Canada – Saskatchewan Region; Email: michael.burak@natureconservancy.ca

Abstract – The Nature Conservancy of Canada (NCC) has been managing a small herd of Plains Bison since 2003, when they were reintroduced at Old Man on His Back Prairie and Heritage Conservation Area (OMB). Since the reintroduction, NCC has generally maintained a hands-off management approach with the OMB bison herd. After the first wild-born calves arrived in the spring of 2006, the herd increased in size to approximately 80 individuals which is where it is currently maintained. As the herd continues to age, NCC has recognized that a shift in the hands-off management of the OMB herd will be required in the near future. Aspects of our upcoming adaptive management plan, written in accordance with the Open Standards for the Practice of Conservation, are presented and discussed, including our management goals/targets, threats to those goals/targets, and actions/strategies to mitigate threats and achieve our goals. The Open Standards encourages consultation and collaboration with, and incorporation of feedback from, multiple stakeholders. Discussion topics also include determining the carrying capacity of the bison pastures at OMB, desired future herd demographics, disease surveillance, infrastructure and handling facilities, visitor safety, and Indigenous cultural perspectives.

Balancing the Needs of Critical Habitat and Grazing Management: Livestock Water Development on Greater Sage-grouse Emergency Protection Order Lands

Tom Harrison[1], Robin Bloom[2], Beatriz Prieto[3] and Krista Connick Todd[1]

[1] South of the Divide Conservation Action Program Inc.; Email: ed@sodcap.com
[2] Canadian Wildlife Service, Environment and Climate Change Canada
[3] Saskatchewan Ministry of Environment

Abstract – In 2017 a Grazing Co-op in southwestern Saskatchewan identified some shortfalls in their water requirements on their 26,000-acre pasture. Drought and low levels of spring runoff had put pressure on their existing water sources. To continue with their grazing system, they planned to install several new dugouts. One of the locations they chose was under protection by the Emergency Order for the Protection of the Greater Sage-grouse (2013). Among other things, the Emergency Protection Order restricts new livestock water sites with a footprint larger than 30 m^2. The majority of that paddock has also been mapped as potential critical habitat for Greater Sage-grouse (*Centrocercus urophasianus*). These designations restricted the possibility of installing a new dugout there.

Through innovation and a historical knowledge of the pasture, the Grazing Co-op was able to create a new system to meet water requirements, while still complying with the critical habitat restrictions. Instead of a dugout, a spring in the adjacent paddock was developed and piped to a trough.

Concerns with new water development on Greater Sage-grouse habitat do not revolve solely around the water site itself, but also around the potential change in grazing patterns close to the site. Does a new water site result in decreased habitat quality due to increased grazing pressure? Monitoring will occur over the next few years to identify any changes to habitat close to the new water trough.

A Conspicuous Absence of Haemosporidian Parasites in Grassland Songbirds of the Northern Great Plains

Paulson G. Des Brisay, Chelsea Enslow and Nicola Koper

Natural Resources Institute, University of Manitoba; Email: pauldesbrisay@gmail.com

Abstract – Grassland songbird populations are declining severely in the North American Great Plains, yet the extent to which avian blood parasites may be contributing to these declines is virtually unknown. Our goal was to document rates of haemosporidian parasitism rates in two grassland songbirds using a nested PCR (polymerase chain reaction) protocol. We screened 103 Chestnut-collared Longspurs (*Calcarius ornatus*) and 69 Savannah Sparrows (*Passerculus sandwichensis*) in Alberta for two genera of haemosporidian parasites (*Haemoproteus* and *Plasmodium*) and detected zero infections. To confirm our laboratory methods could detect infections that were present, we collected samples from 22 Swamp Sparrows (*Melospiza georgiana*) in Manitoba, and detected 5 infections. No previous studies have documented a lack of blood parasites in grassland songbirds, but it is possible that this is a result of publication bias against null results. As climate change shifts vector ranges, naive populations of grassland songbirds may suffer disproportionately if vector presence or parasite transmission is altered.

Reducing Wildlife Risk: Wildlife Habitat Sensitivity Map for the Renewable Energy Sector in Alberta

Brandy Downey, Kristin Cline, Glenn Mack, Patrick Wensveen, Oriano Castelli and Blair Watke

Alberta Environment and Parks; Email: brandy.downey@gov.ab.ca

Abstract – Appropriate site selection is the most critical factor in preventing significant negative effects on wildlife from renewable energy projects. Projects that are sited to avoid important wildlife habitat decrease wildlife mortality, disturbance, and habitat loss, as well as limit the need for mitigation measures to reduce population-level impacts. In order to assist renewable energy project planning, Alberta Environment and Parks has created a map of sensitive wildlife habitat. The goal of this map is to help guide the site selection process to areas with lower risk to Alberta's wildlife and wildlife habitat.

The renewable energy risk datasets were created using a combination of different wildlife sensitivity data, parks and protected areas, and native grassland land-cover data. The data were divided into four categories: critical wildlife zone, high risk areas, moderate risk areas, and low risk areas. The category determination was based on the Wind and Solar Directives, which describe the areas that are at highest risk of negative wildlife impacts from renewable energy development. When multiple layers overlapped, the highest risk value was extracted for each 100 m^2 cell, and then the majority risk in each quarter section was used to assign that area to a risk category. In this way the entire province was evaluated for wildlife habitat sensitivity to renewable energy impacts.

This map is one of the information products that Alberta Environment and Parks has developed to support the sustainable development of wind and solar energy projects in Alberta.

Restoring Grassland Habitat in Alberta's Sagebrush Ecosystem: The Silver Sage Success Story

Brad Downey and Phillip Rose

Alberta Conservation Association; Email: Brad.Downey@ab-conservation.com

Abstract – The Silver Sage Conservation Site was initiated in southern Alberta in 2009 and is a collaborative effort between multiple organizations. Over 2,000 acres of cropland and tame grassland was restored to native grass communities that are representative of the surrounding dry mixed-grass prairie landscape. The goal was to create habitat for grassland birds, enhance landscape connectivity for pronghorn (*Antilocapra americana*) and other ungulate species, restore modified wetlands back to original functioning condition, and maintain the site in an ecologically sustainable state.

Highlights include reseeding with native grass, forb, and shrub species, removal of power lines and abandoned buildings, and installation of wildlife-friendly fences. Baseline inventories were completed for wildlife and range health and used to develop a grazing plan for the site. Ongoing monitoring has also been used to track changes throughout the property. The site has experienced an increase in biodiversity, and eight species at risk were recorded during 2018 inventories including Sprague's Pipit (*Anthus spragueii*), Chestnut-collared Longspur (*Calcarius ornatus*), and Baird's Sparrow (*Centronyx bairdii*).

Emphasis has been placed on working with local landowners. Neighbouring producers were contracted to prepare and seed the land and were granted grazing and haying rights on the property. Silver Sage also provides open access for hunting and recreational use.

The Saskatchewan Breeding Bird Atlas: Putting Saskatchewan's Birds on the Map

Kiel Drake, LeeAnn Latremouille, Denis Lepage, Andrew Couturier and Catherine Jardine

Bird Studies Canada; Email: kdrake@birdscanada.org

Breeding Bird Atlases are five-year projects designed to assess the status, distribution, and abundance of breeding birds within a defined area, often provincially in Canada. Using scientific methods, atlases reveal changes and track trends in bird populations over large areas and long time frames. Atlases require significant collaboration between conservation organizations, government agencies, private businesses and industry, and members of the public, resulting in an invaluable tool for wildlife conservation, education, and research. The Atlas supports the mandate of the Saskatchewan Conservation Data Centre for monitoring biodiversity by way of inventory and assessment and will provide detailed new information to support decision-making, whether for SARA/COSEWIC (regarding species at risk) or the provincial Wildlife Act (regarding harvest regulations).

In the short term, the Atlas will significantly advance local and regional conservation planning, helping to address issues ranging from species at risk and critical habitat conservation to the appropriate development of renewable energy sources, and best practices in natural resource management (e.g., forestry, mining). In the longer term, it will provide a standard framework for landscape-scale biological monitoring. We report on results from the first two field seasons of the Saskatchewan Breeding Bird Atlas (2017–2018), and we highlight upcoming opportunities to help with achieving coverage goals during the final three field seasons (2019–2021).

A Practical Approach to Developing a Land Parcel-based Multiple Species at Risk Management, Research, Recovery, and Land Management Decision Support Tool

Melissa A. Grantham and Cary D. Hamel

Nature Conservancy of Canada – Manitoba Region; Email: melissa.grantham@natureconservancy.ca

Abstract – Building on a concept first developed by Agriculture and Agri-Food Canada, the Nature Conservancy of Canada (NCC) has developed a multi-species at risk (Multi-SAR) decision support tool to assist conservation land managers with adaptive-management-based decision-making. Here we present, using a practical example, NCC's method for development and implementation of the Multi-SAR Research, Recovery, and Land Management Decision Support Tool. Plans are developed using the best available science and data, reference to federal and provincial status and recovery documents and management guidelines, and with expert consultation and review. Plan development considers each species' particular management needs and sensitivities, as well as their dependency on different aspects of the habitat mosaic and disturbance-driven ecosystems within which they reside. Plans are implemented within an adaptive management, multi-year framework, including annual consideration of monitoring results, new science and information, listing changes, and new species observations, and adjusted as needed.

Who are the Champions? Assessment of Current Conservation Response to Globally Rare Species in Manitoba

Lisa Greaves[1], Cary D. Hamel[1], Jordan Becker[1], Stephen Gietz[1], Melissa Grantham[1], Rebekah Neufeld[1] and Chris Friesen[2]

[1] Nature Conservancy of Canada – Manitoba Region; Email: lisa.greaves@natureconservancy.ca
[2] Manitoba Conservation Data Centre, Manitoba Sustainable Development

Abstract – In 2017 NatureServe Canada released a report whose purpose was to identify species and infraspecies native to Canada that are of global conservation concern, as a means of improving awareness about these species and aiding in focusing conservation efforts to ensure these species are protected. In response to this report, we evaluated the current ability of the Nature Conservancy of Canada – Manitoba Region (NCC-MB) to influence conservation of these species, and aimed to highlight species that may need enhanced conservation focus by NCC-MB or other provincial organizations. We determined which species' ranges occurred in Manitoba and investigated the current conservation effort for each of those species by examining the literature and engaging with many Manitoba taxa experts for further information on their respective species. Results show 46 species of global conservation concern occur in Manitoba, with 26 at least partially captured in NCC's current conservation plans, though the level of response varies. Twenty-seven species do not have a demonstrable, coordinated conservation response. Further coordinated consideration by organizations within Manitoba is needed in order to ensure protection of these species.

SARA Permitting

Paul Gregoire

Canadian Wildlife Service, Environment and Climate Change Canada; Email: paul.gregoire@canada.ca

Abstract – The federal Species at Risk Act (SARA) includes regulations to protect sensitive species and their habitat. Activities undertaken by biologists, municipalities, and industry may be subject to the prohibitions under SARA and may require a permit. With the increased identification of critical habitat on the landscape and the establishment of Emergency Protection Orders, the circumstances under which a SARA permit may be required are increasing. Activities on federal lands or on Emergency Protection Order lands have a higher likelihood of requiring a permit. An online application system is in place to facilitate applications; however, approvals may take up to 90 days, therefore project planning is essential to avoid delays. This poster describes SARA permitting under the mandate of Environment and Climate Change Canada.

Introduction

Scientists, land managers, and industry may increasingly find themselves in need of a SARA permit as more species are listed, critical habitat is identified, and Emergency Protection Orders are put in place under the federal Species at Risk Act (SARA). If a person is undertaking field activities that may affect species listed under SARA, and particularly if the activity is located on federal lands, a SARA permit may be required.

The need for a permit

A permit may be required if:

1) an activity affects a species listed under Schedule 1 of SARA as Threatened, Endangered, or Extirpated (not as Special Concern); and

2) the activity has the potential to contravene the prohibitions under SARA: kill, harm, harass, or be in the possession of; damage or destroy the residence of; destroy any part of the critical habitat of, a species; and

3) the activity is located on federal lands or on Emergency Protection Order (EPO) lands.

Federal lands include, but are not limited to, Military Bases, Indigenous Reserves, Agriculture Canada lands, and National Parks and Historic Sites. A permit may be required if the activity is not located on federal lands but affects a migratory bird (as defined under the Migratory Birds Convention Act [MBCA]) or an aquatic species (as defined under the Fisheries Act).

Activities not on federal lands

If an activity is located on private or provincial crown lands, the SARA prohibitions apply only to migratory birds (protected under MBCA) and aquatic species (protected under the Fisheries Act), unless an Order in Council is made. SARA permits are not required for birds that are not protected under MBCA, such as hawks, owls, upland game birds, corvids, blackbirds, pelicans, and cormorants; however, provincial legislation may apply.

The SARA prohibitions do not apply to mammals, reptiles, amphibians, invertebrates, or plants on provincial and private land. However, if the laws of the province do not effectively protect a species, the minister may invoke an Order in Council to have the prohibitions apply. Provincial legislation may additionally apply to protect these species. SARA prohibitions would apply on EPO lands that are located on provincial or private land.

How to apply for a permit

The Department of Fisheries and Oceans Canada issues permits for activities that affect aquatic species (e.g., fish, shellfish). The Parks Canada Agency issues permits for activities in National Parks and Historic Sites. Environment and Climate Change Canada (ECCC) issues permits for all other lands where the prohibitions apply.

ECCC's SARA permit applications are completed and submitted online by visiting https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html

Following the links to "Permits" will take the user to the SARA E-permitting System. Questions can be directed to the Environment Canada regional SARA permit officer for the provinces of Alberta, Saskatchewan and Manitoba [Paul Gregoire, Canadian Wildlife Service, paul.gregoire@canada.ca]. Permits may take between 60 and 90 days to be processed, therefore early application is advised. Permits undergo regional and national approvals, French translation, and are posted on a national registry. Permits are typically issued for up to 3 years.

Conditions that must be met

SARA identifies three preconditions that must be satisfied in the permit application.

> (a) all reasonable alternatives to the activity that would reduce the impact on the species have been considered and the best solution has been adopted;
>
> (b) all feasible measures will be taken to minimize the impact of the activity on the species or its critical habitat or the residences of its individuals; and
>
> (c) the activity will not jeopardize the survival or recovery of the species.

Activities must be well planned and justified. Permits will be reviewed on a case-by-case basis and the precautionary principle will be applied. ECCC retains the discretion to refuse permits outright or to attach conditions necessary to ensure the protection of the species. These conditions may include limits on the activities permitted, number of individuals affected, timing restrictions, measures to protect non-targeted SARA species, disposal, and so forth. Permits will not be issued for insurance purposes.

SARA authorized activities

Three types of activities are authorized and must be identified in a permit application:

> (a) the activity is scientific research relating to the conservation of the species and conducted by qualified persons;

(b) the activity benefits the species or is required to enhance its chance of survival in the wild; or

(c) affecting the species is incidental to the carrying out of the activity.

Incidental activities are activities that may inadvertently affect a species by the carrying out of the activity. Common examples include activities associated with industrial development; e.g., road construction, seismic work, and oil well reactivation.

Greater Sage-grouse Emergency Protection Order (EPO)

This EPO was promulgated in 2013 to protect Greater Sage-grouse (*Centrocercus urophasianus*) from an imminent threat of extirpation. The EPO lands are located in extreme southeastern Alberta and southwestern Saskatchewan on provincial crown land. The EPO confers restrictions on lands identified as critical habitat, and within the proximity of leks. The prohibitions relate to sensory and habitat disturbance. Any activities that would contravene these prohibitions would require an application for a SARA permit. (There are exclusions for specific agricultural operations.)

Efficiencies

There are opportunities to streamline the process in instances where a SARA permit may also require a permit under the Migratory Birds Convention Act (MBCA).

MBCA – If a SARA species is protected under MBCA, a person will require an MBCA Scientific Permit in addition to the SARA permit [e.g., for Loggerhead Shrike (*Lanius ludovicianus*), Canada Warbler (*Cardellina canadensis*)]. However, to reduce duplication of process, SARA permit requirements can be embedded into an MBCA Scientific Permit. Applicants are advised to contact the regional Migratory Bird permit officer on how to proceed [John Dunlop, Canadian Wildlife Service, Saskatoon, SK, john.dunlop@canada.ca].

BANDING – ECCC's Bird Banding Office issues MBCA banding permits to enable the use of federal bands and to monitor species. When banding a SARA species that is protected under MBCA, the Banding Office will add SARA criteria to make the banding permit SARA compliant.

INCIDENTAL TAKE – SARA enables permitting for incidental take/harm activities, but MBCA does not currently have provisions for this. Therefore, a SARA permit cannot be issued for any incidental activities that would be in contravention of MBCA.

European Buckthorn – You Might Already Have It

Renny W. Grilz and Eryn Tomlinson

Meewasin Valley Authority; Email: rgrilz@meewasin.com

Abstract – The relatively unknown invader, European Buckthorn (*Rhamnus cathartica*), was brought into Saskatoon in the 1930s to explore its potential use as a shelterbelt tree. Since then, this tree has rapidly expanded to every corner of the city and along the South Saskatchewan River valley. European Buckthorn is prevalent in riparian forests with preferred niches of Green Ash (*Fraxinus pennsylvanica*), Manitoba Maple (*Acer negundo*), and Aspen (*Populus tremuloides*). In upland sites, it is found in Aspen, Chokecherry (*Prunus virginiana*), and Saskatoon (*Amelanchier alnifolia*) patches and in shelterbelts of other non-native species such as Caragana (*Caragana arborescens*). It is found in urban parks, natural areas, and in backyards within Saskatoon and the surrounding area. European Buckthorn grows best on fertile, sunny, moist and disturbed sites. Seeds typically fall from parent trees forming dense, even-aged stands which crowd and shade out native understory plants. Seed dispersal is aided by rodents and birds. The species has had a significant impact on the diversity of plant communities and wildlife habitats within the South Saskatchewan River valley. Since 1998, Meewasin, in cooperation with the City of Saskatoon, has controlled nearly 1.5 million stems of this provincially designated noxious weed.

Ornamentals Gone Wild – New Invaders in the South Saskatchewan River Valley

Renny W. Grilz and Eryn Tomlinson

Meewasin Valley Authority; Email: rgrilz@meewasin.com

Abstract – As humans encroach on native prairie and natural areas, there is an increase in the number of occurrences of new ornamental species escaping yards. These species can outcompete the native species and have the potential to become serious invaders. Throughout the South Saskatchewan River valley in Saskatoon, Meewasin manages various protected areas. Meewasin's Resource Management staff has encountered many new and unique invaders. Some, like Common Tansy (*Tanacetum vulgare*) and Baby's Breath (*Gypsophila paniculata*), have escaped yards decades ago and are now on the provincial noxious weeds list. Others, such as Asparagus (*Asparagus officinalis*), Bouncing Bet (*Saponaria officinalis*), and Himalayan Balsam (*Impatiens glandulifera*), are alarmingly widespread with not much data alerting us to its invasive nature. Further, there are new occurrences of naturalizing ornamental plants that may not be on the radar. Education is the key to prevention in the case of these early invaders. By mapping these occurrences and watching for trends, we can alert homeowners and resource managers to what might be the next big invader.

Prescribed Burning: Just What the (Range) Doctor Ordered

Renny W. Grilz and Eryn Tomlinson

Meewasin Valley Authority; Email: rgrilz@meewasin.com

Abstract – Native prairie evolved with natural disturbance regimes of grazing and wildfires, with fire created by both by lightning and from Indigenous peoples (either intentional or escaped). These disturbances allowed the land to regenerate and biodiversity to increase as the landscape moves through its successional phases. Many native species have adapted and evolved with these regimes as they reduce competition, increase available sunlight, disperse species, and trigger germination. With the agricultural and urban settlement of the prairies, grassland wildfires have largely been suppressed. Fear and a lack of understanding of the important role fire plays in prairie ecosystems has led to the near-removal of fire as a natural disturbance.

Prescribed burning has been recognized by resource managers as a tool in landscape management. Meewasin has been using prescribed burning for over 30 years as part of an integrated resource management program on their conservation sites within and around the City of Saskatoon. Prescribed burning is used to accomplish a variety of objectives, including: regenerate native plant growth, reduce vegetation litter, reduce shrubby and woody growth, manage invasive species, increase biodiversity, and enhance wildlife habitat, including grassland bird habitat.

Meewasin Valley-wide Resource Management Plan

Renny W. Grilz and Eryn Tomlinson

Meewasin Valley Authority; Email: rgrilz@meewasin.com

Abstract – In 2015, Meewasin received funding from Environment and Climate Change Canada through the Habitat Stewardship Program to develop a Meewasin Valley-wide Resource Management Plan. Meewasin partnered with the Nature Conservancy of Canada – Saskatchewan Region (NCC-SK), who was simultaneously developing a plan for the same region, to use their method of regional conservation planning called Open Standards for the Practice of Conservation.

As part of the planning process, Meewasin and NCC-SK worked with over 60 stakeholders to identify the conservation targets for the region and evaluate the threats to these targets. Viability assessments for each conservation target were conducted to evaluate the target's health. The four conservation targets identified were native prairie, wetlands, hydro-riparian areas, and post-channel glacial scars (swales). The greatest threat to these conservation targets identified in the Saskatoon region was invasive species.

A 10-year resource management plan was developed from the planning process results, with specific actions identified to mitigate the threats to each conservation target. The model used for the development of this landscape-scale management plan can be used to develop site-specific management plans.

Climate Adaptation of Biodiversity Conservation Strategies for Manitoba's Tall-grass Prairie

Cary D. Hamel[1] and Phil Gerla[2]

[1] Nature Conservancy of Canada – Manitoba Region; Email: Cary.Hamel@natureconservancy.ca
[2] Department of Geology & Geological Engineering, University of North Dakota

Abstract – The Nature Conservancy of Canada (NCC) manages >9,700 ha in the Vita region of southeastern Manitoba. These lands are characterized by nationally significant tall-grass prairie and savanna, wet meadow, forest, swamps, and rivers, and support globally imperiled species such as Western Prairie Fringed-orchid (*Platanthera praeclara*) and Poweshiek Skipperling (*Oarisma poweshiek*). Several conservation management techniques are used to promote the maintenance of a diversity of habitats and successional stages, as well as the rare and endangered species these habitats support. Activities are guided by a landscape-scale conservation plan designed to elucidate a set of effective conservation actions to achieve long-term maintenance of biodiversity. This plan recognizes the linked socio-economic-environmental factors contributing to the long-term sustainability of natural areas and local human communities.

An adaptation process was undertaken to assess the potential long-term effectiveness of NCC's conservation plan in light of observed and projected climate change. This process included an analysis of recent changes to ecosystem viability and threats, the development of hypotheses of future ecosystem change, and a situation analysis that incorporated consideration of potential socio-economic trends. A suite of adapted or novel conservation activities was developed for consideration. Approaches adopted to date include:

- Redesigned grazing systems that anticipate increasingly wet conditions that are expected to result in degradation of grazed pastures and reduced agricultural returns.
- A pilot wetland restoration project to restore hydrological connectivity and enhance long-term resilience of expanding wetland systems while also maintaining agricultural access.
- Ongoing monitoring to ensure that modified approaches are effective and to allow continued adaptation as knowledge increases and conditions change.

Valley of Grass: Conservation Efforts in the Grasslands of the Souris River Valley

Lacy Kontzie

Manitoba Habitat Heritage Corporation; Email: lkontzie@mhhc.mb.ca

Also presented in Session 10; see abstract on page 98.

Where are Ord's Kangaroo Rat Populations in Saskatchewan and are They Still Connected?

Jessus Karst

Saskatchewan Conservation Data Centre; Email: jessus.karst@gov.sk.ca

Abstract – Ord's Kangaroo Rats (*Dipodomys ordii*, OKRA) are federally listed as Endangered and their range falls within the sand hills of Alberta and Saskatchewan. As of recently, the Saskatchewan Conservation Data Centre (SKCDC) had no observation data for OKRA outside of the Great and Burstall Sand Hills.

The SKCDC surveyed seven sand hill complexes surrounding the Great Sand Hills during the summer of 2017 and observed OKRA at five of the sand hills surveyed. Within these seven complexes, there were 50 active or semi-active dunes surveyed with 31 having OKRA or OKRA sign. After 2017 surveys, we added 78 new OKRA observations for the SKCDC.

These new OKRA locations led to questions regarding connectivity between the Saskatchewan populations. The average dispersal of a juvenile OKRA is <500 m and the longest recorded distance travelled for an OKRA is 3.2 km; however, the average distance between recent observations from complex to complex is 31.4 km. Current (2018) research undertaken by the SKCDC involved DNA analysis to examine connectivity between all Saskatchewan OKRA populations. This information will help identify possible isolated populations and identify dispersal corridors or stepping stones when combined with a product identifying potential OKRA habitat in the province.

Restoration Assessment of Cultivated Fields Reseeded to Perennial Grasses at Last Mountain Lake National Wildlife Area

Joseph Kotlar

Canadian Wildlife Service, Environment and Climate Change Canada; Email: joseph.kotlar@canada.ca

Abstract – Last Mountain Lake National Wildlife Area permits a variety of agricultural activities, such as grazing, haying, and crop production, to benefit migratory bird, species at risk, and wildlife habitat. Last Mountain Lake's lure crop program was designed to reduce damage to crops in areas particularly susceptible to damage from foraging birds during fall migration. Changes in agricultural practices over time have reduced the effectiveness of the lure crop program and it was phased out between 2006 and 2012. Returning these cultivated lands to perennial grasses to benefit wildlife, including migratory birds and species at risk, was a priority for several years.

Revegetation of native and tame perennial grass took place on 11 different sites totalling over 1000 acres. Restoration Assessment protocols were deployed to monitor establishment, succession, and potential management issues of these sites. The Restoration Assessment scores categories of bare ground, erosion, litter accumulation, community structure and similarity, plants and weeds per 0.25 m^2, to create an overall score. The results categorized one of the 9 sites as being low and 8 of 9 of the sites were rated as normal. None of the sites were in the high category. The Restoration Assessment has identified supplemental seeding, weed management, and time as the three most pertinent management concerns for the majority of these revegetated lands.

Big Valley MAPS: NCC-SK's First Bird Banding Station

Sarah Ludlow and Ryan Dudragne

Nature Conservancy of Canada – Saskatchewan Region; Email: Sarah.Ludlow@natureconservancy.ca

Abstract – Monitoring Avian Productivity and Survivorship (MAPS) is a continent-wide collaborative program that monitors demographic parameters of birds during the breeding season. The MAPS program uses bird-banding techniques to capture birds, and information related to each bird's age, sex, body condition, and reproductive status are recorded. Data produced from the MAPS program are robust, long-term, and wide-ranging and are therefore suited for answering large-scale questions regarding avian demographics and population trends. At the local scale, MAPS data can be used to inform management of the site.

In 2018, the Nature Conservancy of Canada – Saskatchewan Region (NCC-SK) established a MAPS station on their Big Valley property, which is located in the Qu'Appelle Valley. The Big Valley MAPS station has 8 nets set up in a circuitous route and successfully conducted six sessions from June 10 to August 8, 2018. Over the course of the season at Big Valley MAPS, there were 168 newly banded birds of 22 different species, and 38 recaptured birds of 8 different species. NCC-SK is committed to the continuation of this project and is looking forward to the 2019 season!

Public Pastures – Public Interest: A Vision for Multi-use, Publicly Owned Grasslands in Saskatchewan

Kristen Martin and **Joanne Havelock**

Public Pastures – Public Interest; Email address: public4pastures@gmail.com

Abstract – Much of Saskatchewan's remaining grasslands, both native and tame, exist as publicly owned lands, including community pastures and Crown lands. Privatizing these lands by selling them off is threatening biodiversity and habitat quality for species at risk and other wildlife, eliminating access for Indigenous groups and other stakeholders, and reducing grazing opportunities for producers. With the divestiture of the federal Prairie Farm Rehabilitation Administration (PFRA) pastures in 2012, the termination of the provincial Saskatchewan Pastures Program (announced in 2017), and the ongoing sale of Crown land parcels, Saskatchewan's publicly owned grasslands are at risk.

The Public Pastures – Public Interest (PPPI) group, formed in 2012, brings together urban and rural citizens who are concerned about public grasslands. With a vision for multi-use, publicly owned grassland spaces in Saskatchewan, PPPI continues to raise public awareness of Saskatchewan's grasslands, builds and maintains relationships with other stakeholder groups who have an interest in conserving public grasslands, and advocates for better government policies at all levels of government.

Insects and Spiders in the Fall Diet of Plains Sharp-tailed Grouse

Sejer Meyhoff, Scott Bazinet and Dan Johnson

Department of Geography and Environment, University of Lethbridge; Email: sejer.meyhoff@gmail.com

Abstract – Plains Sharp-tailed Grouse (*Tympanuchus phasianellus jamesi*) are known to subsist mostly on vegetation, supplemented by insects at certain times of the year. Knowledge of the species, phenology, and densities of insects available for capture could be important for growth and survival of grouse, with variability within seasons or year-to-year. We obtained crops from grouse harvested by licensed hunting in southern Alberta during October, and separated, identified, and determined the proportions and relative abundance of food types captured by grouse. The research is part of a two-year study of the relative importance of insects in the diet, combined with monitoring and forecasts of changes in the availability and abundance of grassland insects, and use of stable isotope analysis of feathers.

Results showed that certain types of vegetation were over-represented, and that grouse were quite adept at hunting for fescue-preferring grasshopper species like Dawson's Grasshopper (*Melanoplus dawsoni*) in the fall. Changes to climate, weather variability, and increasing pressure from agricultural development and insect pest control have profound effects on the distribution, abundance, and biodiversity of insect species on grassland landscapes. This study yields new local information regarding the role of certain insects, arachnids, and plant parts in the diet of Plains Sharp-tailed Grouse.

Raptor Nest Cameras – Engaging and Educating the Public about Species at Risk in Alberta

Adam Moltzahn

Alberta Conservation Association; Email: adam.moltzahn@ab-conservation.com

Abstract – Media outlets, both online and in print, are readily used to inform the public about species at risk, conservation projects, and species recovery efforts occurring across North America. However, conservation groups are beginning to use live cameras to showcase the secret lives of species at risk in order to bring awareness and to educate the public about those species at risk, and to help individuals feel connected to species they may never encounter in the wild. As part of a collaborative camera project, the Alberta Conservation Association (ACA) worked with local landowners to set up cellular trail cameras above two known Ferruginous Hawk (*Buteo regalis*) nests in southern Alberta to document nesting activity during the spring and summer of 2018. Higher-quality images, accompanied with anecdotal information, were posted on ACA's social media outlets and hawk camera webpage to highlight significant nesting events, and to educate the public on the provincially listed Endangered Ferruginous Hawk. Overall, the hawk camera webpage had over 4,000 visits and several photos were re-shared by users following ACA's Facebook and Twitter accounts in 2018. As this camera project progresses, we suspect that the general public will become more engaged and educated about species at risk in Alberta.

MULTISAR – Empowering Landowners to Conserve Habitat for Species at Risk: Applying Proven Strategies to Develop a Customized Management Plan for Producers in Southern Alberta

Lee Moltzahn and Mike Verhage

Alberta Conservation Association; Email: lee.moltzahn@ab-conservation.com

Abstract – MULTISAR is a multi-partner program that collaborates to conserve species at risk through voluntary habitat stewardship, while maintaining viable ranching operations in Alberta's native grasslands. Our primary partners are landholders, the Prairie Conservation Forum, Alberta Conservation Association, Alberta Environment and Parks, Cows and Fish, Canadian Cattlemen's Association, Canadian Roundtable for Sustainable Beef, and Alberta Beef Producers. Funding for MULTISAR is also provided by Environment and Climate Change Canada.

MULTISAR provides tools for landholders interested in conserving species at risk. A Habitat Conservation Strategy is a detailed, in-depth, and free customized ranch plan that balances healthy rangelands with quality wildlife habitat through grazing recommendations and habitat improvements. The process includes detailed wildlife surveys, range inventories, riparian health assessments, and information on current management practices and ranch history. Survey locations are based on Alberta's Grassland Vegetation Inventory and are situated proportionately throughout each vegetation type existing within a pasture.

The results of the surveys conducted by biologists, agrologists, and riparian specialists are analyzed and compared with landowner knowledge to create a management plan unique to the property. In consultation with the landowner, recommendations are made that allow them to maintain and/or enhance native grasslands and habitat that support species at risk.

Managing for Diversity on Manitoba Habitat Heritage Corporation Lands

Tom Moran and Kasie McLaughlin

Manitoba Habitat Heritage Corporation; Email: tmoran@mhhc.mb.ca

Also presented in Session 10; see abstract on page 98.

Habitat Restoration – Is It Worth It?

Maria Neumann and Scott Beaton

Manitoba Habitat Heritage Corporation; Email: mneumann@mhhc.mb.ca

Also presented in Session 4, see abstract on page 62.

Developing a Conservation Land Management Approach to Riddell's Goldenrod Recovery in Manitoba

Levi J. Newediuk[1], Cary D. Hamel[2] and Julie Pelc[2]

[1] Biology Department, Memorial University of Newfoundland; Email: j.newedi@gmail.com
[2] Nature Conservancy of Canada – Manitoba Region

Abstract – Riddell's Goldenrod (*Oligoneuron riddellii* or *Solidago riddellii*) is a Threatened prairie species in Manitoba. The species' tall-grass prairie habitat depends on frequent natural disturbance (e.g., fire) to maintain habitat openness, but the relationship between Riddell's Goldenrod recovery and the use of managed disturbances like haying and grazing is unclear. In 2017 we established a long-term monitoring program to follow Riddell's Goldenrod response to typical conservation land management activities in the Manitoba Tall Grass Prairie Preserve. We compared stem counts among plots at sites managed by grazing and haying to control sites to test whether management is related to plant density and abundance. Preliminary results suggest that grazing and haying may be compatible with maintaining Riddell's Goldenrod habitat.

Development of Two Scales of Pollinator Habitat Assessments to Support Conservation Decision-making

Marika Olynyk, Diana Wilton and Cary D. Hamel

Nature Conservancy of Canada – Manitoba Region; Email: marika.olynyk@natureconservancy.ca

Abstract – With recent declines in native pollinator communities, the Nature Conservancy of Canada – Manitoba Region has seen an increased need to plan and manage for pollinator conservation, particularly in prairie habitats, which support high pollinator diversity. Because insect pollinators are affected by both their local surrounding habitat and by processes on the larger landscape, two assessment approaches are under development: one for site-scale assessment of local habitat areas (10–40 hectares), and one for landscape-scale assessment of habitat fragmentation and connectivity (1 km radius). The objectives for these assessments are to: a) assess the current value and long-term sustainability of our conservation projects as pollinator habitat; b) identify land management and securement priorities for pollinator conservation; and c) monitor the effects of changes over time to guide adaptive management approaches. Site-scale assessments incorporate site features, pollinator foraging and larval habitat, and land management variables. Landscape-scale assessments incorporate patch size, habitat connectivity, and surrounding land-use variables. Assessment methods have been piloted, and next steps include comparison of results from the two scales of assessment to each other, and continued refinement of variable weights and data collection processes.

Ellis Bird Farm – A Success Story

Myrna Pearman

Ellis Bird Farm; Email: mpearman@ellisbirdfarm.ca

Also presented in Session 6; see abstract on page 75.

Saskatchewan Species at Risk Farm Program: Integrating Species at Risk Conservation and Agricultural Land Management

Heather Peat Hamm

Simply Agriculture Solutions Inc. (Simply Ag); Email: heather@simplyag.ca

Abstract – In 2015, Environment Canada initiated a project through Simply Ag to work with agricultural land managers toward conservation of species at risk (Species at Risk Partnerships on Agricultural Lands, or SARPAL). Simply Ag is a non-profit organization with a history of delivering agricultural programming while protecting the confidentiality of farmers. Simply Ag developed workbooks that included information on species at risk and a guide to evaluating the potential of farms for conserving these species. Workshops were held around the province in agricultural regions. The intent was to guide land managers to develop management plans that were concurrently beneficial or neutral to their farm and beneficial to species at risk – a hands-off approach to enable land managers to combine their expertise with the needs of the species to develop a formal plan for species at risk conservation on their farms. The response was good; 30 workshops were held around the province and 184 Approved Action Plans were developed by participants. The land base managed by the workshop participants is 550,000 acres. With approved Action Plans, farmers were able to apply for Stewardship Project funds. Forty-four Stewardship Projects were funded over the period that the program was fully functional.

Citizen and Government Collaboration Enable Saskatchewan's First Province-wide Breeding Ferruginous Hawk Survey

Beatriz Prieto, Jessus Karst, Andrea Benville, Ryan Fisher, Janet Ng and Jeff Keith

Saskatchewan Ministry of Environment; Email: beatriz.prietodiaz@gov.sk.ca

Abstract – The northern extent of distribution of Ferruginous Hawk (*Buteo regalis*) includes Saskatchewan, where its estimated range covers a good part of the southwestern portion of the Prairie Ecozone. The Saskatchewan Ministry of Environment, with funding from Environment and Climate Change Canada, designed and started a province-wide trend monitoring program for Ferruginous Hawk in 2018. Roadside surveys were conducted during spring of 2018 to locate Ferruginous Hawk nests with the help of an extensive network of volunteers that covered 40% of the study area. Conservation Officers and Ministry of Environment staff covered the remaining 60%, reaching all targeted regions and completing a total of 160 township-size blocks. ESRI Survey123 mobile app was used to collect data in the field and allowed us to follow progress live. A total of 282 nests were recorded, 128 of them occupied by Ferruginous Hawks. Results from the inventory will be used by Nature Saskatchewan to guide stewardship of this federally Threatened species in the province in the next two years.

The Value of an Integrative Approach to Understanding Wolf Ecology in Managed Landscapes

Christina M. Prokopenko[1], Katrien Kingdon[1], Sana Zabihi-Seissan[1], Daniel Dupont[2], Vanessa B. Harriman[3] and Eric Vander Wal[4]

[1] Department of Biology, Memorial University of Newfoundland; Email: cmprokopenko@mun.ca
[2] Wildlife and Fisheries Branch, Manitoba Sustainable Development
[3] Ducks Unlimited Canada
[4] Department of Biology and Cognitive Behavioural Ecology Program, Memorial University of Newfoundland

Abstract – Wolves are apex predators that provide stability to ecosystems across diverse contexts. However, they often experience direct and indirect human pressures. Two sister projects in Manitoba investigate the role of wolves in geographically distinct environments experiencing parallel pressures. Riding Mountain National Park is an insular protected landscape in southwestern Manitoba that supports abundant and diverse prey populations. The park is surrounded by human development and subject to a large-scale disease management program (1990s), corresponding with a dramatic reduction in primary prey, elk. In eastern Manitoba, a provincial management unit (GHA 26) experiences extensive resource extraction (forestry and hydroelectric transmission line development), leading to a network of linear features throughout the region. This primarily moose-dominated area experienced a significant population decline, prompting a 2010 hunting closure.

Wolves in both systems are supported by multiple prey, and demonstrate prey switching over spatio-temporal scales. Human introduction of environmental change can alter ecological stability by influencing movement and selection behaviour within predator-prey systems. By comparing and contrasting our observations, we can generalize ecological commonalities in wolf-prey systems. Wolf-prey systems represent an important trophic cascade, the effects of which are strongly mediated by human activity, with implications for ecosystem functioning and socioeconomic security.

Climate and Grazing Effects on Root Biomass in Manitoba, Saskatchewan, and Alberta Grasslands

Diego Steinaker[1], Scott Wilson[2], Bradley Pinno[3], Edward Bork[4], Shannon White[5] and James Cahill, Jr.[5]

[1] Saskatchewan Prairie Conservation Action Plan; Email: pcap@sasktel.net
[2] Department of Biology, University of Regina
[3] Department of Renewable Resources, University of Alberta
[4] Department of Agricultural, Food & Nutritional Sciences, University of Alberta
[5] Department of Biological Sciences, University of Alberta

Also presented in Session 12; see abstract on page 108.

The Saskatchewan Prairie Conservation Action Plan (SK-PCAP): Framework 2019–2023

Diego Steinaker[1], Orin Balas[1,2], Caitlin Mroz[1], Julie-Anne Howe[1], Carolyn Gaudet[1], Chad MacPherson[2], Mary Brick[3], Jordan Ignatiuk[4], Beatriz Prieto[5] and Heather Facette[6]

[1] Saskatchewan Prairie Conservation Action Plan; Email: pcap@sasktel.net
[2] Saskatchewan Stock Growers Association
[3] Saskatchewan Ministry of Agriculture
[4] Nature Saskatchewan
[5] Saskatchewan Ministry of Environment
[6] Grasslands National Park, Parks Canada Agency

Abstract – The Saskatchewan Prairie Conservation Action Plan (SK-PCAP) Partnership brings together organizations representing producers, industry, provincial and federal governments, NGOs, and research and educational institutions to speak with one voice and work under a common vision for prairie conservation. SK-PCAP partners believe that it is both possible and desirable for groups with diverse interests to find mutually agreeable solutions to the challenges of prairie conservation. Building upon 20 years of collective experience, the Partnership developed a new Framework for the next five years. The 2019–2023 Framework combines efforts into three focus areas: 1) Education and awareness, 2) Responsible land use, and 3) Ecosystem management. The three focus areas are aimed to deliver innovative and critical prairie conservation activities that consider and integrate ecological, socio-cultural, and economic interests.

The SK-PCAP sees prairie as a working landscape that can include people and their livelihoods as a positive part of the ecosystem. SK-PCAP partners also recognize that prairie ecosystems and associated species have intrinsic value, beyond any human use. The new Framework finally aims to engage people in learning about and experiencing the prairie as a means to promote conservation. People who understand prairie learn to value prairie, and people who value prairie will work to conserve it.

Species at Risk Conservation and Protection in the Prairies: Crowdsourcing Data on Conservation Actions by Partners

A.F. Joy Stevens

Canadian Wildlife Service – Prairie Region, Environment and Climate Change Canada;
Email: joy.stevens@canada.ca

Abstract – When species are listed as Extirpated, Endangered, or Threatened under the federal *Species at Risk Act* (SARA), a recovery strategy or action plan must be developed, in which critical habitat must be identified to the extent possible. The prairie grasslands of Alberta, Saskatchewan and Manitoba are home to approximately 30 species for which critical habitat has been identified in a finalized recovery strategy or action plan under SARA. An overview of the main provisions within SARA that pertain to protection of species at risk will be presented. Recent publications on the SARA registry will be provided and summarized to provide context for implementation of critical habitat protection in the Prairies.

Author's Note – This poster was presented as a backgrounder to initiate interactive communication with conference attendees regarding a potential evergreen database of conservation actions currently being taken in the Prairie Provinces that provide protection-related outcomes for species at risk and their habitat. The text that follows is an edited version of the poster material. Please feel free to contact the author for more information.

Species at Risk

A total of 120 species are listed on Schedule 1 of the *Species at Risk Act* (SARA) in the Prairie Provinces as of February 2019. Of these, 43 have *critical habitat*, which is the habitat that is necessary for the survival or recovery of a listed wildlife species, and that is identified in a recovery strategy or action plan. The numbers by province are:

- Alberta – 81 species listed; 27 with critical habitat
- Saskatchewan – 80 species listed; 20 with critical habitat
- Manitoba – 73 species listed; 18 with critical habitat

Legislative Context: The *Species at Risk Act*

Protection for individuals and residences of species listed as Extirpated, Endangered, or Threatened is enabled under s.32 and s.33 of SARA. Prohibitions apply immediately upon listing to a) aquatic species; b) migratory birds protected under the *Migratory Birds Convention Act, 1994*, wherever they are found in Canada; and c) all other Extirpated, Endangered, or Threatened species on federal lands or on lands that are in a territory and that are under the authority of the Minister of the Environment or the Minister responsible for the Parks Canada Agency.

Under SARA, the provinces and territories are provided with the first opportunity to protect other listed species that are not aquatic or migratory birds on provincial, territorial, and private land. However, the Minister may recommend to the Governor in Council that an order be made

to apply the prohibitions. To date, the Government of Canada has not made any such orders under SARA.

Emergency orders can be made for the protection of a listed wildlife species under s.80. The competent minister must recommend an emergency order to the Governor in Council if he or she is of the opinion that a listed wildlife species faces imminent threats to its survival or recovery. The final decision on whether or not to issue the emergency order rests with the Governor in Council. Socio-economic considerations are also taken into account when making the decision.

Protection of critical habitat under SARA depends on the type of species and the location of the critical habitat. SARA s.58(1) and 61(1) make it an offence to destroy critical habitat. However, these prohibitions do not automatically apply when critical habitat is identified.

On federal land, s.58 requires that critical habitat of all listed species be legally protected within six months after it is identified in a finalized SARA recovery strategy or action plan, using a gazette statement on federal protected areas (e.g., national parks, national wildlife areas), or a ministerial order or other legal provisions on other federal land.

For terrestrial species on non-federal land, provincial laws may provide protection for critical habitat. Alternatively, an order under s.61(2) may be applied to portions of critical habitat specified by the Governor in Council, upon the recommendation of the Minister. To date, the Government of Canada has not made any such orders under SARA.

The Pan-Canadian Approach

The "Pan-Canadian Approach to transforming Species at Risk conservation in Canada" was approved by federal, provincial, and territorial ministers in June 2018. This reaffirms the commitment to the *Accord for the Protection of Species at Risk* and the complementary *National Framework*. Collaborative work on shared priorities will be guided by agreed-upon principles and common criteria to support a transformative approach to operationalize species at risk conservation. Principles include (but are not limited to):

- Multi-species and ecosystem-based approaches: Develop and implement multi-species, ecosystem-based and/or threat-based initiatives that collectively maximize the ability to protect and recover species at risk.
- Shared leadership: Recognizing and using the many federal, provincial, and territorial tools that can be used to advance conservation and protection outcomes, with emphasis on a "stewardship-first" approach.
- Improved monitoring and reporting: More robust and comprehensive assessments of progress regionally and nationally.

Priority places, species, sectors, and threats were identified using common criteria and considerations.

Tracking and Reporting

Implementation of the Pan-Canadian Approach requires a robust tracking and reporting framework of conservation actions for species at risk, migratory birds, and other species and their habitats. This can be achieved using an adaptive management process, such as the *Open Standards for the Practice of Conservation*.[2] As well, a database of conservation actions being taken in the Prairie Provinces that provide positive outcomes for wildlife and their habitat could be used for tracking and reporting, in alignment with the Pan-Canadian Approach.

For more information, please see the Government of Canada Species at Risk website: https://www.canada.ca/en/services/environment/wildlife-plants-species/species-risk.html

[1] Available online: https://www.canada.ca/en/services/environment/wildlife-plants-species/species-risk/pan-canadian-approach.html

[2] Open Standards website: https://cmp-openstandards.org/

Invasive Weed Management in the Native Prairie Landscape in Southwestern Saskatchewan

Melanie Toppi, Jamie and Marie Hansen, Stacy and Yvonne Smith

South of the Divide Conservation Action Program Inc.; Email: aegp@sodcap.com

Abstract – Invasive weeds are a threat in many areas of the country, including southwestern Saskatchewan. More than half of the area in southwestern Saskatchewan is native prairie, which is an important area for species at risk and for agriculture. South of the Divide Conservation Action Program (SODCAP) Inc. is actively working with agriculture producers to protect and maintain this important ecosystem. One program currently in progress is to manage the invasive species Leafy Spurge (*Euphorbia esula*). Management methods include chemical application, target grazing with small ruminants, and biological control (insects). By managing leafy spurge and decreasing the invasions, the native prairie will be enhanced and the amount of forage for livestock will increase. Areas being managed will be monitored via biomass, stem density, and observing plant height. This will determine both the vigor of the plants, and indicate the effectiveness of the various methods of management.

Restoration of Sagebrush Grassland for Greater Sage-grouse Habitat in Grasslands National Park

Autumn Watkinson[1], M. Anne Naeth[1] and Shelley Pruss[2]

[1] Department of Renewable Resources, University of Alberta; Email: autumnly@ualberta.ca
[2] Natural Resources Conservation Branch, Parks Canada Agency

Abstract – Sagebrush is a necessary component of Greater Sage-grouse (*Centrocercus urophasianus*) habitat. Loss of sagebrush has led to the decline of grouse populations and subsequent species at risk designation. Canada's Species at Risk Act Recovery Strategy for Greater Sage-grouse suggests low-quality habitat could support positive population growth if it is enhanced or restored. However, little research has been conducted on Silver Sagebrush (*Artemisia cana*) restoration, and conventional restoration methods such as broadcast seeding and out-planting container-stock seedlings have limited success. Our research objective is to develop restoration methods to improve establishment, growth, and survival of seeded or transplanted sagebrush to increase size and improve quality of sagebrush habitat. This will facilitate recovery of grouse populations and other species at risk.

To achieve cover targets and restore sagebrush habitat, a better understanding of sagebrush population ecology is required. Field surveys of naturally occurring, healthy sagebrush stands and individual plants in Grasslands National Park were used to develop a predictive model. This model can be used to inform practitioners when, where, and how many individuals to plant or seed to achieve desired outcomes within specific time frames. Nutrient loading is being investigated as a way to improve survival of container-grown seedlings. To improve seeding outcomes, seed preparation methods were investigated. Research results will contribute to our scientific understanding of sagebrush ecology to advance restoration and enhancement techniques for native prairie grassland habitats in Grasslands National Park and elsewhere in North America.

Alberta Environmental Farm Plan Species at Risk Tool

François Blouin[1], **Paul Watson**[2], Robin Bloom[3], Jeff Harder[2], John Wilmshurst[4] and David Johns[5]

[1] Private Consultant
[2] Alberta Environmental Farm Plan, Agricultural Research and Extension Council of Alberta;
Email: efp@areca.ab.ca
[3] Canadian Wildlife Service, Environment and Climate Change Canada
[4] ProofreadCanada
[5] Alberta Environment and Parks

Also presented in Session 13; see paper on page 112.

Last Mountain Bird Observatory

Lacey Weekes

Nature Saskatchewan; Email: lweekes@naturesask.ca

Abstract – The oldest bird sanctuary in North America, Last Mountain Lake National Wildlife Area and Migratory Bird Sanctuary was founded in 1887. It was first recognized as an important waterfowl breeding ground, and later for its importance as a migratory stopover for waterfowl and other groups of birds, including Sandhill Cranes (*Antigone canadensis*) and Whooping Cranes (*Grus americana*), shorebirds, birds of prey, and land birds. Birds travelling through at least 40 different countries, from Siberia and Arctic Canada south to Chile and Argentina, use the area's varied habitats to rest and feed.

Last Mountain Bird Observatory (LMBO) was established in 1989. It is part of the Canadian Migration Monitoring Network and, together with other observatories, keeps track of the numbers of land birds migrating between their breeding grounds in the boreal forests of Alaska and Canada and their wintering grounds from the southern US to central South America. Since 1989 over 90,000 birds of 120 species have been banded at LMBO. Data gathered from these birds have been used to answer a number of important questions about land bird migration through LMBO and the prairies. Once captured in mist nets, each bird is tagged with a uniquely numbered aluminum band on its leg, and then aged, measured, fat content determined, and weighed before it is released.

Annual Dispersal of Endangered Burrowing Owls: The Effects on Survival Estimates in a Migratory Population

Morganne Wall[1], Erin Bayne[1] and Troy Wellicome[2]

[1] Department of Biological Sciences, University of Alberta; Email: mwall1@ualberta.ca
[2] Canadian Wildlife Service, Environment and Climate Change Canada

Abstract – The migratory population of Burrowing Owl (*Athene cunicularia*) in Canada has undergone significant population declines over the past three decades. To understand population changes for long-distance migrants, including endangered species, reliable estimates are needed for reproduction and survival, as well as immigration and emigration. For the endangered Burrowing Owl population in Canada, annual survival estimates are currently obtained using band-return data, where survival is calculated according to those individuals re-sighted each year, with minor corrections to account for a few known missing sightings. However, such survival estimates do not differentiate emigration from mortality; any individuals that disperse outside of the study area are considered dead using this approach.

By considering dispersal and associated permanent emigration we can gain a more accurate apparent survival for the long-distant migratory population of Burrowing Owls within Canada. Previous methods attempting to correct for permanent emigration have neglected to use spatial information on banding and re-sighting locations within study areas, in concert with statistical functions created from observed dispersal events. Emigration out of local study sites in southern Alberta and Saskatchewan, where owls are detected, should reveal that apparent survival estimates are lower due to low site-fidelity exhibited by migratory Burrowing Owls. Using these proposed estimates of emigration out of study areas, we can then correct survival estimates in local populations of owls within Canada.

Pronghorn Xing: Citizen Scientists Help Conserve the Fastest Animal in Canada

Megan Jensen[1], **Danah Duke**[1], Paul Jones[2] and Andrew Jakes[3]

[1] Miistakis Institute; Email: danah@rockies.ca
[2] Alberta Conservation Association
[3] National Wildlife Federation

Abstract – In the Northern Sagebrush Steppe, pronghorn (*Antilocapra americana*) undertake daily and seasonal migratory movements to meet life requirements. Across this region, highways fragment the landscape and cause direct morality and/or disrupt movement patterns. Pronghorn Xing is a citizen-science program developed to ground truth seasonal migratory pinch-points identified by connectivity modeling across highways in the Northern Sagebrush Steppe, and increase public engagement in pronghorn science and conservation. Information on wildlife sightings collected by the public will enable us to better understand where pronghorn and other wildlife are commonly crossing, involved in collisions, or moving adjacent to the highway. Ultimately this will lead to development of informed strategies to reduce wildlife vehicle collisions while ensuring the safe passage of wildlife across highways. The generated information will be shared with government officials in Alberta, Saskatchewan, and Montana. Recently, this successful program has been brought to northern Montana and is being used by local high-school science classes as a long-term monitoring project. Our hope is to engage as many local communities as possible. We share preliminary findings to show the utility of the program.

Join the Dark Night: Nocturnal Preserves

Laura Griffin and Maureen Luchsinger

Ann and Sandy Cross Conservation Area; Email: lgriffin@crossconservation.org

Abstract – This presentation is a short film, "Join the Dark Night: Nocturnal Preserves". The film was created with funding from the 2016 PCESC Young Professional Stewardship Grant to provide teachers with a resource material about light pollution and its environmental impacts, particularly in prairie ecosystems. The film was designed to highlight the collaboration between several organizations in the community to engage the public in our dark skies advocacy, including the Royal Astronomical Society of Canada, Rothney Astrophysical Observatory (University of Calgary), Municipal District of Foothills, and the Cochrane Ecological Institute.

The Ann & Sandy Cross Conservation Area, just southwest of Calgary, Alberta, became Canada's first Nocturnal Preserve in 2015, as recognized by the Royal Astronomical Society of Canada. This film shares what a Nocturnal Preserve is, the ecological roles it plays, and the impacts it can have on the community in which it is located.

It is our hope that by sharing this film, more people will become aware of light pollution and become inspired to incorporate light-efficient practices into their ecosystem management approaches. It is a success story of organizations coming together to create a new dark-sky designation that is a key component of a comprehensive national strategy to preserve and protect the natural nocturnal environment.

The Manitoba Trails Project: Connecting Manitobans to Nature through Recreation and Technology

Jordan Becker

Manitoba Trails Project; Email: manitobatrailsproject@gmail.com

Abstract – With some of the most scenic and accessible hiking trails across the prairies, Manitobans have the opportunity to learn about the natural history of our province and explore true wilderness right off their doorstep. The Manitoba Trails Project aims to gather information about all of the province's recreational trails in one place, and to showcase that information in a way that makes trail discovery easier than ever before.

The project begun in 2016 and was born out of a desire to have easily accessible information readily available for trail enthusiasts and amateurs alike. Initial funding for the project was provided in part by a Young Professional Stewardship Grant at the 2016 Prairie Conservation and Endangered Species Conference. Since 2016, the project has identified 250 trailheads, over 100 of which have been mapped, and has connected Manitobans to trail information by sharing photos, news, and trail information over social media and other outlets. The project embraces the idea of open data and encourages the public to get involved. Trail information is collected by, and made freely available to, all of Manitoba's residents and visitors.

Long-distance Migration of Burrowing Owls across Western North America

Troy I. Wellicome[1,2], Courtney J. Conway[3,4], David H. Johnson[4], Julie L. Conley[5], David R.W. Bruinsma[1], Carl G. Lundblad[4], Sharilyn M. Westworth[1] and Ryan J. Fisher[6]

[1] Canadian Wildlife Service, Environment and Climate Change Canada; Email: troy.wellicome@canada.ca
[2] Department of Biological Sciences, University of Alberta
[3] US Geological Survey
[4] Department of Fish and Wildlife Sciences, University of Idaho
[5] US Fish & Wildlife Service
[6] Saskatchewan Ministry of Environment

Abstract – Identifying causes of declines in long-distance migrants is hampered by a lack of knowledge of migratory routes, destinations, and annual dispersal. We documented migration patterns of Burrowing Owls (*Athene cunicularia*) throughout their range in North America. From 2009–2014, we deployed light-level geolocators on 367 adult owls, breeding in 8 states and 3 provinces in the US and Canada. We obtained winter site locations from 51 of these owls recaptured in subsequent years. From 2013–2017, we also deployed solar-powered satellite transmitters on 78 adult owls, in 9 states and 3 provinces, from which we obtained data for 34 complete southward migrations to winter sites. Owls breeding in BC, Washington, or Oregon wintered in the US, with most females migrating to California and most males wintering in Washington. In contrast, owls breeding in the interior states or provinces wintered almost exclusively in Mexico. Most owls that bred on the Great Plains remained east of the Rocky Mountains and funnelled through western Texas when migrating southward. Our results demonstrate that Mexico and California are important wintering areas for Burrowing Owls. Conservation efforts to halt population declines and recover owl populations need to consider mitigation of threats in those regions.

Swollen Proventriculus in Male Bumble Bees May Add Another Piece to the Pathogen Puzzle

Kirsten Palmier[1,2], Andrew D.S. Cameron[1] and Cory S. Sheffield[2]

[1] Department of Biology, University of Regina; email: kir.palmier@gmail.com
[2] Royal Saskatchewan Museum

Native bumble bees (*Bombus* spp.) are proficient pollinators of many agricultural and natural landscapes. However, in recent years bumble bee populations have experienced dramatic global declines, including in Canada. The closely related Yellow-banded Bumble Bee (*Bombus terricola*) and Western Bumble Bee (*B. occidentalis*) have both experienced dramatic population declines and reductions in their respective ranges in Canada. The exact causes of these declines are still unknown, but are likely due to a combination of stressors that includes pathogens. Our current knowledge of bee pathogens is limited as evidenced by the fact that newly recognized pathogens are still being identified.

Field-caught specimens were dissected and screened for various pathogens, parasites, and additional abnormalities within the gut. During the initial dissections, it was noted that some male specimens of *B. terricola* and *B. occidentalis* exhibited an enlarged proventriculus. Microscopy and polymerase chain reactions have confirmed that these structures contained an unknown fungal proliferation. Here we present the first observations of this "mystery yeast" in both of these bumble bee species at risk. Whether the presence and/or imbalance of this yeast is a contributing factor to their declines is still unknown; however, it is one more piece of the pathogen puzzle worth exploring.

Transboundary Grasslands Partnership

Sasha Herriott[1], Linda Cerney[2], **Kevin Ellison**[3] and Diego Steinaker[4]

[1] Prairie Conservation Forum
[2] Alberta Environment and Parks
[3] World Wildlife Fund – US; Email: kevin.ellison@wwfus.org
[4] Saskatchewan Prairie Conservation Action Plan

Wildlife, watersheds, conservation planning, and outreach on grasslands do not need to be interrupted by political borders. The Transboundary Grasslands Partnership formed in 2016 as a forum for coordination on grasslands conservation among organizations and individuals from Alberta, Saskatchewan, Montana, and several First Nations who work within the Milk River Watershed. The watershed covers an area of 61,642 km^2, with the Milk River originating in Montana, flowing through Alberta and Saskatchewan, back into Montana and the Missouri River. Approximately 6,500 km^2 (11%) of the watershed lies in Alberta, 14,942 km^2 (24%) in Saskatchewan, and the remainder (65%) in Montana. The area in the provinces is a part of the Mississippi River watershed that extends into Canada. It supports the northernmost distribution of over 15 species of concern, across several taxa.

Participants range from cattle producers, conservation and watershed NGOs, agency staff, academics, First Nations, and industry consultants. This new group has held four annual meetings that move among each of the provinces/state. Here we describe the focal geography, partners, and types of projects that coordination has developed around, as well as planned steps forward.

AUTHOR INDEX