Conservation of Rare Reptiles and Amphibians: Should We Conserve Isolated Populations?

Pamela Rutherford
Department of Biology, Brandon University

Abstract – Many species at risk occur in small, disjunct populations and this is certainly true for prairie reptiles and amphibians. From a conservation perspective, geographically peripheral populations may not be of concern if they are only listed because they occur in separate jurisdictions but the species' range is widespread. In contrast, if they are genetically or morphologically unique populations, they may have considerable conservation value. I discuss the conservation of rare amphibians and reptiles in this context, and consider the strengths and weaknesses of focusing conservation efforts on isolated populations.

Celebrating the Journey Home: The Reintroduction of Black-footed Ferrets in Canada

Bill Bristol
Agriculture and Agri-Food Canada

Joanne Tuckwell
Parks Canada

Abstract – After 5 years of planning, the Black-footed Ferret has returned home to Grasslands National Park in southwest Saskatchewan. The last confirmed sighting of a ferret in Canada was in the early 1900s, and ferrets were thought to be extinct until a small population was discovered in Wyoming. That discovery prompted the start of a captive breeding program that has produced over 6000 kits and contributes to the reintroduction program in the U.S., Mexico and now Canada. Seven zoos across the U.S. and Canada breed ferrets that are all sent to a pre-conditioning facility in Colorado before being reintroduced. This pre-conditioning facility is run by the U.S. Fish and Wildlife Service and is a part of the Species Survival Program. The maintenance of whatever genetic diversity is left in this population is a high priority for the program in order to minimize inbreeding depression and maximize the success at each reintroduction site. The successes or failures of each reintroduction site are shared across North America through the Black-footed Ferret Reintroduction Implementation Team. The Canadian reintroduction and the yearly monitoring that is planned for this population will provide valuable information for the species at the northern extent of its range where the environmental conditions and the prey populations differ from the reintroduction sites at the central and southern parts of its range. Through research partnerships we hope to maximize our learning, regardless of the final outcome.

Is it Time for a Paradigm Shift in Prairie Rare Plant Conservation?

Nancy P. Sather
Minnesota Department of Natural Resources

Abstract – Protection priorities and management and recovery practices in conservation biology change not only because of advances in scientific knowledge, but in response to public perception, politics and prevailing paradigms. Because public, government and donor acceptance of emerging practices is so hard won, once they have gained acceptance, prevailing paradigms tend to overshadow potentially useful approaches that do not fit the mold. The paradigm I question is our increasing reliance on standardized databases and statutory protection for rare plants, coupled with the shift of emphasis in protection and management to multi-partner, large landscape projects intended to address the needs of multiple species. I suggest a renewed emphasis on species-specific recovery for rare plants based on species autecology, habitat needs, and population genetics. To best accomplish the protection of the rarest of the rare, we may need to reconsider reliance on statutory regulation and *in situ* protection.

All opinions expressed in this paper are my own and do not reflect the position or policies of the Minnesota Department of Natural Resources or the Prairie Bush Clover and Western Prairie Fringed Orchid Recovery Teams.

We wouldn't be here today if we didn't ascribe to Aldo Leopold's simple mandate: "To keep every cog and wheel is the first precaution of intelligent tinkering." But how? And where? Since the emergence of the conservation ethic, we have come a long way. Conservation of rare species is an integral part of a much wider range of efforts than it was when I first entered the practice in 1979. Nonetheless, some of our greatest successes may today be a double-edged sword.

Our present state and provincial data centers are an outgrowth of The Nature Conservancy's Natural Heritage methodology, which at birth had the mission of saving "the last of the least and the best of the rest." Increasingly, as on-the-ground protection has moved toward large landscapes (the best of the rest), we have relied on listing and statutory protection to conserve the last of the least. In the world of rare plant protection, I believe this reliance is counter-productive in some cases.

Many jurisdictions use and rely on the standardized procedures of BIOTICS, the NatureServe occurrence and life history database used by most Natural Heritage programs, state surveys and Conservation Data Centers. Data entered into individual program databases is often subject to range-wide standardized procedures.

Listing generally takes into account only those occurrences within a given jurisdiction. With the exception of Canada's *Species at Risk Act* (SARA) and the United States' *Endangered Species Act* (ESA), most listing occurs at the state and provincial level based on locally-determined criteria. Often the number of documented occurrences outweighs life history traits or present and potential threats.

Inconsistent criteria across jurisdictions result in discrepancies in legal protection, often leaving the 'mother lode' of a species unprotected. Because documented occurrences outweigh threat in some listing jurisdictions, this apparent security could be compromised by simple changes in land use. An example is Cooper's Milkvetch (*Astragalus neglectus*), a widespread but usually rare legume whose range extends from Virginia to Saskatchewan. Globally-ranked G4, the species is listed as apparently secure in Minnesota, but at some level of risk in all other jurisdictions where it occurs (NatureServe 2010). Although the species is apparently responsive to disturbance or lack of competition, its tolerance of herbicides is unknown. A simple change in right-of-way management in Minnesota from mowing to herbicide application could jeopardize the species (Schultz 2003).

The patchwork of listing criteria, statutes and permits resulting from the trends listed above hampers range-wide research and recovery efforts. This situation is exacerbated when a species' North American range straddles international boundaries. Attempts to conduct range-wide research or integrate recovery planning are generally modest efforts with few players. Here, plant conservationists could take a lesson from bird and mammal biologists, who have developed transnational working groups large and strong enough to more successfully overcome hobbling bureaucracies.

Listed plant species are generally subject to statutory protection. In some jurisdictions, significant staff and monetary resources are spent in environmental review and permitting for populations whose long-term viability may be in question.

Over the past decade and a half, protection efforts have shifted from small isolated habitats for selected rare species to multi-partner, large-landscape projects and corridors intended to protect multiple habitats and species. Although these areas provide greater opportunity to restore pre-settlement ecological functions, increasing reliance on large landscape portfolios could place narrowly endemic plants and habitat specialists at risk. Examples are plants of cliffs, rock outcrops, talus slopes, alvar, and calcareous seepage fens. These species are among the rarest of the rare (Rabinowitz 1981).

We need to augment the increasing interest in molecular genetics with a renewed emphasis on species autecology. Only by coupling an understanding of intra- and inter-population genetic variability with an understanding of the nuances of species' life history and phenological triggers will we be positioned to access which species are likely to be most resilient and which are at greatest risk. The relationship between life history traits and genetics is not always as dichotomous as the literature suggests (Hamrick et al. 1979, Cole 2003). For example, Prairie Bush Clover (*Lespedeza leptostachya*) is a midwestern prairie legume that may once have been widespread in mesic prairies. It is a perennial, primarily-selfed species with high fecundity (Sather 1986, 1988a) but low genetic diversity (Cole 1989). Observers throughout the range have anecdotally reported strong recruitment in response to decreased competition and successful responses to intentional and accidental introductions. This appears to be a species that, if released from the prohibitory restrictions of statutory protection, might best be recovered by incorporation into traditional prairie restoration seed mixes, thus moving it incrementally into areas beyond its present range.

Reintroduction of birds and mammals has long been an accepted form of species conservation, but conservation programs within state and provincial governments have emphasized *in situ* conservation of rare plant species by protecting their habitats. Reliance on *in situ* protection, coupled with limited resources for regular monitoring and life history studies, is exacerbated by the standardized data management criteria that are slow to respond to the extirpation of populations whose habitat persists. For both animals and plants, the paradigm of the late 20th century has been to reintroduce (if at all) only into areas believed to be part of the species' range prior to European settlement (IUCN 1987, 1995). The rate of climate change challenges the paradigm.

As it becomes increasingly apparent that some species will not be able to migrate rapidly enough to meet the combined forces of climate change, habitat loss and competition with exotic species, our hard-won conservation practices may not be enough to prevent loss for some species. The Western Prairie Fringed-orchid (*Platanthera praeclara*) may be an example of such a species. Listed as endangered in Canada and threatened in the United States, this tall grass prairie orchid is enigmatically declining from south to north. Apparently dependent on wet prairie or subsurface groundwater (Hof et al. 2002, USFWS 2009) and specialized Sphingid pollinators (USFWS 2009), the species' genetics are known from only a handful of populations (Sharma 2002), not including the population in southern Manitoba (the largest and apparently most viable in the range). Analyses based on observations at Pipestone National Monument in southwestern Minnesota suggest that flowering is highly dependent on the timing of precipitation in the species' phenological cycle (Willson et al. 2006). The species is declining in the southern end of its range but holding its own in Canada (USFWS 2009). Despite strong communication between researchers and conservation programs in the two countries, formal recovery of the species follows the guidelines of two independent recovery plans (Davis 1995, Environment Canada 2006, USFWS 1996), with no formal transnational group to coordinate addressing the increasing risk to the species from climate change.

Whereas Natural Heritage Programs and Conservation Data Centres tend to apply the precautionary principle suggested by a recent analysis of the success of rare plant reintroductions (Godefroid et al. 2011), botanical gardens have long been more comfortable with manipulating species and are leading the way toward a new paradigm. Unlike near-provenance moves associated with mitigation for site-specific efforts, assisted migration addresses global patterns of change. Assisted migration is characterized as "the purposeful movement of species to facilitate or mimic natural range expansion as a direct management response to climate change" (Vitt et al. 2010). At the present time, assisted migration of plants is a new concept engendering strong disagreement within the conservation community (Hoegh-Guldberg et al. 2008, McLachlan 2007, Schwartz et al. 2009). The purposive nature of such moves is based on a stepwise decision-making process for determining eligibility for restorations and assisted migration (Vitt et al. 2009). Application of species distribution modelling such as MaxEnt to present distributions enables modellers to determine which populations are outside the future climate envelope. Together with unprotected populations and those at the edge of the range, these populations become sources for potential assisted migration. GIS-based habitat matching protocols can then be used to inform migration strategy (Vitt et al. 2009, 2010). A pilot application of this process for *P. praeclara* (Vitt et al. 2009) suggests shifts in the species' climate envelope that will move it onto the unsuitable substrate of the Canadian Shield. This appears to be a species that, without accelerated understanding of range-wide genetics and proactive planning across international boundaries, may be at risk of losing a considerable component of its genetic variability at range edges.

Every model is only as good as the information that goes into it. The MaxEnt model for *P. praeclara* is a case in point, as it does not incorporate the species' substrate preferences, ranges of pollinators, or phenological triggers. For many species, this information is not even available. At the present time, although molecular genetic studies are popular, field-based autecology is not. The long-at-odds *in situ* and *ex situ* plant conservation communities need to join forces with academic researchers and citizen scientists to collect and use the genetic, autecological and phenological data required for the tinkering we will need to do to keep all of our cogs and wheels. To do so, we will need greater cross-jurisdictional collaboration than is possible with our present infrastructure for listing and recovery.

Literature Cited

Cole, C. 1989. Isozyme and mitochondrial DNA variation in *Lespedeza capitata* and *L. leptostachya* (Fabaceae). Ph.D. dissertation, University of Minnesota. Minneapolis, MN.

Cole, C.T. 2003. Genetic variation in rare and common plants. *Annual Review of Ecology, Evolution, and Systematics* 34: 213–237.

Davis, S.K. 1995. National recovery plan for the western prairie fringed-orchid, *Platanthera praeclara*. Endangered Plants and Invertebrates in Canada Program, Canadian Nature Federation, Ottawa, ON.

Environment Canada. 2006. Recovery strategy for the western prairie fringed-orchid (*Platanthera praeclara*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa, ON.

Godefroid, S., C. Piazza, G. Rossi, S. Buord, A.-D. Stevens, R. Aguraiuja, C. Cowell, C.W. Weekley, G. Vogg, J.M. Iriondo, I. Johnson, B. Dixon, D. Gordon, S. Magnanon, B. Valentin, K. Bjureke, R. Koopman, M. Vicens, M. Virevaire and T. Vanderborght. 2011. How successful are plant species reintroductions? *Biological Conservation* 144: 672-682.

Hamrick, J.L., Y.B. Linhart and J.B. Mitton. 1979. Relationship between life history parameters and allozyme variation in plants. *Annual Review of Ecology, Evolution, and Systematics* 10: 173-200.

Hof, J., C.H. Sieg, and M. Bevers. 2002. Topography-based dispersal: habitat location for the western prairie fringed orchid. Pages 125-141 *in* J. Hof and M. Bevers (eds.), Spatial Optimization in Ecological Applications. Columbia University Press, New York, NY.

Hoegh-Guldberg, O., L. Hughes, S. McIntyre, D.B. Lindenmayer, C. Parmesan, H.P. Possingham and C.D. Thomas. 2008. Assisted colonization and rapid climate change. *Science* 321: 345-346.

McLachlan, J.S., J.J. Hellman and M.W. Schwartz. 2007. A framework for debate of assisted migration in an era of climate change. *Conservation Biology* 21: 297-302.

IUCN. 1987. International Union for the Conservation of Nature Position Statement on Translocation of Living Organisms. Species Survival Commission, Commission on Ecology and Commission on Environmental Policy, Law and Administration, Gland, Switzerland.

IUCN. 1995. Guidelines for re-introduction. Species Survival Commission, International Union for the Conservation of Nature, Gland, Switzerland.

NatureServe. 2010. NatureServe Explorer: An online encyclopedia of life (web application). Version 7.1. NatureServe, Arlington, VA. http://www.natureserve.org/explorer. Accessed February 22, 2010.

Rabinowitz, D. 1981. Seven forms of rarity. Pages 205-217 *in* H. Synge (ed.), The Biological Aspects of Rarity. John Wiley & Sons, New York, NY.

Sather, N.P. 1986. Studies of *Lespedeza leptostachya* at Red Rock Prairie, Minnesota. A report on research conducted under the Small Grants Program of the Minnesota Chapter of The Nature Conservancy, Minneapolis, MN.

Sather, N.P. 1988a. Studies of *Lespedeza leptostachya* at Red Rock Prairie, Minnesota. A report on research conducted under the Small Grants Program of the Minnesota Chapter of The Nature Conservancy, Minneapolis, MN.

Schultz, J. 2003. Conservation Assessment for Cooper's Milkvetch (*Astragalus neglectus*) (T&G) E. Sheld. US Forest Service Eastern Region, Milwaukee, WI. http://www.fs.fed.us/r9/wildlife/tes/ca-overview/docs/plant_Astragalus_neglectus-Coopers_Milkvetch.pdf

Schwartz, M.W., J.J. Hellman and J.S. McLachlan. 2009. The precautionary principle in managed relocation is misguided advice. *Trends in Ecology and the Evolution* 24: 474-475.

Sharma, J. 2002. Mycobionts, germination, and conservation genetics of federally threatened *Platanthera praeclara* (Orchidaceae). Ph.D. Dissertation, University of Missouri, Columbia, MO.

U.S. Fish and Wildlife Service (USFWS). 1996. *Platanthera praeclara* (Western Prairie Fringed Orchid) recovery plan. U.S. Fish and Wildlife Service, Fort Snelling, CO.

U.S. Fish and Wildlife Service (USFWS). 2009. Western Prairie Fringed Orchid Five year review: Summary and Evaluation. U. S. Fish and Wildlife Service, Twin Cities Field Office, Bloomington, MN.

Vitt, P., K Havens and O. Hoegh-Guldberg. 2009. Assisted migration: part of an integrated conservation strategy. *Trends in Ecology and Evolution* 24: 473-474.

Vitt, P., K. Havens, A.T. Kramer, D. Solleberger and E. Yates. 2010. Assisted migration of plants: Changes in latitudes, changes in attitudes. *Biological Conservation* 143: 18-27.

Willson, G.D., M.J. Page and F.A. Akyuz. 2006. Precipitation and fire effects on flowering of a rare prairie orchid. *Great Plains Research* 16: 37-43.

WORKSHOP 6 – CHANGING RELATIONSHIPS

Moderators: Julie Sveinson Pelc, *Nature Conservancy of Canada – Manitoba Region*
Mike Quigley, *City of Winnipeg*

Workshop Summary

Relationships between society and the natural environment are always changing, with Canada's prairie population increasingly living in urban centres. Although past and current generations may have had genuine experiences with the natural environment, future generations will likely experience a greater degree of removal from direct association with the land. Despite some of these trends, much is being done to conserve prairie habitat through increased public engagement, awareness and appreciation of native prairie ecosystems.

In this workshop, the speakers presented their views on social trends in prairie conservation. A major theme was evident: the assertion that the social realm is as important as the biological. Stéphane McLachlan (page 104) argued that approaches to wilderness often view human exclusion from protected areas as a preferred management approach. Rather, he suggested that conservation strategies must include human use and input from communities and neighbourhoods into the management of protected areas and the environment.

Expanding on this perspective, Ryan Brook (page 114) argued that the scientific community often fails to effectively communicate its results to the general public. This communication gap can raise barriers to research, as members of the public and local community may not understand the rationale behind the research or may not trust the motives of the researchers. To help alleviate this problem, he suggested that scientists need to do a better job at involving the community in their projects.

In their presentation, Marilyn Latta and Gene Fortney (page 105) gave examples of how the Manitoba Tall Grass Prairie Preserve benefited from partnerships and community support. In particular, they highlighted the importance of community involvement in, and awareness of, the Preserve in helping to engender greater political support. They also outlined the power of partnerships in protecting and acquiring habitat, as well as enabling ongoing research on the preserve.

Focussing on the younger generation, Natalie Swayze, Deanna Kazina and Rob Apatagon (page 109) discussed their approach to providing environmental learning to urban youth in a natural setting. The Bridging the Gap program incorporates indigenous cultural ideas and the concept of respect – for the earth, animals and humans. Students learn about the natural world by visiting two high quality natural areas located within the City of Winnipeg. In addition to its focus on habitats and ecosystem interactions, the program teaches that humans are part of the natural world, not separate from it.

People, Place, and Posterity: From a Dichotomous Past to a Collaborative Future

Stéphane McLachlan
Clayton H. Riddell Faculty of Environment, Earth, and Resources, University of Manitoba

Abstract – Tall grass prairie is at the brink of extirpation in Manitoba. Family farms and rural communities are in extreme crisis. Diverse green spaces and neighbourhoods are being displaced by parking lots, high-rises and McMansions. In response, wilderness-defined approaches to conservation continue to view human presence as inherently negative and instead affirm the importance of limiting, if not excluding, human use in protected areas and other high-value natural habitat. While the potential co-existence of conservation and development is still actively debated in the Global South, what about the compatibility between conservation and sustainable livelihoods in a northern prairie context? And what is the role of research, and more generally universities, in responding to these challenges? Conventional biological research does little to address these questions and, as I argue, actually accelerates the environmental race to the bottom. Protected areas that exclude the livelihoods of resource-generating families and communities, whether related to farming, hunting, fishing or logging, are a signpost to the past, a past that has failed the environment and one that ensures that this decline will continue.

In contrast, those of us working in the Environmental Conservation Lab at the University of Manitoba affirm the mutual dependence of environment and humanity, and thus the importance of directly involving those very same communities and neighbourhoods in the priority setting and management of protected areas and environment. This is especially important for marginalized segments of society, whether they be the Indigenous, the rural, or the urban poor. Yet the input of these lived experts is still denied by most governments and scientists in Canada.

I present a number of case studies that highlight alternative and trans-disciplinary approaches to conservation-related research that begin by bridging the social and biological and by linking scientific and lived expertise. The first case study, based on work with Paul Mutch and Jacqui Kotyk, shows the biological and socio-political outcomes of long-term urban tall grass prairie restoration in Winnipeg. The second case study, based on work with Melisa Yestrau, shows the crucial role that holistic management plays in growing both cattle and tall grass prairie in rural landscapes. The third case study, based on work with Brad Kennedy and Dave Vasey, shows how farmer knowledge can be used to assess the implications of, and to manage, invasive species. I conclude that it is only by rejecting human-natural dichotomies and by affirming the mutual dependence of nature and sustainable livelihoods that we will be able to address the environmental crises that already threaten the futures of our great-grandchildren.

Manitoba Tall Grass Prairie Preserve: The Evolution of a Partnership

Marilyn Latta
Nature Manitoba

Gene Fortney
Nature Conservancy of Canada – Manitoba Region

Abstract – Partnerships are essential both for attracting funding for new projects and for advancing them through the various growth stages. The Manitoba Tall Grass Prairie Preserve is an example of how partnerships can be used to initiate, grow and maintain a project. The search for tall grass prairie, initiated in 1987 by the Manitoba Naturalists Society (now Nature Manitoba), culminated in a proposal to establish a 1000 hectare tall grass prairie preserve in the Rural Municipality of Stuartburn in south-eastern Manitoba. Establishment of the Preserve became one of the goals of the newly established Critical Wildlife Habitat Program in 1989 and, twenty years after the first piece of land was purchased for the Preserve, it has grown to over 5000 hectares. The Nature Conservancy owns most of the properties while others are owned by Nature Manitoba, Manitoba Habitat Heritage Corporation or are provincial Wildlife Management Areas. Stewardship of these lands today is maintained by a Management Committee, working under a Memorandum of Understanding. A variety of government and non-government partners, as well as the general public and the local community, have played roles at various times in establishing, growing and managing the Preserve. This presentation explores how some of these relationships evolved, the changing needs of the project, and the difficulties and successes that have been a part of the process.

A map of North America shows tall grass prairie on the east side of the central plains stretching from northern Texas to Southern Manitoba. It is characterized by relatively high rainfall and is found on rich, dark soils. The dominant grass species are Big Bluestem (*Andropogon gerardi*), Indian Grass (*Sorghastrum nutans*), Switch Grass (*Panicum virgatum*) and Porcupine Grass (*Stipa spartea*), and there are a high diversity of forbs.

In 1987 and 1988, the Manitoba Naturalists Society (now Nature Manitoba) carried out a systematic inventory of tall grass prairie in Manitoba. Program funding was provided by World Wildlife Fund (WWF), Wildlife Habitat Canada (WHC) and job training grants, with logistical support from Manitoba Natural Resources (now Manitoba Conservation). A brochure and film were developed to increase awareness about this endangered ecosystem.

Nearly 3400 potential sites were visited and of those, only 88 sites totalling 2008 ha were considered to contain good-quality tall grass prairie. In the primary study area (the historical range of the tall grass prairie), there were 22 sites totalling 102 ha, with an average size of 5 ha. The peripheral area provided 44 sites totalling 1906 ha, with an average size of 29 ha. Although not all potential sites were investigated, it was safe to say that only a fraction of 1% of Manitoba's tall grass prairie still remained. The final report of the project recommended that a 1000 ha tall grass prairie preserve be established in the peripheral area in the Rural Municipality (RM) of Stuartburn.

In 1989 the Critical Wildlife Habitat Program (CWHP), a new five-year cooperative initiative with a focus on wildlife habitat in agro-Manitoba, was established. Initial program partners were Manitoba Conservation, Manitoba Habitat Heritage Corporation (MHHC), Nature Manitoba, WWF and WHC, with the Nature Conservancy of Canada (NCC) and the Canadian Wildlife Service (CWS) joining the program in 1993 and 1994, respectively. CWHP assumed administration of the Tall Grass Prairie Conservation Project and adopted the goal of establishing the Preserve.

To help raise additional funds for acquisition, Nature Manitoba embarked on a new fund-raising initiative called the Prairie Patrons Program. Participants donated $50 to "buy" one acre of tall grass prairie, and Nature Manitoba committed to finding matching funding. It was an outstanding success. Individuals, schools, church groups and businesses all helped and in less than a year, $25,000 had been raised. A matching grant of $25,000 from Manitoba Natural Resources' Special Conservation Fund allowed Nature Manitoba to take title to their first 130 ha prairie. A new certificate for Prairie Patrons was produced featuring the Western Prairie Fringed-orchid (*Platanthera praeclara*), an endangered species whose only Canadian location is within the vicinity of the Preserve, and another $25,000 was raised. This time, Nature Manitoba entered into a partnership with NCC to provide funding and, using another grant of $25,000 from the Special Conservation Fund, was able to purchase four additional prairies to bring its total holdings to 356 ha. The importance of involving the general public in the growth of the preserve cannot be understated. Public awareness and interest in the Preserve generated considerable political good will and support.

Other properties that were purchased through CWHP became the property of the MHHC or were donated by the RM of Stuartburn to become a Wildlife Management Area. By the end of the five-year agreement, the goal of 1000 ha had been realized and the Manitoba Tall Grass Prairie Preserve had become a reality. Once NCC joined the program, they took over acquisitions for the Preserve and have steadily increased the Preserve holdings to over 5000 ha today (Fig. 1). Table 1 shows the land ownership as of May 2009; it has continued to grow since then.

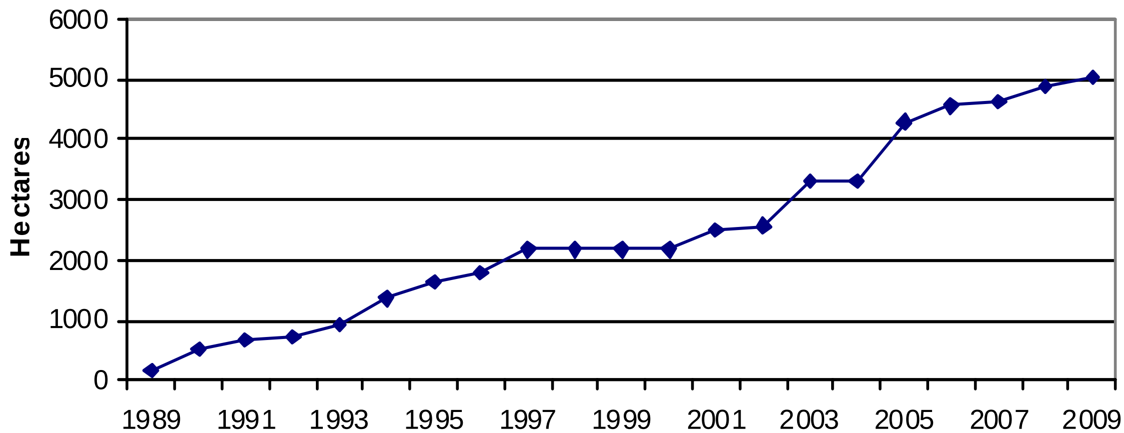


Figure 1. Preserve growth over time (courtesy of C. Borkowsky).

Table 1. Preserve Land Ownership (May 2009)

Manitoba Habitat Heritage Corporation	390 ha
Manitoba Conservation WMA	325 ha
Nature Manitoba	358 ha
Nature Conservancy of Canada	3515 ha

WWF and WHC gradually withdrew their participation as NCC and CWS became more involved in the project. Today, activities in the Preserve are overseen by a management committee comprised of the five remaining program partners and a Local Advisory Committee. The Management Committee operates under a Memorandum of Understanding that is renewed every five years. The main objectives of this committee are to ensure the long-term protection of the Preserve, develop a comprehensive management strategy, and arrange for funding for all activities. Another objective is to find a legal designation that would protect the area in the long term. Although Preserve properties have been included in Manitoba's Protected Areas Initiative, there is still no legal mechanism allowing this objective to be met.

Another area in which partnerships have played a role is in research activities at the Preserve. Preserve staff carry out baseline inventories and actively monitor management regimes, but expertise from universities has been required to determine whether differences observed are actually statistically significant. As well, the Universities of Manitoba and Winnipeg and others have shown an interest in doing research at the Preserve or incorporating the Preserve as part of their study area. The abundance of species at risk at the Preserve has also promoted interest as well as funding opportunities. The Preserve is home to three federally and/or provincially listed endangered species: Western Prairie Fringed Orchid, Small White Lady's-slipper (*Cypripedium candidum*) and Great Plains Ladies'-tresses (*Spiranthes magnicamporum*). Six threatened species of flora and fauna also occur here: Culver's Root (*Veronicastrum virginicum*), Riddell's Goldenrod (*Solidago riddellii*), Western Silvery Aster (*Symphyotrichum sericeum*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Dakota Skipperling (*Hesperia dacotae*) and Powesheik Skipperling (*Oarisma powesheik*), as well as several species of concern.

Educating the public about the Preserve and tall grass prairie in general led to the production of a brochure about the Preserve and to the development of education programs. Nature Manitoba developed a curriculum-based school program in 1998 that provides free classroom presentations and optional field trips. NCC has expanded on this program and has worked to secure funding to cover the transportation costs for schools to visit the preserve.

The Prairie and the People

It was 1896 when the Ukrainian pioneers first settled the area in southeastern Manitoba known today as the Stuartburn Municipality. These people were farmers, and had travelled to Canada to avoid political persecution in their homeland. They were looking for a peaceful place to continue their traditional lifestyle. They observed many large fields of thick grass (indicating rich soils and good pasture for cattle) with rich forests that could be used for building materials for their homes.

The Homestead Act required the pioneers to begin development of the acreages granted to them soon after their arrival to Canada. They began the process of breaking the land and converting it to something considered usable. Formidable challenges greeted them as they encountered swamps and fields of ‘sleeping sheep’ (large boulders), and each year they were expected to expand their cultivated acreages. The homeland of these pioneers contained richer soils and had a better climate while these new lands had severe limitations for agriculture. The soils had formed from glacial deposits and poorly sorted glacial till was evident everywhere. These new Canadians adopted a pastoral lifestyle once they determined the limitations of their new properties.

The grassland community that the pioneers had settled on was indeed tall grass prairie, which in this modern world is very rare and has a very high value as a natural resource. In 1992 the Nature Conservancy of Canada accepted a much larger role with the hiring of a Land Manager responsible for leading both land securement and stewardship on the preserve.

Haying (forage harvest) and grazing was the most common form of land use within the local community, resulting from over 100 years of land use by the pioneers and their descendants. Once the land was broken, the capability for agriculture increased and the land could be used for cultivated crops or as good hayland. The hayland would be either a mixture of introduced and native species or only native species. Otherwise, if the land was stony and contained many wetlands along with woody species, it would be fenced and used as pasture. The type of grazing was nearly always season-long. These types of land uses became part of the local farm culture.

Tall grass prairie is a warm-season grassland community with growth typically beginning in late May or early June. It produces seed in July and is most vulnerable to over-grazing prior to the three-leaf stage. Research conducted by North Dakota State University had determined that the most effective way to graze this type of native grassland was by using a twice-over grazing system. This system promoted grazing during the three-leaf to flowering stage, and then again following the flowering stage. The management of the Tall Grass Prairie Preserve adopted the twice-over grazing system, even though the season-long system familiar to the local community was simpler and easier to manage. Both grazing systems required hay to be harvested and processed for winter use. The twice-over grazing system required that the pastures be divided into paddocks and the cattle rotated through each paddock on a predetermined schedule. A partnership was struck between the Stuartburn Piney Agricultural Development Association, Manitoba Agriculture, Food and Rural Initiatives, and the Preserve partnership. The grazing project was launched and was monitored both for cattle weight gain and to determine the impact of grazing on prairie health. This partnership became the first joint initiative between the Preserve partnership and the local community.

The grazing project ran for approximately eight years. The cattle appeared to maintain a significant weight gain but the prairie health declined. The cattle producers had difficulty understanding the benefits of the system when measured against the amount of effort needed for its maintenance. Input from monitoring resulted in a refinement of the system, and more effort is made each year to refine the grazing system as well as the monitoring process. More effort is needed to promote the resource, the value of the native grasslands, and the concept that it is worth the additional effort to ensure the survival of the rare native prairie.

The grazing project partnership, along with the establishment of the Local Advisory Committee, facilitated the development of better public understanding of the how’s and why’s of managing tall grass prairie. Woody encroachment can result from lack of fire, over-grazing or removal of traditional haying practices. Woody encroachment is also one of the largest threats to the survival of this native grassland. Prairie managers use a variety of methods to combat this invasive process. Local methods for managing this challenge were enhanced with this additional knowledge.

Prairie managers across the Great Plains use prescribed fire to control invasion by woody species and introduced grass species, and for the general enhancement of native grasslands that have evolved with fire. Since settlement, the local community has viewed fire as a damaging, undesirable disturbance that could result in the destruction of property, loss of human life, as well as kill livestock. Adopting managed burns as a legitimate management tool proved to be a hurdle that the local community had to overcome. Public forums were held to inform the public about preferred prairie management strategies. The annual Prairie Day event was developed to encourage public visitation to the Preserve, as well as to provide a venue where visitors could ask questions about the development of management strategies. This venue allows management to showcase the resource and to legitimize accepted land management practices. The establishment of local partnerships with community members or groups is essential to maintaining the link that allows information to flow from preserve management to the community.

The land securement process began in the late 1980s on a project-by-project basis, with land purchases completed by Nature Manitoba and the provincial government. At the time, the local community was amused to see an organization from outside their community purchase what they considered to be waste land. Securement increased over the years as additional prairie sites became available. The local community did support fee-simple purchase, as most of the lands purchased were idle and were needed to consolidate the holdings.

Competition for these lands was virtually non-existent until the economy changed and large corporations showed interested in purchasing large blocks of land in the area on which to construct facilities for the hog industry. Land was needed to spread the liquid waste accumulated in these large barns, and land quality seemed irrelevant. The local community had mixed feelings about this new initiative and began to scrutinize land securement for the preserve as well as for the hog industry. Eventually, the world market for the products of the hog industry diminished. Support for the work and advancement of the tall grass prairie project returned.

The Local Advisory Committee was pivotal in the establishment of the first ecotourism venture on the preserve, the Prairie Shore trail east of Tolstoi. The Committee received provincial grant funding to complete a walking trail over a mile in length. This trail would be the only focus for many public activities on the preserve for many years until the Nature Conservancy of Canada completed the Agassiz Trail on Provincial Road 201. Both of these facilities play an essential role in allowing the public to experience and enjoy the preserve. As the work and research on the preserve continues to grow, the demand for more educational facilities increases. Education programs for school-aged children were discovered to be especially successful.

Over the years the funding support for the tall grass project has evolved from predominantly local support to international support and interest. NCC led the partnership in the development of a comprehensive planning process. This process, called Ecoregional/Natural Areas Conservation Planning, includes land stewardship goals as well as securement goals. These plans validate the on-the-ground processes and are required for successful partnerships with larger funding agencies.

If one were to summarize the reasons the Manitoba Tall Grass Prairie Preserve has been a success, one of the key reasons would be that all of the partners have been committed to the same goal. However, flexibility in the partnership has allowed partners to meet their own needs as well as those of the Preserve. There has been a continuity of core partners, while at the same time partnerships continue to evolve to meet the changing needs of the Preserve. As well, different partners can access different types of funding. Encouraging the public to become part of the process makes the Preserve more relevant to society and engenders political good will. Involvement of the local community is an essential but often difficult process, due to the differing needs and values in the community.

As a closing note, the continuity of the seasonal staff at the Tall Grass Prairie Preserve has been a huge benefit. Laura Reeves (botanist), Christie Borkowsky (biologist), and land manager John Tkachuk are an extremely loyal and dedicated team and the enthusiasm and continuity they bring to the Preserve are priceless.

Engaging Indigenous Urban Youth in Environmental Learning: The Importance of Place Revisited

Natalie Swayze
Faculty of Education, University of Manitoba

Abstract – Bridging The Gap (BTG) is an innovative environmental learning program based in Winnipeg, Manitoba, providing free full-day field trips and follow-up programs for Grade Four students from the Inner City District of the Winnipeg School Division. Students visit two of Winnipeg's largest, high-quality natural areas, Assiniboine Forest and Living Prairie Museum. Students engage in curriculum-based, hands-on learning activities and participate in relevant initiatives that show respect for, and gratitude and appreciation of, Manitoba's natural environment. BTG's programming incorporates indigenous cultural ideas into program content. A key element of the program is the concept of respect – for the earth, for the animals and for each other.

Note – *The presentation at the conference also included contributions from Deanna Kuzina and Rob Apatagon.*

Introduction

Life is full of choices. Yet sometimes the most influential aspects of our lives are those that we don't choose. Our families, our ethnicity, the places where we grow up – these reflect the critical "unchoices" in our lives. As an environmental educator, researcher, and human, I am becoming increasingly aware of the impacts these "unchoices" have on me, and the children that I teach and learn with. With this awareness comes a sense of responsibility and a commitment to carefully decide how I develop my environmental learning[1] programs.

Coupled with a growing sense of an "impending environmental crisis" comes a recognition of the human role in contributing to it. Indeed, this sense of crisis has historically been a powerful impetus for environmental learning. Transforming behaviours and relationships with the environment, and ultimately developing individual and community capacity to actively engage in environmental stewardship, is generally regarded as environmental learning's ultimate goal (Hungerford and Volk 1990, Tilbury 1995). However, there are various mechanisms, strategies and techniques employed in environmental learning to achieve this goal.

As an environmental educator, I am determined to think carefully about the choices I make when developing programs, as I become critically aware of the various influences that impact my decision-making process. Non-formal environmental learning programs targeting school-age children frequently seek to meet curriculum standards from formal education, thereby becoming accountable within a larger educational system. When striving to meet these curriculum outcomes and fit within other national and/or international mandates, I must ask: How relevant are these standards within a local context, and to my specific place[2]?

As the field of environmental learning evolves and our societies become increasingly diverse and complex, I am mindful that all education is political and inherently value laden. All rational thought in today's post-colonial contexts requires questioning of context, values and relativeness (Willinsky 1998). In order to adequately accommodate a multiplicity of views, one must consider that "curricula are created by people within temporal, political, cultural, economic, and cultural contexts," (Ornstein and Hunkins 2004: 62), with models and techniques "filtered through a political or social lens, especially race, class, and gender" (91). These complex issues must be considered when seeking to teach and plan in inclusive ways. What is worth knowing in environmental learning and who should be involved in deciding this? Whose views are most important? Are we prepared to be critical of national and/or international mandates, or even challenge them? Would it be more beneficial to instead develop teaching and learning strategies that are contextualized at a local level, relevant within a specific place and its unique social, environmental and economic contexts? This paper will explore these issues while describing my pedagogical decision-

[1] Although various opinions exist regarding nomenclature, my view and the use here of the term "environmental learning" is inclusive of "environmental education," "education for sustainable development," "education for sustainability," and other relevant terms.

[2] The term "place" is used here with a view that place embodies multiple dimensions, including spatial, geographical/political, and temporal.

making process in developing and delivering a program for urban Indigenous youth called Bridging the Gap (BTG).

The Context – Situating the BTG Program

BTG initially began in 2004 as an innovative, informal environmental learning program based in Winnipeg, Manitoba. The city lies at the confluence of the Assiniboine and Red Rivers, a historic focal point of routes travelled by Aboriginal peoples. The rivers provided transportation for trade and knowledge sharing, and linked many Aboriginal peoples. The general area surrounding Winnipeg was populated for thousands of years by Aboriginal peoples who would use the area for camps, hunting, fishing, and trading. Winnipeg is located within the prairies of western Canada, in a native tall grass prairie ecosystem. At one time, tall grass prairie covered one million square kilometres in central North America, and in Manitoba alone, it covered one and a half million acres. Today, tall grass prairie is all but gone. In Manitoba, only 1/20th of 1% of the original tall grass prairie remains.

I developed BTG while employed with the City of Winnipeg's Naturalist Services Branch. The Naturalist Services Branch has been actively involved in developing and delivering curriculum-aligned, environmental learning programs for youth in urban contexts, playing a key role in promoting awareness of the cultural and ecological benefits of Winnipeg's natural areas and encouraging stewardship of natural habitats within an urban setting. Native habitats within the city including wetlands, aspen parkland forest, and endangered tall grass prairie are now permanently protected from development through policy measures. Resident indigenous plant and animal communities are now preserved as an integral component of Winnipeg's ecological and cultural heritage.

However, like many large cities, the majority of Winnipeg's high-quality natural areas are located in the suburbs, and few natural areas are found in the downtown area. As a result, for students in inner-city neighbourhoods, there are inherently fewer opportunities to visit and explore high-quality urban natural areas. Along with this, an over-representation of low wages, poverty and family instability commonly persist in inner-city neighbourhoods. BTG was designed to attempt to address these issues. The program was created to provide free programs for Grade Four students from the inner city of Winnipeg. As part of a full-day field trip, children visit high-quality urban natural areas, spending time in guided explorations, facilitated discussions, hands-on activities and data collection. When BTG began, it originally had an ecology-based focus and was designed to address learning outcomes from Manitoba's Science curriculum. The program has since evolved to reflect some of its place-specific attributes.

Using an action research methodology**,** the program focus is now being continuously modified to reflect three key considerations: 1) the fastest growing segment of the province's population is Aboriginal; 2) Winnipeg is home to the largest urban Aboriginal population in the country (Hanselmann 2001, Mays 2005); and 3) the highest percentage of Winnipeg's population of Aboriginal youth lives in and attends school in the core area of the city (the inner-city) (Statistics Canada 2003). For the group of learners participating in BTG, over fifty percent are of Aboriginal descent (Métis, First Nations or Inuit).

There is a close fit between the program's goals and traditional Indigenous cultural values, identified as concepts at the heart of sustainability, and a need to rekindle traditional cultural values of sustainable living for this urban, largely Indigenous population, affected by historical issues related to colonialism (disruption of culture and loss of connection to land) (Aikenhead 2000, Cajete 1999). In exploring ways to respectfully include traditional Indigenous cultural perspectives within the BTG program, the ongoing challenge has been to ensure that attempts to do this meaningfully support learning while respectfully reflecting the local cultural traditions, languages, beliefs and perspectives. What initially began as token attempts to include traditional Aboriginal cultural ideas has since become a more holistic approach to making the program culturally relevant. What is hoped is that the decisions I have made to date, and those that are yet to come, will continue to reflect and be relevant to the specific place that I inhabit along with the children and others taking part in the BTG program.

Theoretical Framework – A Critical Pedagogy of Place in an Urban Indigenous Context

David Gruenewald's "critical pedagogy of place" (2003) (hereafter referred to as CPP) provided the theoretical framework to engage in a process of critical reflection about my pedagogical decision-making process when including Indigenous knowledge in BTG. A CPP was selected as a framework with particular relevance to BTG in relation to the potential influences while revising the original program. From my perspective, a CPP not only provides an ideal structure to improve my understanding of this program and my pedagogical decision-making process, it also expanded my views on how placed-based education can be applied, and the role of critical, place-based approaches within broader educational reform movements.

The following analysis reflects the changes I have made as a researcher-practitioner in BTG as the program has transitioned from using the provincial science curriculum as the primary focus and starting point in designing learning experiences, to a program that is adapted to, and accounts for, BTG's unique socio-ecological situation. In analyzing my decision-making process within a CPP, I became intrigued by the notion of "inhabiting" vs. "residing" in a place, and the potential existence of a continuum between these two. This continuum reflects my belief and those shared by other Aboriginal educators (Aikenhead 2000, Cajete 1999) that learning is a continual lifelong journey, one that we embark upon along with the learners we work with, ideally moving towards the "inhabitant" end of the spectrum. As the primary program developer in BTG, have the decisions I've made to date contributed to movement towards the "inhabitant" end of the spectrum while achieving progress toward the broader goals of the program? I dare to say yes. I believe the success realized to date with BTG is based on a commitment to:

a) De-Emphasizing the Formal Curriculum – When BTG began, it had an ecology-based focus and was designed to address learning outcomes from Manitoba's Science curriculum. A new emphasis on embracing the local ecological and cultural attributes would require that place-specific elements be used as the starting point when developing teaching and learning activities, not the formal curriculum. Specific Learning Outcomes (SLOs) from the provincial curricula are then selected based on the following criteria. First, SLOs must be relevant to the types of natural areas that are studied in the program (wetlands, tall grass prairie, and aspen parkland forests) and the specific issues involved in preserving and protecting these natural areas (as well as the resident plant and animal populations within the urban setting). Secondly, the SLOs must provide suitable connections to the Elders' cultural teachings and align with specific Indigenous knowledge bundles. As a result, curricular SLOs are incorporated in the program if they fit with the local ecological and cultural realities, not vice versa.

b) *Embracing Place-specific Ecological Attributes* – In light of BTG's urban context, the concept of an "urban habitat" should be embraced. Children should be encouraged to recognize that humans are dependent on the natural world and use living things and natural resources. They should be guided to discover that nature exists within an urban context, and to consider their role as residents of an urban habitat and what it means to live respectfully from the land within this context. For example, after sharing ideas about how wildlife living in local natural areas meet their habitat needs, children could discuss some of their similar needs for food, water and space. After discussing some of the traditional ways that humans have met their needs (traditional plant use, hunting, trapping), children could be guided to consider how the ways in which these needs are met have changed over time, particularly in contemporary urban settings. Learners could be guided to reconsider common misconceptions of human relationships with the land (i.e., food does not "come from the store" and water does not "come from the tap").

c) *Embracing Place-specific Cultural Attributes* – Relevant cultural attributes of BTG should be embedded in the program goals, and embraced proactively as integral components of BTG, not as afterthoughts or add-ons. The overall learning objectives for the program should include the original ecological concepts and skills from the Science curriculum, but also should place equal emphasis on relevant learning outcomes from Manitoba's Aboriginal Languages and Cultures Curriculum Framework. Accordingly, key learning objectives for BTG should include the ability of children to:

1. recognize how knowledge of plant and animal populations and interactions helped Aboriginal peoples to survive in the past;
2. demonstrate proper protocols when working with Elders; and
3. describe the traditional Aboriginal perspective on natural resources (e.g., no ownership of natural resources; all resources are to be shared).

Elders should also continue to be involved in the outdoor field trips as part of BTG and provide traditional cultural teachings, but additional changes should be considered to enhance Elder involvement. For example, through follow-up activities, learners would have more exposure to Elders and Indigenous perspectives which could facilitate opportunities for building relationships. Consideration of distinct worldviews is also important when seeking to develop compatible learning experiences and teaching strategies. A continued emphasis within BTG should be to reinforce the concept that humans are animals, a concept aligned with the traditional Indigenous view of our relationship with the natural world. This requires assuming a distinct viewpoint where all humans, perceived as animals, are part of a larger ecological system. Children involved in BTG should be encouraged to view themselves as human animals, an integral and interdependent part of the environment, not removed from it. Rather than having a distinct or superior status to other life forms, all human activities are discussed as integral aspects of the environment.

d) *Re-envisioning Program Goals* – It is important to be mindful that re-inhabiting and decolonizing place takes time and involves significant work in the face of global pressures. Like many other environmental educators, I have what could be referred to as idealistic ambitions and hopes for the future of the world, and the potential of the transformative role of environmental learning. While hesitating to suggest that my expectations for the program should be lowered, I sense that they perhaps must become more realistic. I must accept that transformations of behaviours, and ultimately developing individual and community capacity to actively engage in environmental stewardship, takes time, and that feelings about a place take longer to develop than abstract knowledge. Coming to knowing is a life-long journey, one that will not be accomplished through one program alone. I cannot expect children to instantly develop pro-environmental behaviours as a result of participating in BTG (or any other program for that matter), and to evaluate the success of BTG based on such an ambitious goal fails to account for some of the important achievements that the program can make. Although the transformative goals of environmental learning may be lofty, when applied at the local level and made relevant to a specific place, there is tremendous potential to realize progress in preserving cultural and ecological integrity.

Conclusion

It has been suggested by others that all education is environmental education. Whether or not this is true, not all environmental education is good education. In today's world, many of us find global information available at our fingertips, yet often neglect to consider the direct relevance of this information within the places we actually reside and seek to inhabit. Environmental learning grounded on a set of basic principles or an imposition of universal values ignores the particularities of varied socio-ecological contexts. Even what some consider to be best practices must be called into question, and assessed based on their relevance to the specific socio-ecological contexts in which we work. My experience with Bridging the Gap has caused me to be more critical about the choices I make when designing my programs, given me the courage to question prevailing notions of best practices, and changed the way I view environmental learning.

Mindful that environmental learning has traditionally represented the voice and vision of the white middle-class (Russell et al. 2000), there is a need to come to terms with the potential monoculturalism that pervades it. As Canadian society becomes more complex, more urbanized, and more ethnically, linguistically, and geographically diverse, people of diverse ethnic, cultural, linguistic and racial groups, along with the working class, continue to be under-represented in environmental learning – either overlooked or playing marginal or insignificant roles. As a practitioner, part of this challenge will be my ability to recognize that different cultures may value different bodies of knowledge and different ways of knowing, while remaining cognizant that all education is political and value-laden. When planning programs, it is essential that I continue to be cautiously aware of the potential for education to be used negatively to maintain a certain status quo, and I must remain willing to challenge prevailing norms and demands to fit within generalized guidelines and practices. During a period of growing demands for accountability and pressures to fit within national or internationally mandated priorities, I have a new sense of responsibility to consider the relevance of these priorities to the specific places that I work.

Whether or not education can save the world, or whether the world needs saving in the first place, humanity's role in historical and contemporary social, economic and ecological injustices cannot be ignored. I choose to believe in the human capacity to contribute to positive change in seeking resolution to injustice as we endeavour to re-inhabit our shared home. With this opportunity comes an accordingly huge responsibility. I must be cautiously aware of the lure to conform to universalized standards and the potential to inadvertently or unintentionally reinforce a specific status quo or world-view. I choose to believe that education plays a critical role in seeking to resolve the root causes of environmental problems and commit to do my part. Mindful that "no one lives in the world in general," (Geertz 1983: 262) I will continue to carefully consider how my decisions as a researcher, educator and human reflect and influence my own lived experiences and those of others with whom I am engaged. Although the transformative goals of environmental learning may be lofty, I have found that when applied at the local level and made relevant to a specific place, there is the potential to realize progress in preserving cultural and ecological integrity. Challenged to "do my part" and "be the change," the ideal starting place is clearly my own backyard.

Literature Cited

Aikenhead, G. 2000. Rekindling Traditions: Cross-cultural science & technology units project. University of Saskatchewan College of Education. http://www.usask.ca/education/ccstu/ Accessed March 17, 2006.

Cajete, G. 1999. Igniting the sparkle: An Indigenous science education model. Kivaki Press, Skyand, NC.

Geertz, C. 1983. Local knowledge: Further essays in Interpretive Anthropology. Basic Books, New York, NY.

Gruenewald, D. 2003. The best of both worlds: A critical pedagogy of place. *Educational Researcher* 32(4): 3-12.

Hanselmann, C. 2001. Urban aboriginal people in western Canada. CanadaWest Foundation, Calgary, AB.

Hungerford, H. and T. Volk. 1990. Changing learner behaviour through environmental education. *Journal of Environmental Education* 21(2): 8-21.

Mays, A. 2005. Community pathways of aboriginal young leaders. University of Winnipeg, Winnipeg, MB.

Ornstein A. and F. Hunkins. 2004. Curriculum foundations, principles and issues. Pearson Educational Press, Boston, MA.

Russell, C., A. Bell and L. Fawcett 2000. Navigating the waters of Canadian environmental education. Pages 196-227 *in* T. Goldman and D. Selby (eds.), Weaving Connections. Sumach Press, Vancouver, BC.

Statistics Canada. 2003. Aboriginal peoples of Canada: A demographic profile. Statistics Canada, Ottawa, ON.

Tilbury, D. 1995. Environmental education for sustainability: Defining a new focus of environmental education in the 1990s. *Environmental Education Research* 1: 195-212.

Willinsky, J. 1998. Learning to divide the world: Education at empire's end. University of Minnesota Press, Minneapolis, MN.

Cultivating a Future for Prairie Conservation

Ryan Brook
College of Agriculture and Bioresources, University of Saskatchewan

Abstract – The demographics, livelihoods, attitudes and values of people living on the prairies appear to be changing at an unprecedented rate, and these transformations have vital, but poorly understood, implications for conservation. While biological issues such as landscape change, invasive species, and maintaining networks of native vegetation are essential elements of conservation efforts, generating and maintaining a culture of support for conservation is at least equally important.

I begin by providing an overview of some broad trends in conservation perspectives and issues. I then provide a case study from the corridor between Riding Mountain National Park and Duck Mountain Provincial Forest as an example of the trends in changes in land management by protected area managers, farmers, recreational landowners and aboriginal peoples. Many of these observed transformations mirror broader changes at provincial and national levels. Analysis of use of the corridor region by elk, deer, moose and wolves indicates that understanding habitat use and conservation attitudes requires an integrated approach involving diverse approaches and datasets.

I advocate for a renewed commitment for engaging youth in outdoor activities and conservation research activities. At the same time, all stakeholders in conservation must be more effectively informed about the issues in their region and involved in an integrated decision-making process. Local and traditional knowledge can be used effectively with scientific data to support these decisions and together they can provide effective monitoring of environmental and social change.

POSTER SESSIONS

PATTERNS OF GLOBAL CHANGE

Adapting Conservation Strategies for Future Climate Change in the Tallgrass Aspen Parkland

Phil Gerla, Cary Hamel*, Russ Reisz, Meredith Cornett, Marissa Ahlering and Jon Eerkes
The Nature Conservancy
*Nature Conservancy of Canada – Manitoba Region

Abstract – The Tallgrass Aspen Parkland of Manitoba and Minnesota lies within a North American ecotone between the boreal region, tall grass prairie, and northern hardwood forest. Roughly 20% of this landscape is protected through ownership or management by government agencies or conservation organizations. Historically, a dynamic mosaic of prairie, woodland and wetland dominated the landscape. Fire previously shaped upland ecology, driven by fluctuations in Holocene climate. Current threats to biodiversity include fire suppression and aspen encroachment, ditching and channelization, invasive/alien species, and the loss of moose through disease. Accelerated global climate change will likely exacerbate the threats. A model ensemble suggests that by 2050 annual temperature will rise by >3°C, with the greatest increase occurring in winter. Precipitation is predicted to increase by 20% for the period from December through February. We identify likely aggravated threats and possible adaptation strategies for the Tallgrass Aspen Parkland:

1. The timing of increased precipitation will worsen spring floods and disrupt riparian species composition, facilitating spread of invasive species. Wetlands will experience more open water, radically changing current habitat. These stresses underscore the urgent need for protection of key areas representing the full range of landscape variability. Restoration of hydrology that is currently impaired is also important to addressing this threat.
2. A longer growing season and an atmosphere enriched in carbon dioxide will enhance aspen expansion at the expense of native grass. Concurrently, present fire management techniques designed to control encroachment will become increasingly difficult to implement and less effective. To mitigate the impact, by 2020 at least 20% of prescribed burns should occur outside the current spring season timeframe.
3. Increasing temperature (and perhaps precipitation) may compromise the health of large mammals. For example, the moose population in northwestern Minnesota has declined significantly. It may not be possible to maintain moose as a conservation target in this landscape under changing conditions.

Impacts of Climate Change on the Grasslands of the Canadian Prairies

Jeff Thorpe
Saskatchewan Research Council

Abstract – The grasslands of Canada's Prairies Ecozone show trends in composition and productivity that are driven by climate. These trends can be represented by mathematical models. Models have been extended to future climatic scenarios by using the grasslands of the U.S. Great Plains as analogues for a warmer future. The zonation of grassland types is predicted to shift northward, with future climates becoming increasingly suitable for U.S. types such as short grass prairie. These changes imply gradual northward movement of species not currently found in Canada, and the proportion of warm-season (C4) species in our grasslands will probably increase. However, models suggest that climatic warming will cause only modest changes in grassland productivity, which is limited mainly by levels of precipitation.

Do I Need a SARA Permit? Overview of Need and Conditions for Permitting

Paul Gregoire
Canadian Wildlife Service

Abstract – The federal *Species at Risk Act* (SARA) provides legal protection for species at risk. The Act prohibits the killing, harming or harassing of individuals, the damage or destruction of the residence, and the destruction of critical habitat, except under authority of a permit. Research activities that may impact federally listed species at risk may require a federal SARA permit. Specific criteria and time lines must be met before a permit can be issued. Not all activities are permitted. It is important that research and monitoring activities be planned well in advance of the need for a permit to avoid any delays in field work.

Introduction

Researchers may spend many months preparing for field work only to encounter delays due to regulatory and bureaucratic requirements that have not been met. If a person is undertaking field work on species listed under the federal *Species at Risk Act* (SARA), and particularly if the activity is located on federal lands, a SARA permit may be required. This poster describes the protocols for obtaining a SARA permit issued by Environment Canada**.**

Do I need a permit?

Consider the following questions:

1. Does the activity affect a species listed under Schedule 1 of SARA?
2. Is the species listed on Schedule 1 as threatened, endangered or extirpated under SARA? (not as Special Concern)
3. Does the activity have the potential to contravene the prohibitions under SARA:
   (a) kill, harm, harass, or be in the possession of;
   (b) damage or destroy the residence of;
   (c) destroy any part of the critical habitat of a species.
4. Is the activity on federal lands?
5. If the activity is not on federal lands, will it affect a migratory bird (as defined under the federal *Migratory Birds Convention Act* [MBCA]) or an aquatic species (as defined under the federal *Fisheries Act*)?

If the answers to 1 through 3 are all YES, *and* the answer to either 4 or 5 is YES, then the person is advised to apply for a SARA permit.

What if my activity is not on federal lands?

SARA comes into full force on lands that the federal government has jurisdiction over, namely federal lands. If the activity is not on federal lands, i.e., it is on private or provincial lands, the prohibitions apply only to migratory birds (protected under the MBCA), and aquatic species (protected under the *Fisheries Act*), unless an Order in Council is made. Therefore on private and provincial lands, a person would only require a SARA permit for migratory birds and aquatic species. The prohibitions would not apply to such species as Burrowing Owl[1], Swift Fox, Woodland Caribou, as well as plants and invertebrate species on these lands[2].

Be advised, however, that one may still require a Provincial permit to disturb these species.

Who can issue a permit?

Only the Competent Minister can issue a permit. The Competent Minister includes Environment Canada, the Parks Canada Agency, and the Department of Fisheries and Oceans.

[1] Hawks, owls, upland game birds and blackbirds are not protected under the MBCA.

[2] If the provincial laws do not effectively protect the species, the minister may invoke an Order in Council to have the prohibitions apply.

If the activity affects aquatic species under the *Fisheries Act*, the permit application should be submitted to Fisheries and Oceans Canada.

If the activity is on Parks Canada lands or historic sites, the application should be sent to Parks Canada.

If the activity is on other federal lands (i.e., Agriculture and Agri-food Canada lands (formerly PFRA), Department of National Defence lands, or Reserve lands under the Indian Act), the application should be sent to Environment Canada.

If the activity affects listed migratory birds (under the MBCA) anywhere, the application should be sent to Environment Canada.

How do I apply for a permit?

SARA permit application forms are available on the website http://www.sararegistry.gc.ca. Choose the "Permits & Agreements" heading located to the left of the screen. There are then three choices:

1. for activities in National Parks or preserves, follow the link to the Parks Canada website;
2. for activities affecting aquatic species protected under the Fisheries Act, follow the link to the Fisheries and Oceans Canada website;
3. for all other species and locations, fill out the Environment Canada Permit form.

Completed Environment Canada applications should be sent to the regional federal permit coordinator. Permit applications for the provinces of Alberta, Saskatchewan and Manitoba should be sent to:

Paul Gregoire
SARA Permit Coordinator
Canadian Wildlife Service
Environmental Stewardship Branch
Environment Canada
Room 200, 4999-98 Avenue
Edmonton, Alberta, Canada T6B 2X3
paul.gregoire@ec.gc.ca
Ph: 780 951-8695

It may take between 60 and 90 days to process a permit, so early application is advised. Permits undergo two science reviews, regional and national approvals, French translation, and are posted on a national registry.

Tip: To prevent delays, the applicant is reminded to include a detailed, stand alone, description of the field methodology, as that information is essential for the permit officer.

What activities are authorized?

Three types of activities are authorized and must be identified in the permit application.

> S.73(2) The agreement may be entered into, or the permit issued, only if the competent minister is of the opinion that:
>
> (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 activities and gas wells.

What conditions must be met?

SARA identifies three pre-conditions that *must* be satisfied in the permit application.

> S.73(3) The agreement may be entered into, or the permit issued, only if the competent minister is of the opinion that
>
> (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.

Research activities must be well planned and justified. Permits will be reviewed on a case-by-case basis and the precautionary principle will be applied. Environment Canada retains the discretion to refuse permits outright or to attach conditions necessary to ensure the protection of the species, to minimize the impact of the authorized activity on the species, or to provide for its recovery. This may include limits on the activities permitted, the number of individuals affected, timing restrictions, measures to protect non-target SARA species, disposal, etc. Permits will not be issued for "insurance" purposes.

Permit duration

No permit may be issued for a term longer than three years. Agreements shall not exceed five years (but are rarely issued).

Special Cases

Birds under the Migratory Birds Convention Act

Efficiencies: If a SARA species is protected under the MBCA, a person will require an MBCA Scientific Permit in addition to the SARA permit (e.g., for Piping Plover, Loggerhead Shrike, Sage Thrasher, Mountain Plover). However, to reduce duplication of process, the SARA permit requirements can be embedded into the MBCA Scientific Permit. If this is your case, you are advised to contact the regional Migratory Bird permit coordinator on how to proceed (John Dunlop, Canadian Wildlife Service, Environment Canada, Saskatoon, SK).

Banding: The federal banding office only issues banding permits. These permits are only issued to enable the use of federal bands and incorporation into the database. When banding MBCA SARA species, the banding office will add a SARA clause to make the banding permit compliant with SARA. If a person will be undertaking more than simply banding the species, the person will require a separate SARA permit. When banding non-MBCA SARA species on federal lands, banders are required to acquire a separate SARA permit from their regional office allowing them to band on federal lands. When banding non-MBCA SARA species on private or provincial lands, the banding office will issue conditional banding permits for provincial SARA species (to enable the use of federal bands), but because there is no federal jurisdiction on these lands, they are only subject to the appropriate provincial approvals.

Incidental take: SARA enables permitting for incidental take/harm activities, but the MBCA does not currently have provisions for this. Therefore, a SARA permit cannot be issued for incidental activities that would be in contravention of the MBCA.

The Impacts of Drought on Species at Risk and Their Habitat in the Northern Mixed Grass Prairies

Susan Rever
University of Regina

Abstract – Drought is linked to land degradation, therefore future management of mixed prairie grasslands will require an improved understanding of past and future climate trends. Past grassland productivity analyses show that vegetation index averages were typically lower during drought years. During a severe drought, photosynthesis is significantly reduced, which decreases grassland productivity. I found that the normalized difference vegetation index and soil adjusted vegetation index are negatively correlated with temperature, while the normalized difference moisture index is positively correlated with precipitation and aridity, and negatively correlated with potential evapotranspiration (PET). The moisture stress index is positively correlated with PET, and negatively correlated with precipitation and aridity.

Past aridity measurements for the West Block of Grasslands National Park (GNP) indicate that this area was a semi-arid ecoregion from 1978 to 2006. If current trends continue, GNP will fall into the arid classification by 2020 for the month of July. All three global climate models (CGCM2 A21, CSIROMk2b B11 and HadCM3 B21) predict a significant decrease in density and vigour of vegetation by 2050. A decrease in grassland productivity, vegetation density, vigour and canopy water content, along with a more arid climate, will have a considerable impact on the vegetation communities that currently dominate the West Block of GNP. This means a decrease in habitat diversity and suitability for many animal species.

The configuration, density and quality of landscape elements, such as foraging and nesting habitat, required by species at risk to reproduce and find prey will likely be altered in response to increased aridity. In addition, species at risk could experience higher mortality rates and lower reproduction in response to higher temperatures and water stress. Management is needed to protect remaining mixed prairie grasslands and ensure viable populations of species at risk. This includes grassland restoration, conducting long-term climate studies, maintaining dense and widespread populations of prey, and maintaining alternative water sources.

Good Management is the Key: The Canadian Cattlemen's Association National Environmental Stewardship Award

Peggy Strankman
Canadian Cattlemen's Association

Abstract – The Canadian Cattlemen's Association Environmental Stewardship award provides national recognition of a cattle operation that exemplifies the initiatives undertaken by Canadian producers in their role as innovative stewards of the land. This year the award went to the Campbell family, of the B & C Ranch, Inc. of Meadow Lake, Saskatchewan, in recognition of their significant work in protecting the environment.

The Campbells say that they have never thought of themselves as environmentalists, but they have implemented practices that best serve the operation's domestic and wildlife inhabitants. They feel it is encouraging that not only are ranchers changing their perception of what it means to be an environmentalist, but also that the general public is beginning to see that farmers and ranchers could be the environment's best hope. They believe that exposure from awards like The Environmental Stewardship Award (TESA) serves as an important catalyst on the way to significant change.

The Campbells worked with Ducks Unlimited Canada to install a system of water control gates along the Beaver River to ensure the wetlands always contain water. On-farm, they implemented practices to maintain and enrich grazing lands – key factors in reducing greenhouse gas emissions from cattle and reducing fossil fuel use.

To be eligible for the national TESA, nominees must win their provincial cattle association stewardship award. Each nominee demonstrates significant dedication to environmental stewardship, proving that these sustainable practices improve all aspects of the environment for current and future inhabitants. As environmental stewardship role models, their willingness to share their experience typifies the commitment that Canadian farmers and ranchers make to the environment and the agricultural community. Living and working on it daily, our producers are true stewards of the land.

Species at Risk, Agriculture and Agri-Food Research Farms, and Creating Awareness

Erl Svendson
Agriculture and Agri-Food Canada

Abstract – When one thinks of a farm, and in particular a research farm, one usually imagines that the land has been cropped from edge to edge of the property. This is true in many cases; however, there are always exceptions. At Agriculture and Agri-Food Canada (AAFC), there are research farms across Canada with significant portions that have not been cultivated or developed due to topography, soils, hydrology or research focus. And while these properties by themselves (with one exception) are too small to represent an ideal home for most species at risk, they are adjacent to similar uncultivated land, thereby contributing to a larger habitat.

To date, 33 COSEWIC-ranked species at risk have been documented on 7 research sites in British Columbia, Alberta and Quebec. For a few species, such as Soapweed and the three moth species associated with this plant, the only self-sustaining populations are found on AAFC research land. For all species at risk, these sites provide good to excellent habitat and, since the *Species at Risk Act* (SARA) applies primarily to federal land, a measure of protection as well.

Discovering species at risk on research properties has meant creating a greater awareness of species at risk issues for the staff that work there. AAFC staff ask questions such as: what is SARA and what are the prohibitions; which species at risk can be found on a site; what will it mean for research, general operations and infrastructure maintenance/development; and how can habitat be improved or managed more effectively? The questions are dealt with through information sessions, brochures and on-going consultation.

Can Plains Rough Fescue Grasslands be Restored after Well Site and Pipeline Construction?

Mae E. Elsinger
Agriculture and Agri-Food Canada

M. Anne Naeth
Department of Renewable Resources, University of Alberta

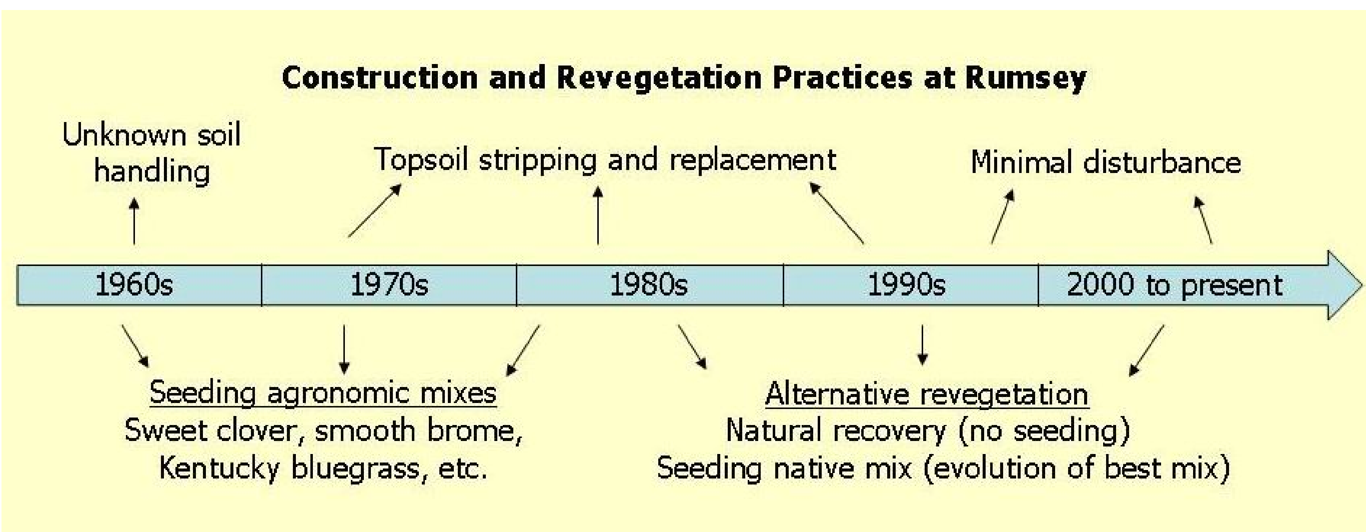
Abstract – Rumsey Block is a remnant of Plains Rough Fescue (*Festuca hallii* (Vasey) Piper) prairie in southern Alberta, Canada. Reclamation success of 17 pipelines and 36 well sites was assessed by comparing them to undisturbed prairie and determining the influences of age, construction and revegetation methods, and cattle grazing. With few exceptions, these disturbances had different soil and plant community characteristics than undisturbed prairie. Reclamation success was more closely related to methods of construction and revegetation and grazing pressure than to age. Greater similarity between undisturbed prairie and well sites or pipelines was related to construction methods that leave sod and topsoil intact.

Revegetation by natural recovery resulted in a more diverse community than seeding either native or non-native mixes, but progress is slower on open soil disturbance than on minimal disturbance. In most cases increased grazing pressure was associated with lower reclamation success.

Introduction

This poster is based on a Master of Science research project conducted by the first author under the supervision of the second author. The project is an investigation of soil properties and plant community characteristics on well sites and pipelines that had been constructed over a forty-year period as construction and reclamation techniques have evolved.

The assessment was completed with the overall objective of determining whether or not the disturbances had recovered.



Research Questions

Do plant community and soil properties differ between reclaimed well sites or pipelines and adjacent Plains Rough Fescue grassland?

Do age and methods of well site or pipeline construction and reclamation influence restoration of Plains Rough Fescue grassland?

Site Description

The 183 km^2 Rumsey Ecological Reserve and Natural Area, located southeast of Red Deer, Alberta, contains one of the largest remnants of Plains Rough Fescue (*Festuca hallii* (Vasey) Piper.) grassland in the world. Oil and gas development and summer cattle grazing are the major anthropogenic disturbances.

Methods

Plant community composition and ground cover were assessed on 53 well sites and pipelines and adjacent undisturbed areas in July 2006. Communities consisted of 129 vascular plant species and canopy cover of live vegetation, litter, stones, feces, club moss and bare soil.

Physical and chemical properties of soil were assessed in the same locations as vegetation in June and July 2007. Properties consisted of total organic carbon and nitrogen concentrations; calcium, magnesium, sodium and potassium cation concentrations; pH, electrical conductivity, penetration resistance and bulk density.

Data were statistically explored with bar charts and non-metric multi-dimensional scaling (NMS) ordinations. Group differences were tested with multi-response permutations procedures (MRPP).

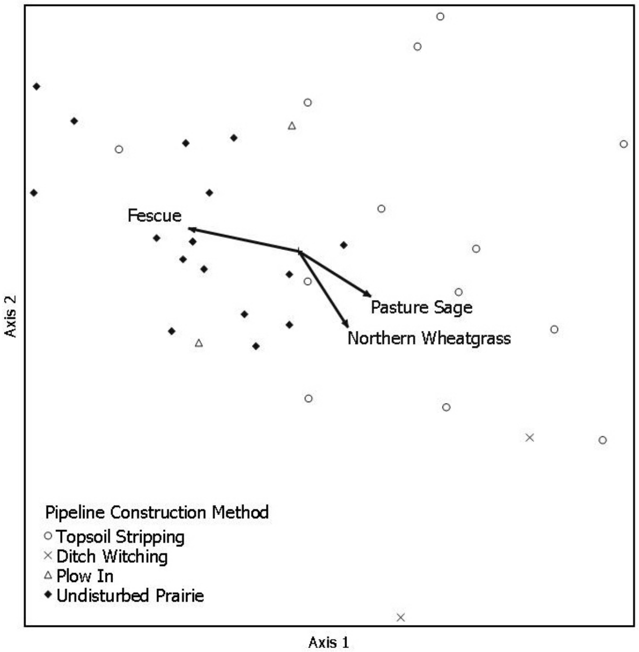
Results

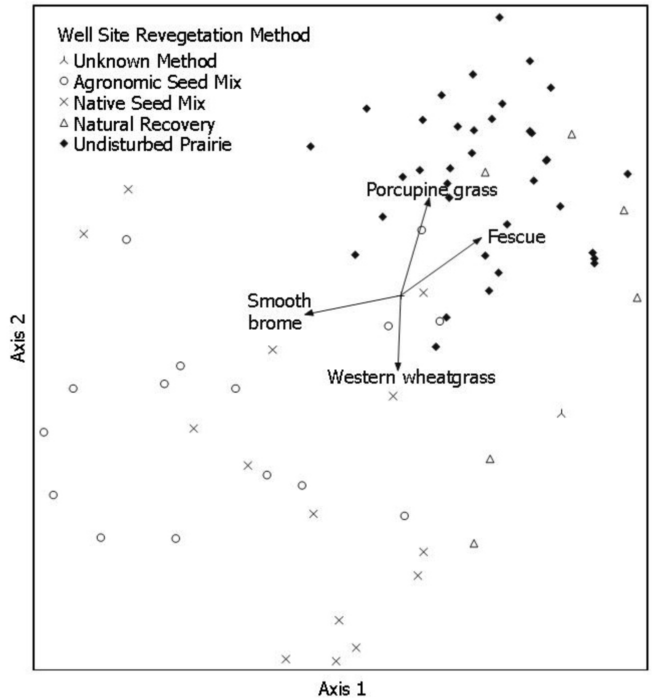
Most disturbances had different soil and plant community properties than adjacent prairie. Construction, revegetation and grazing had more influence than age on restoration success.

Disturbance	Undisturbed Prairie
More disturbance colonizers (Wheat Grass, Smooth Brome, Kentucky Bluegrass)	More late seral species (fescue and Porcupine Grass)
More bare ground, extreme values in litter and herbaceous cover	More club moss
Higher cation concentrations, pH, EC, surface bulk density and penetration resistance	Higher total organic carbon and nitrogen

Soil handling caused significant changes in plant community and soil properties. Disturbances seeded with agronomic or native mixes had different plant composition from undisturbed prairie. Data points (sampling sites) are located in the following ordination diagrams according to multiple species abundance values. Sites furthest apart on the diagrams are most dissimilar.

Grazing may retard plant community succession and increase bare soil but increases plant species richness.





Implications for Ecological Change

Preserved plant roots, seeds, asexual propagules and soil microorganisms allow plant communities on physically intact topsoil to recover in a relatively short time period. Soil manipulation exceeds a threshold beyond which recovery time is greatly increased.

The ultimate intent of seeding a mixture of native plant species is to accelerate restoration, but this generally has not been achieved at Rumsey in the time frames studied. Community composition of many disturbances that have been seeded has not moved beyond those species that were present in the seed mixture.

Continuous grazing pressure is associated with slower recovery. Grazing systems that incorporate effective rest periods are likely to improve the rate of recovery.

If the pace of industrial development exceeds the pace of recovery, the total area of alteration increases. Will these cumulative impacts threaten wildlife, species at risk and the Plains Rough Fescue plant community?

Recommendations

- Keep topsoil and sod intact.
- Construct during fall and winter months and minimize the size or width of soil stripping and excavation zones.
- Where there are small areas of soil disturbance, allow revegetation by natural recovery while preventing and controlling invasion by non-native plant species.
- Incorporate rest periods during the growing season into grazing systems.

Acknowledgements

Agriculture and Agri-Food Canada, Agri-Environment Services Branch
Alberta Sustainable Resource Development – Public Lands
Canadian Natural Resources Ltd.; Trident Exploration; Husky Exploration
University of Alberta Department of Renewable Resources
Peggy Desserud, Melanie Wood, Darin Sherritt, Tremayne Stanton-Kennedy,
Anayansi Cohen-Fernandez, Hélène Marcoux, Barry Cole, Wilbur Stewart

Revisiting the Nesting Ecology of Western Grebes after 40 Years of Changes at Delta Marsh, Manitoba

Nicholas La Porte and Nicola Koper
Natural Resources Institute, University of Manitoba

Abstract – As one of the largest marshes on the Canadian prairies, Delta Marsh is a major nesting area for Western Grebes (*Aechomophorus occidentalis*) in Manitoba. Since the 1970s, artificially stabilized hydrology, the increased presence of Common Carp, and invasion by a cattail hybrid that is out-competing native vegetation have significantly impacted Delta Marsh and may have severely impacted its Western Grebe population. To evaluate the impact of stressors within Delta Marsh on Western Grebes, and to facilitate comparisons across time, in 2009 we repeated surveys originally conducted by G.L. Neuchterlein (M.S. thesis, Colorado State University, 1975) on the nesting ecology of Western Grebes at Delta Marsh in 1973 and 1974. We calculated changes in the number of nests and colonies, nesting success and loss rates, chick-to-adult ratio, and habitat structure by comparing 2009-10 data with Nuechterlein's data.

In 2009, 49% of initial nests in the two largest colonies were successful, compared to 84% in the corresponding high-water year of 1974, and chick-to-adult ratio was 0.55, compared to 0.88 in 1974. In terms of nesting losses, 47% of nests in the two largest colonies were destroyed by wave action, compared to 22% in 1973-74. The increase in the proportion of nests destroyed by wave action and the significant structural changes in marsh vegetation used for nesting suggest that the breeding success of Western Grebes at Delta Marsh may have been negatively impacted. These data will help identify and prioritize actions to improve the management and conservation of Western Grebes in Delta Marsh and similar coastal marshes.

Canada's Endangered Shrub-steppe Ecosystem

William Preston

Abstract – In Canada, the Shrub-steppe Ecosystem occurs in the south Okanagan Valley from Penticton south to the International Boundary, a distance of approximately 60 kilometres, as well as in the adjacent Similkameen valley. This is the nearest to desert of anywhere in Canada and has been described as a northward extension of the Great Basin Desert of Washington, Oregon and Nevada. Due to current agricultural practices – mainly the wine industry – much of this ecosystem has been lost or badly fragmented. Another major threat is real estate development that is moving further and further into the surrounding hills. All of this has had an adverse effect on the unique wildlife of the valley, resulting in perhaps more endangered and threatened species than anywhere else in Canada. Many of these species occur nowhere else in Canada.

The shrub-steppe ecosystem in Canada extends from Penticton, B.C. south to the International Boundary, a distance of approximately 60 kilometres – a tiny part of Canada. This ecosystem, comprised of Antelope Bush (*Purshia tridentata*), Big Sage (*Artemisia tridentata*), and Rabbitbush (*Chrysothamnus nauseosus*), occurs nowhere else in Canada. It is essentially a northern extension of the Great Basin Desert of Washington, Idaho, eastern Oregon and northern Nevada, and is the only desert-like area in Canada.

Both plant and animal species occur here that are found nowhere else in Canada. Some examples are:

- desert race of the White-tailed Jackrabbit (*Lepus townsendii townsendii*), not seen since 1980 (extirpated?)
- Great Basin Pocket Mouse (*Perognathus parvus*), now considered endangered
- Pallid Bat (*Antrozous* pallidus)
- Poorwill (*Phalaenoptilus nuttallii*)
- Desert Night Snake (*Hypsiglena chlorophaea*), endangered
- Great Basin Gopher Snake (*Pituophis catenifer deserticola*), threatened
- Western Rattlesnake (*Crotalus oreganus*), threatened
- Great Basin Spadefoot (*Spea intermontanus*)
- Tiger Salamander (*Ambystoma mavortium*), endangered

A few of the numerous insects and other invertebrates found here are:

- Ground Mantis (*Litaneutria minor*)
- several species of shield-backed katydids
- several species of *Eleodes* (Tenebrionidae)
- a mydas fly (*Nemomydas pantherina*)

Most of these have only recently become endangered or threatened, since major loss and fragmentation of habitat due to the expanding wine industry. Others disappeared long before the advent of the wine industry:

- Sage Grouse (*Centrocercus urophasianus*)
- Burrowing Owl (*Athene cunicularia*)
- Pygmy Horned Lizard (*Phrynosoma douglassii*).

Agriculture and the ever-expanding human population probably had some bearing on their disappearance.

Unfortunately, Antelope Bush habitat is excellent for growing grapes, and the greater part of it has been taken over by vineyards. The greatest loss has been the sandy benchlands covered by Antelope Bush and Big Sage along the east side of the valley. This has resulted in a great many threatened and endangered species – more than anywhere else in Canada.

My purpose for this poster was to show some of the habitat, what has happened to it, and a few of the interesting species making up the unique fauna. This poster was based on my own observations, having grown up in the valley, having conducted studies on the Western Rattlesnake, and from frequent visits to the area over the years.

Field Evidence of Non-target and Secondary Poisoning by Strychnine and Chlorophacinone Used to Control Richardson's Ground Squirrels in Southwest Saskatchewan

Gilbert Proulx
Alpha Wildlife Research & Management Ltd.

Abstract – Richardson's Ground Squirrels (*Spermophilus richardsonii*) are considered to be major pests in southwest Saskatchewan where recent population outbreaks have caused damage to grasslands, pastures and crops. Although it is known that poisons pose potential threats to wildlife, since 2008, southwest Saskatchewan farmers have used large quantities of 0.4% strychnine (an acute poison available as freshly mixed and ready-to-use baits) and chlorophacinone (an anticoagulant that causes fatal hemorrhages) to control ground squirrels. In the last two years, I have gathered field evidence that both strychnine and chlorophacinone kill ground squirrels but also a diversity of songbirds, small mammals, and predators including raptors, American Badger (*Taxidea taxus*), and Long-tailed Weasel (*Mustela frenata*). The control of Richardson's Ground Squirrel populations and the future of all predators, including species at risk, lie in the implementation of an Integrated Pest Management Program.

Introduction

In 2000-2001, the Canadian prairies experienced a severe drought with a warm winter and low precipitation (Liu et al. 2004) that depressed plant growth (Heath et al. 1973) and created ideal habitat conditions for Richardson's ground squirrel (*Spermophilus richardsonii*) (Yensen and Sherman 2003). Ground squirrel populations irrupted with spring densities often exceeding 40 adults/ha (Proulx and Walsh 2007, Proulx et al. 2009). Poor grassland management, the use of inefficient rodenticides, the loss of predators, and socio-economic changes further exacerbated the situation created by the drought (Proulx 2010). In 2007, an Emergency Registration program of 2% liquid strychnine was granted by the Pest Management Regulatory Agency of Canada and became effective in 2008 (Wilk and Hartley 2008) for the control of ground squirrels. The program requires that 2% liquid strychnine be mixed with grain to formulate 0.4% freshly mixed (FM) baits. In 2008, distributors of anticoagulant (chlorophacinone) baits also offered ready-to-use (RTU) oat mixtures to farmers. As a result, massive poisoning campaigns were conducted across private land (Fig. 1). For example, in the rural municipality of Mankota (1,696 km² of farmland located about 150 km southeast of Swift Current, Saskatchewan) alone, 730 cases (12 x 250 ml bottles per case) of liquid strychnine, producing 8,760 kg of poison bait, were sold in May-June 2008, compared to a total of 30 cases in the previous 10 years (M. Sherven, Administrator, R.M. of Mankota, pers. commun., 2008).

Figure 1. Bait stations with anticoagulant-treated oats placed at the border of a cropland to control Richardson's Ground Squirrels, southwest Saskatchewan, summer 2008.

Over 2,000 kg of RTU chlorophacinone-treated oats were sold to farmers during the same time period (T. Schultz, Edmonton Exterminators, pers. commun., 2008). Even though non-target and secondary poisoning has been frequently reported in the past (Howell and Wishart 1969, Hegdal and Gatz 1977, Wobeser and Blakley 1987, James et al. 1990), federal Members of Parliament and Senators argued that the 1993 strychnine ban was unjustified and requested that the poison be made available to all farmers (Government of Canada 2001, Standing Senate Committee on Agriculture and Forestry 2001). Even though secondary poisoning of predators feeding on rodents poisoned by anticoagulants was reported in the past (McDonald et al. 1988, Hosea 2000), RTU chlorophacinone baits were sold as posing no secondary poisoning problems (Schultz 2008).

The purpose of this paper is to

1. report primary poisoning of non-target species and secondary poisoning of predators in southwest Saskatchewan, and
2. raise concerns about the negative impact of such poisoning on the survival of species at risk and predators in general.

Study Area

The study was carried out in southwest Saskatchewan (Fig. 2) in grassland plots (0.4 to 1.4 ha) with similar ground squirrel populations.

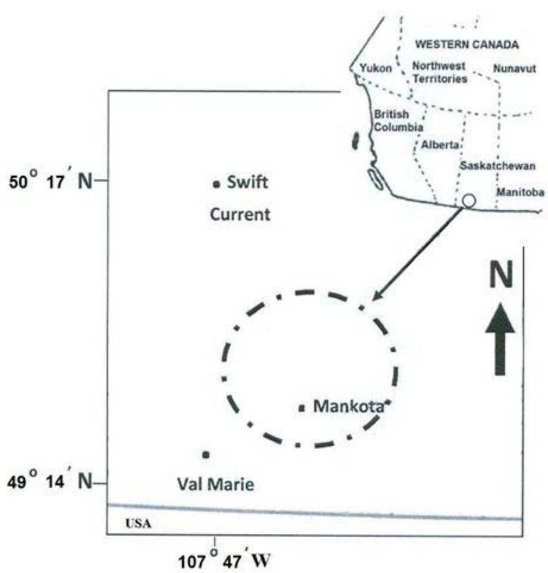


Figure 2. Location of study area in southwest Saskatchewan, Canada.

Methods

Ground squirrel trapping occurred in spring (5 May-1 June) and summer (14 June-2 July). Poison tests were carried out during two test periods: spring (13 April-1 June, 2007-2009) and summer (14 June-2 July, 2008-2009). Ground squirrels were captured in 15 x 15 x 48 cm Tomahawk live-traps (Tomahawk Live Trap, Tomahawk, WI) baited with peanut butter on bread. Poison baits (hulless oats or canary seeds) were applied as per label instructions. Strychnine baits (Nu-Gro Co., Brantford, ON, and Maxim Co., Regina, SK) were applied at burrow systems where ground squirrel captures and recaptures occurred, and in all holes with signs of activity located within the delineated study plots. Active holes were identified by flagging and shovelling dirt in all openings the day before treatment, and marking reopened holes on treatment day. One tablespoon of bait (13-15 g) was placed as far as possible into burrow openings using a long-handled spoon. Treated holes were covered with dirt. Anticoagulant baits (13-15 g of 0.7% chlorophacinone mixed with hulless oats or winter wheat; Nu-Gro Co., Brantford, ON) were placed in burrow openings, which were left open after treatment. A second treatment of burrow openings occurred 48 h later. Anticoagulant applications also involved bait stations with 1 kg of treated grains that were placed 40 m apart along the perimeter of a few study plots; they were refilled 48 h later. Some treatments involved the combined use of treatment at burrow openings and bait stations. Bait rejection was monitored in all 2008 study plots 24 h after treatment. Since bait rejection was almost nil with anticoagulants, only data related to strychnine were reported here. Live trapping was initiated the day following completion of treatments, and lasted up to 15 days to capture all animals present. Dead animals found on surface were collected and autopsied.

The assessment of the potential impact of poisoning on Burrowing Owls (*Athene cunicularia*) was assessed with regurgitation pellets collected at three different nests located near study plots. Pellets were dated, bagged and kept frozen until analysis by Alpha Wildlife Research & Management laboratory in Sherwood Park, AB. They were soaked overnight in a mild water-bleach solution, washed through a sieve, and oven-dried at 75°C. Pellet remains were identified according to Chandler (1916) and Moore et al. (1974). Frequencies were compared to each other with Fisher and Student-*t* tests; comparisons of means involved analysis of variance followed by Tukey test (Zar 1999).

Table 1. Frequency of strychnine bait rejection and non-target species found dead on surface, spring and summer 2008 and 2009.

Poison bait	Study plot size (ha)	# of ground squirrel burrow openings treated	# of burrow openings with rejected bait (%)	Non-target species
		Spring 2008		
RTU 0.4% oats	0.6	442	34 (7.7)	3 Horned Larks[1], 1 Deer Mouse[2]
	0.7	435	40 (9.2)	1 Horned Lark, 3 Chestnut-collared Longspurs[3]
FM 0.4% oats	1.4	440	31 (7.1)	2 Deer Mice
	0.6	455	46 (10.1)	4 Deer Mice
FM 0.4% canary seeds	0.7	406	14 (3.5)	–
	0.8	651	47 (7.2)	–
FM 0.2% oats	1.1	276	45 (16.3)	1 Horned Lark, 1 Common Grackle[4]
	1.0	433	49 (11.4)	1 Horned Lark
		Summer 2008		
RTU 0.4% oats	1.1	357	57 (19)	1 Olive-backed Pocket Mouse[5]
	0.9	265	38 (16.7)	–
FM 0.4% oats	0.7	393	67 (20.6)	2 Deer Mice
	0.9	307	34 (12.5)	1 Common Grackle
FM 0.4% canary seeds	0.7	258	15 96.2)	4 Deer Mice
	0.4	252	29 (13.0)	–
FM 0.2% oats	0.9	269	28 (11.6)	1 Horned Lark, 1 Deer Mouse
	0.7	533	56 (11.7)	–
		Spring 2009		
RTU 0.4% oats	0.7	363	–	1 Western Meadowlark[6]
	3.5	788	–	–
FM 0.4% oats	1.1	258	–	1 Vesper Sparrow[7] 1 Northern Harrier[8], 7 Deer Mice
	0.8	196	–	1 Deer Mouse
	2.2	1652	–	–
	0.9	567	–	1 Vesper Sparrow
	0.9	427	–	1 Western Meadowlark
	1.2	509	–	–
		Summer 2009		
RTU 0.4% oats	0.3	144	–	4 Deer Mice
	0.4	126	–	–
FM 0.4% oats	0.3	197	–	–
	0.7	208	–	–
	0.3	364	–	2 Deer Mice
	0.5	619	–	1 Horned Lark, 4 Deer Mice
	0.3	276	–	1 Deer Mouse
	0.2	81	–	–

[1]*Eremophila alpestris*, [2]*Peromyscus maniculatus*, [3]*Calcarius ornatus*, [4]*Quiscalus quiscula*, [5]*Perognathus fasciatus*, [6]*Sturnella neglecta*, [7]*Pooecetes gramineus*, [8] *Circus cyaneus*

Table 2. Average number of Richardson's Ground Squirrels found dead on surface in fields treated with 0.4% strychnine baits and anticoagulant baits, spring and summer 2008 and 2009.

Poison bait (n)	Average study plot size – ha (standard deviation)	Average # of Richardson's Ground Squirrels dead on surface (SD)
	Spring 2008	
0.4% strychnine baits (6)	0.8 (0.3)	9.3 (8.6)
Anticoagulant baits (10)	0.7 (0.2)	11.7 (5.4)
	Summer 2008	
0.4% strychnine baits (6)	0.8 (0.2)	5.8 (5.3)
Anticoagulant baits (10)	0.7 (0.3)	0.9 (1.2)
	Spring 2009	
0.4% strychnine baits (8)	1.4 (1.0)	4.6 (5.4)
Anticoagulant baits (8)	0.7 (0.2)	21.1 (20.5)
	Summer 2009	
0.4% strychnine baits (8)	0.4 (0.2)	2.0 (2.4)
Anticoagulant baits (8)	0.4 (0.1)	1.9 (2.3)

Results

Bait Rejection and Non-target Species

On average, strychnine bait rejection was greater in summer (13.9%) than in spring (9.1%) ($t = 2.275$, $P < 0.05$; Table 1). However, non-target species found dead on surface were frequent during both seasons, in 2008 and 2009 (Table 1).

In 2008, one White-tailed Jackrabbit (*Lepus townsendii*) was found dead beside a bait station filled with anticoagulant-treated oats. An autopsy confirmed the presence of hemorrhages in the body cavity. In 2009, two Deer Mice were found in fields treated with anticoagulants.

Number of Ground Squirrels Dead on Surface

On average, seven (SD: 6.8) ground squirrels were found dead on surface in study plots that averaged 0.7 ha (±0.3 ha) in size (Fig. 3). The number of Richardson's Ground Squirrels found dying or dead on surface was significantly different ($F_{7,56} = 4.950$, $P < 0.05$) between seasons and years (Table 2). The highest abundance of ground squirrels found dead on surface was in study plots treated with anticoagulant baits in spring of 2008 and 2009, and strychnine baits in spring 2008 (Table 2). The least number of ground squirrels found dead on surface was in a study plot treated with anticoagulant baits in summer 2008. All study plots with numbers between those with the highest and lowest abundances of ground squirrels found dead on surface had similar ($P > 0.05$) abundances of dead ground squirrels on surface.

Secondary Poisoning

Anticoagulants: One American Badger (*Taxidea taxus*) and three Long-tailed Weasels (*Mustela frenata*) died nine days after the first day of treatment with chlorophacinone-treated baits, in spring 2008 and summer 2009, respectively. Signs of bleeding were present at the badger den. Long-tailed Weasels captured in study plots died while under observation. Autopsies confirmed the presence of intestinal hemorrhages, bleeding from the anus, and blood seeping from gums and underfoot pads.

One male weasel captured on July 6, 2009 in a poison-free pasture was radio-collared for further studies, but was found dead the next day with intestinal hemorrhages

Figure 3. Richardson's Ground Squirrels found dead on surface in a study plot treated with poison baits, southwest Saskatchewan, summer 2008.

Table 3. Frequencies and mean volumes (%) of food items in Burrowing Owl regurgitation pellets, southwest Saskatchewan, 2008.

Food item	May (n = 9) Frequency %	May (n = 9) Mean volume[1] % (SD)	June–July (n = 19) Frequency (%)	June–July (n = 19) Mean volume[1] % (SD)	August (n = 5) Frequency (%)	August (n = 5) Mean volume[1] % (SD)
MAMMALIA						
Richardson's Ground Squirrel	3 (33.3)	32.4 (48.7)	5 (26.3)	26.2 (45.1)	1 (20.0)	14.0 (–)
Deer Mouse	5 (55.6)	34.9 (41.5)	4 (21.1)	19.6 (39.8)	1 (20.0)	18.0 (–)
Western Harvest Mouse[2]	–	–	1 (5.3)	5.3 (22.9)	–	–
Unknown	–	–	5 (26.3)	26.9 (43.1)	–	–
Total	8 (88.9)	67.3 (39.3)	15 (78.9)	69.5 (43.6)	2 (40.0)	32.0 (–)
AVES						
Passeriformes	–	–	–	–	1 (20)	12.0 (–)
Galliformes	–	–	1 (5.3)	1.3 (5.7)	–	–
ARTHROPODA						
Beetles and crickets	7 (77.8)	32.1 (39.8)	11 (57.9)	29.2 (41.8)	5 (100)	56.0 (41.6)
VEGETATION						
Unknown	1 (11.1)	0.5 (1.7)	1 (5.3)	0.1 (0.2)	–	–

[1]Some pellets contained more than one food item; [2] *Reithrodontomys megalotis*

resulting from anticoagulant poisoning. Bait stations with anticoagulant-treated oats were found along roadsides a few hundred metres away from the edge of the pasture.

In July 2009, a juvenile Swainson's Hawk (*Buteo swainsoni*) was observed moving in a strange manner on the ground, near its nest tree. Its body was found a few days later but without the head and intestinal tract. Several regurgitation pellets with anticoagulant-treated oats were found at the base of the tree, located a few hundred metres from fields with these baits.

Strychnine: One Northern Harrier (*Circus cyaneus*) was found in spring 2009 in a study plot treated with 0.4% strychnine baits. One Deer Mouse (*Peromyscus maniculatus*) was found in its stomach. An autopsy of the mouse revealed the presence of at least two strychnine-treated kernels.

Burrowing owl food habits

In 2008, small mammal remains in regurgitation pellets from three nests were similar in frequency (Fisher, $P > 0.05$) and volume ($F_{2,30} = 1.588$, $P > 0.05$) from May to August. In May and June-July, however, small mammal remains were found in >78% of pellets, and represented, on average, > 67% of pellet volumes (Table 3). Ground squirrel remains were found in 33% and at least 26% (some bone remains could not be identified with certainty) of pellets in May and June-July, respectively.

Discussion

Because farmers fail to find carcasses after poisoning, they usually claim that non-target species poisoning is infrequent (G. Proulx, pers. observ.). Carcass detection rates may be low due to scavenging or difficulty in finding small animals in vegetation (McKinnon et al. 2002, G. Proulx, pers. observ.). Our findings are field evidence of poisoning of non-target species by both strychnine and anticoagulants.

Many Richardson's Ground Squirrels and other small mammals poisoned by strychnine and anticoagulant baits were found on surface. Small mammals are important prey of terrestrial carnivores (Proulx et al. 2009) and raptors (MacCracken et al. 1985, Schmutz and Hungle 1989), and secondary poisoning may be significant in landscapes with greater use of ground squirrel poison baits. As predators preferentially select for prey moving slowly and abnormally, they focus on ground squirrels, mice and voles displaying a pre-lethal anticoagulant-toxicosis-induced behaviour that increases exposure and vulnerability to predation (Wood and Phillipson 1977, Brakes and Smith 2005). This is true for Burrowing Owls, which are considered opportunistic predators (Gleason and Craig 1979, Green et al. 1993). Burrowing Owls nesting in agricultural fields may adopt a specialized diet (Moulton et al. 2005) centered on an abundance of poisoned ground squirrels. As MacArthur and Pianka

(1966) suggested, a species may specialize when prey availability is high and search time is low. Differential consumption and caching of prey, decomposition rate of remains, and age- or sex-based differences in foraging may bias pellet collections and composition (York et al. 2002, Moulton et al. 2005). However, when one considers food consumption and pellet formation rates (Marti 1973), the high frequency of Burrowing Owl pellets with mice and ground squirrel remains from May to July suggests multiple feedings, a necessary condition for anticoagulants to produce mortality (Marsh 1994). Burrowing owls may also feed on carrion (Coulombe 1971), and strychnine-killed ground squirrels may have an impact on the health of owls (James et al. 1990).

Because it is difficult to find carcasses and ascertain cause of death, proof of secondary poisoning is difficult to assemble. The death of a badger in 2008 was based on circumstantial evidence. The deaths of weasels in 2009, however, were indisputable field evidence of secondary poisoning by anticoagulants. The 2008 and 2009 field observations raise concerns about the sustainability of predator populations. Nearly 30 years ago, the Long-tailed Weasel was considered threatened in western Canada by COSEWIC (Proulx and Drescher 1993). This status was based on Gamble's (1982) report suggesting that population declines resulted from habitat loss and increased use of agricultural pesticides. Proulx et al. (2009) collected 197 weasel scats from April to September 2008. In 2009, Proulx et al. (2010) found only 33 scats in the same landscapes. Similarly, 41 American Badger scats were found in 2008 (Proulx et al. 2009) vs. nine in 2009 (Proulx et al. 2010). This drop in the presence of carnivore signs is worrisome and suggests that the intensive use of poison baits to control ground squirrels may have a severe impact on predators in southwest Saskatchewan.

Concern about the future of terrestrial predators in poisoned landscapes extends to species at risk. Undoubtedly, Burrowing Owls feed on Richardson's Ground Squirrels from May to August. In spite of valuable stewardship programs (e.g., Operation Burrowing Owl, Keel et al. 2001), owls may leave their protected nesting sites to hunt in poisoned fields. The likelihood of poisoning these birds is even greater as some landowners will not disclose the presence of Burrowing Owls on their land for fear of losing control over the management of their property (G. Proulx, pers. notes). Therefore, poison baits may be used by neighbours unaware of the nearby presence of nesting sites. The future of Swift Foxes (*Vulpes velox*) and Black-footed Ferrets (*Mustela nigripes*) may also be bleak outside the borders of Grasslands National Park where they have recently been re-introduced (Parks Canada 2009a, b).

In the past, attempts to control outbreaks of Richardson's Ground Squirrel populations have been ineffective (Proulx 2010). The control of ground squirrel populations, and the future of terrestrial and avian predators lies in the implementation of an Integrated Pest Management Program involving farmers, government agencies, conservation groups and professional wildlife managers (Proulx 2010). This is a long-term proactive program where monitoring, preventive cultural practices, and various control methods (mechanical, physical, biological and chemical) must be strategically coordinated to maintain rodent population at acceptable density levels (Witmer and Proulx 2010).

Acknowledgements

Funding for this work was provided by Advancing Canadian Agriculture and Agri-Food in Saskatchewan (ACAAFS) (as a Collective Outcome Project with ACAAF in Alberta), the Alberta Ministry of Agriculture and Rural Development (Agriculture Development Fund) and the Saskatchewan Association of Rural Municipalities (SARM). Thank you to Neil MacKenzie, Keith MacKenzie and Kara Walsh for field assistance, and to Benjamin Proulx for analysis of Burrowing Owls pellets. I am grateful to Geoffrey Holroyd and Helen Trefry, Canadian Wildlife Service, and Neil MacKenzie and Pauline Feldstein, Alpha Wildlife, for comments and discussions during the preparation of this manuscript.

Literature Cited

Brakes, C.R. and R.H. Smith. 2005. Exposure of non-target small mammals to rodenticides: short-term effects, recovery and implications for secondary poisoning. *Journal of Applied Ecology* 42: 188-128.

Chandler, A.C. 1916. A study of the structure of feathers with reference to their taxonomic significance. *Zoology (California)* 13: 243-266.

Coulombe, H.N. 1971. Behavior and population ecology of the burrowing owl, *Speotyto cunicularia*, in the Imperial Valley of California. *The Condor* 73: 162-176.

Gamble, R.L. 1982. The ecology and distribution of *Mustela frenata longicauda*. COSEWIC Report, Ottawa, ON.

Gleason, R.L. and T.H. Craig. 1979. Food habits of burrowing owls in southeast Idaho. *Great Basin Naturalist* 39: 273-276.

Government of Canada. 2001. House of Commons Debates 137 (099), 37th Parliament, October 22, 2001, Ottawa, ON.

Green, G.A., R.E. Fitzner, R.G. Anthony and L.E. Rogers. 1993. Comparative diets of burrowing owls in Oregon and Washington. *Northwest Science* 67: 88-93.

Heath, M.E., D.S. Metcalfe and R.F. Barnes. 1973. Forages. The science of grassland agriculture. Iowa State University Press, Ames, IA.

Hegdal, P.O. and T.L. Gatz. 1977. Hazards to seed-eating birds and other wildlife associated with surface strychnine baiting for Richardson's ground squirrels. Environmental Protection Agency report under Inter-agency Agreement EPA-IAGD4-0449, Washington, DC.

Hosea, R.C. 2000. Exposure of non-target wildlife to anticoagulant rodenticides in California. *Proceedings, Vertebrate Pest Conference* 19: 236-244.

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

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

Keel, M.A., J. Keith and C.S. Palaschuck. 2001. A population decline recorded by Operating Burrowing Owl in Saskatchewan. *Journal of Raptor Research* 35: 371-377.

Liu, J., R.E. Stewart and K. Szeto. 2004. Moisture transport and other hydrometeorological features associated with the severe 2000/01 drought over the Western and Central Canadian Prairies. *American Meteorological Society* 17: 305-319.

MacArthur, R.H. and E.R. Pianka. 1966. On optimal use of a patchy environment. *American Naturalist* 100: 603-609.

MacCracken, J.G., D.W. Uresk and R.M. Hansen. 1985. Burrowing owl foods in Conata Basin, South Dakota. *Great Basin Naturalist* 45: 287-290.

Marsh, R.E. 1994. Current (1994) ground squirrel control practices in California. *Proceedings Vertebrate Pest Conference* 16: 61-65.

Marti, C.D. 1973. Food consumption and pellet formation rates in four owl species. *The Wilson Bulletin* 85: 178-181.

McDonald, R.A., S. Harris, G. Turnbull, P. Brown and M. Fletcher. 1988. Anticoagulant rodenticide in stoats (*Mustela erminea*) and weasels (*Mustela nivallis*) in England. *Environmental Contamination* 103: 17-23.

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

Moore, T.D., L.E. Spence and C.E. Dugnolle. 1974. Identification of the dorsal guard hairs of some mammals of Wyoming. Wyoming Game and Fish Department Bulletin No. 14. Cheyenne, WY.

Moulton, C.E., R.S. Brady and J.R. Belthoff. 2005. A comparison of breeding season food habits of burrowing owls nesting in agricultural and non-agricultural habitat in Idaho. *Journal of Raptor Research* 39: 429-438.

Parks Canada. 2009a. Black-footed ferret FAQs. http://www.pc.gc.ca/pn-np/sk/grasslands/edu/edu1/f.aspx Accessed February 18 2010.

Parks Canada 2009b. The Swift Fox – a long road home. http://www.pc.gc.ca/pn-np/sk/grasslands/edu/edu1/c.aspx Accessed February 18 2010.

Proulx G. 2010. Factors contributing to the outbreak of Richardson's ground squirrel populations in the Canadian Prairies. 24th Vertebrate Pest Conference, Sacramento, CA.

Proulx, G. and R.K. Drescher. 1993. Distribution of the long-tailed weasel (*Mustela frenata longicauda*) in Alberta as determined by questionnaires and interviews. *Canadian Field-Naturalist* 107: 186-191.

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

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

Proulx, G., K. Walsh, N. MacKenzie and K. MacKenzie. 2009. Assessment of the effectiveness of Rozol®, Phostoxin®, Strychnine, RoCon®, and various treatments to control Richardson's ground squirrels (*Spermophilus Richardsonii*) in southern Saskatchewan, in spring and summer 2008. Alpha Wildlife Research & Management Ltd. report to Saskatchewan Agriculture Development Fund, Regina, SK.

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

Schultz, T. 2008. Rozol tips. Edmonton Exterminators Information Sheet provided to Mankota farmers, Mankota, SK.

Standing Senate Committee on Agriculture and Forestry. 2001. Issue 29 – Evidence, Ottawa, ON.

Wilk, C. and S. Hartley. 2008. Management of Richardson's ground squirrel. Agriview, Saskatchewan Agriculture. http://www.agriculture.gov.sk.ca/agriview_March_08_7 Accessed 18 February 2010.

Witmer, G. and G. Proulx. 2010. Rodent outbreaks in North America. Pages 253-268 *in* G. Singleton, S. Belmain, P. Brown, and B. Hardy (eds.), Rodent outbreaks – ecology and impacts. International Rice Research Institute, Metro Manila, Philippines.

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

Wood, D.A. and J. Phillpson. 1977. The utilization of poison hoppers designed for grey squirrel (*Sciurus carolinensis*) control. *Biological Conservation* 11: 119-127.

Yensen, E. and P.W. Sherman. 2003. Ground squirrels: *Spermophilus* and *Ammospermophilus* species. Pages 211-231 *in* G.A. Feldhammer, B.C. Thompson, J.A. Chapman (eds.), Wild mammals of North America: biology, management, and conservation. The Johns Hopkins University Press, Baltimore, MD.

York, M.M., D.K. Rosenberg and K. Sturm. 2002. Diet and food-niche breadth of burrowing owls (*Athene cunicularia*) in the Imperial Valley, California. *Western North American Naturalist* 62: 280-287.

Zar, J.H. 1999. Biostatistical analysis. 4th edition, Prentice Hall, Englewood Cliffs, NJ.

Deferring Grazing Has Immediate Nesting Success Benefit

Laura Rogasky and Robert B. Emery
Ducks Unlimited Canada

Abstract – Grazing is a major land-use of prairie grasslands but overgrazing can reduce range health and therefore the ability of a site to produce forage. The impact of heavy grazing on prairie wildlife, including waterfowl, is a concern. Preliminary results from research supported by Ducks Unlimited Canada (DUC) suggested that duck nesting productivity was higher in pastures that received moderate grazing pressure than in either idled or heavily grazed pastures. Using data collected during 2002-2008 by DUC's Spatial and Temporal Variation in Nesting Success of Prairie Ducks study (SpATS) at ninety-one 41 km^2 study sites in Alberta, Saskatchewan and Manitoba, we modelled the relationship between grazing pressure and duck nesting success to see if similar effects were evident at a broader spatial scale.

SpATS is a long-term study (10 years: 2002-2011) examining how nesting success of prairie waterfowl varies in relation to landscape composition. We recorded grasslands as grazed or idled in both the previous year (Year 1) and current year of the study (Year 2). We found that duck nesting success in grasslands grazed in Year 1 and idled in Year 2 was higher (grazed-idled; 20.5%, 95% CI = 14.7 - 26.4%, n = 499 nests) than in grasslands idled in both years (idled-idled; 14.2%, 95% CI = 8.4% - 19.9%, n = 232) and in grasslands grazed in both years (grazed-grazed; 12.4%, 95% CI = 8.5 - 16.4%, n = 766). A lack of idled-grazed grasslands precluded nesting success estimates for this land-use type (n = 15 nests). As a proxy for grazing pressure, mean visual obstruction of vegetation (VOR) was 2.00 (SD = 1.50), 2.27 (SD = 1.61), and 2.59 (SD = 1.54) at nests in grazed-grazed, grazed-idled, and idled-idled grasslands, respectively. This work corroborates a link between good range management and the sustenance of prairie wildlife populations.

The Effects of Hydrology on the Plant Community Structure of the Tall Grass Prairie

Ryan Sheffield and John Markham
Department of Biological Sciences, University of Manitoba

Abstract – The distribution and abundance of tall grass prairie plant species shifts in both space and time. Heterogeneity also exists in the environmental factors of a prairie, such as soil water conditions, nutrient availability, fire history and soil biota. My research investigates whether the changes in the environment correspond to the differences in the plant community. Recent literature has found strong trends between grassland plant species distribution and soil water conditions. At the scale of tens of meters, we hypothesize that soil water is the dominant environmental factor controlling the spatial differences in the plant community. Water availability can limit plant growth and survival in two ways: flooding creates anaerobic soil conditions and dry soils create water limitation.

The Tall Grass Prairie Preserve in Southern Manitoba is a predominantly lowland tall grass prairie and we have found water-logged conditions to be more prevalent than water limitation. Thirty permanent one m^2 plots were set up at each of three different locations at the Tall Grass Prairie Preserve. Soil water content, depth of aerobic soil and depth to water table were measured weekly throughout the past two growing seasons. Vegetation assessments surveying the presence and abundance of the plant species in each plot were completed in both seasons and the maximum cover value for each species was analyzed. One analysis that provided evidence for correspondence between the plant community and the environment was for plots grouped according to vegetation data with a cluster analysis. When these groups were imposed onto the environmental data and then an ANOVA test performed, the groups created by the vegetation data also showed significant environmental differences. Analyzing the water conditions over time with a regression equation elucidates trends not found in the spatial analysis previously mentioned. Soil water conditions have proven to affect the plant community structure in the tall grass prairie and further analysis may reveal a stronger control of the environment on the vegetation in this ecosystem.

Effects of Bison and Cattle Grazing on Grassland Songbirds

Maggi Sliwinski and Nicola Koper
Natural Resources Institute, University of Manitoba

Abstract – Grassland songbirds are experiencing significant declines, in part due to loss and degradation of habitat following transformation of many grasslands to agricultural lands. Grasslands were historically grazed by large, free-roaming herds of bison numbering in the millions, but bison have been largely replaced by fenced cattle. Research on grazing strategies, preferences and behaviours of bison and cattle have shown that they are different and cause disparate effects on the landscape; they may, therefore, differ in their effects on songbird abundances. We conducted songbird surveys in Grasslands National Park (GNP) in Saskatchewan to compare songbird abundance between habitat grazed by bison (West Block GNP) and habitat grazed by cattle (East Block GNP) in 2009. Site selection in both blocks was stratified across ungrazed (controls), medium and heavily grazed sites. We used generalized linear models to determine whether there was an interaction between grazer species and grazing intensity. Western Meadowlarks and Savannah Sparrows responded differently to bison grazing intensity than to cattle grazing intensity, while Baird’s Sparrow, Chestnut-collared Longspur, and Sprague’s Pipit did not. This research will be continued for at least one additional year to decrease any effect of spurious results. Cattle may be an appropriate ecological substitute for bison for managing abundance of some songbird species, but not others.

Diverse Diet and High Productivity Show the Adaptability of Swift Foxes in Southeastern Alberta to Changing Environments

Helen Trefry and Geoffrey L. Holroyd
Environment Canada

Abstract – Swift Foxes have been successfully reintroduced into Canada over the past 30 years and appear to be increasing at Onefour in southeastern Alberta, where we have documented them depredating Burrowing Owl nests. Little is known about their summer diet in Canada. In 2008 and 2009 we were able to monitor activity for five Swift Fox pairs with kits in southeastern Alberta using motion-activated "Reconyx" cameras. Of five den sites located, two were re-used the following year. Each Swift Fox pair had three or four kits emerge with high survival before dispersal. Dispersal occurred quickly in mid-August when all foxes disappeared from the burrow system and did not return the following month. Females were in attendance at the den burrow full-time during the first half of the summer, and then spent less time as the kits grew and became more active.

Prey were identified on the camera images and from feathers that we collected during camera changes. Reconyx cameras did not capture all food deliveries and prey items could not always be identified to species. However the prey deliveries captured reveal a diverse diet and indicates the importance of a healthy varied prairie ecosystem to conserve this fox. The diet of some pairs was predominantly ground squirrels while others ate primarily birds or Sagebrush Voles. The flexibility in prey bodes well for the success of these reintroduced predators in a changing landscape. The role of the much maligned and poisoned ground squirrel is especially important for some pairs. While no poisoning of ground squirrels occurred in our study area, the Swift Fox would be very vulnerable to secondary poisoning of this prey elsewhere.

PlantWatch Saskatchewan: Become a PlantWatch Volunteer and Help Track Climate Change

Deanna Trowsdale-Mutafov
Nature Saskatchewan

Abstract – It is increasingly well-documented that not only is climate change occurring, but it is due primarily to greater emissions in greenhouse gases over the last few decades. Higher temperatures, extended drought periods, greater air pollution, widespread habitat changes, more forest fires and a prevalence of extreme weather provide evidence for this claim. Prairie ecosystems, as well as other ecosystems, are being impacted.

PlantWatch Saskatchewan is a volunteer monitoring program that has been designed to help identify changes that are affecting our environment. This program enables citizen scientists to contribute to an understanding of how and why the natural environment is changing. PlantWatch is an active phenology program which provides baseline data to document biological responses to climate change. Since plants flower largely in response to the amount of warmth to which they are exposed, earlier flowering occurs after warmer winters, and later flowering occurs after colder winters. Because our climate is changing, winters are becoming warmer and Canadian PlantWatch data indicates that plants are blooming earlier in the spring. Analysis of this data also allows scientists to measure impacts of climate change on ecosystems, and on the plants and animals that inhabit them.

The PlantWatch program not only encourages volunteers to record blooming dates for 20 indicator plant species, but also provides plant watching and climate change information to participants and to the public. The message of plant watching and climate change has been presented to many schools through a PowerPoint presentation and PlantWatch materials over the past several years. Presentations are given to schools and groups about observation and appreciation of wild plants, responsible stewardship of our environment, and climate change and reduction of greenhouse gas emissions. The very popular PlantWatch Saskatchewan poster was recently printed in both official languages. It is available to all interested individuals, schools and other groups.

CHANGES IN THE PHYSICAL ENVIRONMENT

Benefits of Crop Conversion Programs for Prairie Species Restoration

Holly L. Hennin
Department of Biology, University of Regina

Ray G. Poulin
Royal Saskatchewan Museum

Christopher M. Somers
Department of Biology, University of Regina

Abstract – Agriculture has caused the loss of more than 80% of native grasslands across North America, resulting in large-scale declines of associated animal species. As a means of restoring or maintaining grassland biodiversity, some organizations employ crop-conversion programs (converting cropland into non-native grassland) as a conservation tool. The effectiveness of these crop conversion programs and their benefits to endangered species and native biodiversity has not been adequately assessed. We compared the abundances of four taxa: raptors, small mammals, grasshoppers and fossorial mammals (e.g., ground squirrels, badgers) on three different habitat types: crop conversion (non-native grassland; N=33), native prairie (N=33) and cropland (N=33) across much of southern Saskatchewan. To determine species density and diversity we used various standardized surveying and sampling techniques. We analyzed these data using multivariate statistics paired with AIC to model which vegetative and landscape factors have the most influence on each taxa. We suggest how to improve crop conversion programs to enhance native species diversity and abundances on the prairies of North America.

Determining Critical Habitat for the Northern Prairie Skink: Ground-truthing a GIS Mapping Method

Pamela Rutherford and William McFadden
Department of Biology, Brandon University

James Duncan and Nicole Firlotte
Manitoba Conservation

Abstract – In Canada, the Northern Prairie Skink (*Plestiodon septentrionalis*) is limited to a small area of sandy soils in southwestern Manitoba. This species was listed as endangered by COSEWIC in 2004. The primary conservation issue for the prairie skink is habitat loss, which is occurring at their primary and secondary locations (Carberry and Lauder Sandhills, respectively). As in the rest of North America, the amount of mixed grass prairie habitat has declined as a result of numerous factors: cultivation, urbanization, road construction, fire suppression and the invasion of the exotic Leafy Spurge. In February 2009, a Prairie Skink Recovery Team working group developed and applied a GIS protocol to delineate suitable (aka "proposed critical habitat") and recovery habitat for the Northern Prairie Skink. Using ArcView 3.2a, the group mapped two polygons around all skink capture sites in Spruce Woods Provincial Park:

1. recovery habitat: 100 m radius circle around the capture location based on knowledge of their movement patterns, and
2. suitable habitat: all known suitable habitat, e.g., grassland, low shrub and sand, within the 100 m radius recovery habitat polygon.

Recovery and suitable habitat polygons were mapped using the best available orthophotos, and current knowledge of prairie skink biology. In summer 2009, suitable habitat polygons mapped by GIS were ground-truthed in the field by walking within their perimeters while recording actual suitable habitat polygons in ArcPad on a handheld PDA. In addition, orthophotos were taken using an UAV (unmanned aerial vehicle) at one site. The degrees of overlap between the three methods were mapped and compared in ArcMap 9.3. The degree of overlap between the orthophoto and ground-truthed polygons ranged from 27 - 94% (N=12 sites). There was more overlap between the ground-truthed and UAV polygons than between the ground-truthed and orthophoto polygons (5% vs 86%).

How Does Petroleum Development Affect Burrowing Owl Nocturnal Space-use?

Corey Scobie, Troy I. Wellicome*, Erin M. Bayne and Alan Marsh
Department of Biological Sciences, University of Alberta
*Canadian Wildlife Service

Abstract – The Burrowing Owl is a federally listed endangered species that continues to decline throughout its Canadian range. The prairies have seen a steady increase in petroleum development, raising concerns about potential impacts to species at risk, such as the Burrowing Owl. Risk to Burrowing Owls from petroleum development include changes to habitat and the introduction of sensory disturbances that might alter nocturnal space-use while foraging at night. The female owls incubate and brood chicks while the male flies as far as four km from the nest to hunt prey. Some habitat features may present increased mortality risk if owls are attracted to them (e.g., roads), or other features may increase overall home-range size if they are avoided (e.g., compressor stations), thus influencing prey delivery and associated fledging rate. We predicted that owls will avoid auditory disturbances, such as compressor stations and oil wells, but will be attracted to perches from which they can hunt (gas wells) and to areas of lush vegetation (road ditches).

We tracked 57 adult male Burrowing Owls in Alberta and Saskatchewan using miniature GPS data loggers. Their nests were surrounded by varying amounts of petroleum development and maintenance. Sound was measured from sound-producing structures within owl home ranges, and traffic data was collected with pneumatic-tube traffic counters from 53 roads near nests, concurrent with owl tracking. Anthropogenic features (roads, gas and oil wells, buildings, etc.) and habitat types were classified and recorded around all nests. A resource selection function was used to evaluate owl use of habitat features and areas with anthropogenic disturbances. We show whether adult male Burrowing Owls are influenced by anthropogenic features and sensory disturbance while travelling at night. In the future, we will explore how these movements may influence owl survival, nest success and fledging rate.

CHANGING SOCIO-ECONOMIC PRESSURES

Why do Landowners Practice Biodiversity-friendly Farming in the Central Parkland Region of Alberta?

Shawn A. Banack and Glen T. Hvenegaard
University of Alberta, Augustana Campus

Abstract – The reasons why landowners engage in biodiversity-friendly practices in Alberta are either not well known or are region-specific. This study sought to understand landowner motivations, triggers and barriers associated with biodiversity-friendly farming practices, using a case study from the Central Parkland Region of Alberta. Using snowball sampling, in March 2009 we conducted in-depth semi-structured interviews (13-35 minutes each) with nine landowners engaging in biodiversity-friendly farming practices. Landowners mentioned fifteen practices; those most often mentioned were reduced tillage, direct seeding, rotational grazing, nesting projects, reduced use of pesticides and fertilizers, and crop rotation. All landowners wanted to do more for biodiversity, such as fencing wetlands and delaying hay harvests.

The interviews revealed that the landowners were motivated by moral obligation, self-fulfillment, wildlife, economics, future generations, and positive reinforcement. By comparison, in other regions which offer financial incentives, landowners are more often motivated by economics. Key triggers to action included personal concern, relevant courses, mentors and economic opportunities. However, landowners faced several barriers in practicing biodiversity-friendly farming, such as financial constraints, social isolation or lack of time. To overcome such barriers, landowners maintained self-confidence, sought positive reinforcement, gathered more information and ignored societal judgments.

If governments and society want to protect more biodiversity in the Central Parkland Region of Alberta, they should address these motivations and barriers in current and future programs that target landowners. While economic gain is not a central motivator for landowners, time and money are key barriers. Thus, economic incentives (e.g., cost-sharing or tax relief) would help overcome significant barriers. Education and demonstration programs would appeal to landowners' major motivations and allow the public to see the benefits that arise from such practices. Recognition programs can also help create positive reinforcement and self-fulfillment for landowners and overcome social barriers.

Introduction and Background

Agricultural farming practices can have detrimental effects on biodiversity (McLaughlin and Mineau 1995), reducing the potential for many benefits to society. Farming in Alberta's Central Parkland region (64,455 km^2) has contributed to habitat degradation and conversion (e.g., tillage, wetland drainage, misuse of fertilizers and pesticides, improper grazing, crop rotation), leaving between 5% (van Tighem 1993) and 12% in native vegetation (Bjorge et al. 2004). As a result, government and conservation agencies have developed programs to promote biodiversity on farms. Moreover, some landowners voluntarily engage in biodiversity-friendly farming practices. To help agencies improve programs and increase participation rates, this study sought to understand landowners' motivations, triggers and barriers associated with biodiversity-friendly farming practices.

Past studies show that people engage in environmentally-friendly behaviour for many different reasons. Such behaviour can be conceptualized through the theory of reasoned action (Ajzen and Fishbein 1980) which can be applied to farming practices in Alberta. This theory states that behaviour is influenced by intention to engage in that specific behaviour. In turn, that intention is a function of personal attitudes and subjective norms about the behaviour. First, attitudes are affected by one's evaluation of the outcome of a behaviour and by whether one believes that this behaviour will lead to an outcome (Needham and Rollins 2009). Second, subjective norms are what you think other people think you should do, as determined by beliefs about what others feel is appropriate and whether or not you are motivated to comply with others. This relates to farming practices (the behaviour) and desired outcomes (an increase in biodiversity), as influenced by perceptions of what is appropriate (e.g., economic growth, status quo, ecological integrity), what others think (e.g., what will the neighbours think of me?), willingness to comply with others (e.g., should I be influenced by what my neighbours think?), and whether one feels that an action will lead to a certain outcome (e.g., does delayed haying really help duck nesting success?).

Methods

In March 2009, we used snowball sampling to conduct in-depth semi-structured interviews (M = 19 min) with nine landowners that engaged in biodiversity-friendly farming practices near Camrose, Alberta, within the Central Parkland natural region. The interviews addressed farm characteristics and landowners' motivations, triggers and barriers associated with biodiversity-friendly farming practices. We recorded, transcribed and analyzed interviews for common themes.

Results

The landowners' mean age was 53 years. The mean farm size was 731 acres (ranging from 320 to 1400 acres). Landowners reported biodiversity-friendly farming practices on 58 occasions, representing 14 categories. These included (number of responses in brackets):

- Maintain or improve soil health (9)
- Protect areas with native vegetation (7)
- Fence off or protect riparian areas and wetlands (6)
- Provide nest boxes for birds (6)
- Increase edge cover and corridors for wildlife habitat (5)
- Plant or maintain shelterbelts (5)
- Rotate crops appropriately (5)
- Directly seed crops (5)
- Reduce or eliminate pesticides and/or fertilizers (3)
- Graze rotationally (3)
- Feed cattle away from water bodies (1)
- Leave brush piles on land (1)
- Keep cattle out of pastures with nesting ducks present (1)
- Prepare an environmental farm plan (1)

All landowners wanted to participate in more of these biodiversity-friendly farming practices.

Landowners reported 40 motivations which we grouped into six categories: moral obligation, self-fulfillment, wildlife, economic, future generations, and positive reinforcement. Table 1 provides a summary of these motivations with some representative quotes.

Landowners reported 19 triggers that started their interest in biodiversity-friendly farming. We categorized these into four categories: personal concern, courses, mentors, and economic opportunities (Table 2).

Landowners reported 22 barriers to their biodiversity-friendly farming practices. We grouped these into three categories: financial issues, lack of time and knowledge, and social issues (Table 3).

Table 1. Motivations of landowners to engage in biodiversity-friendly farming practices
(L1 = landowner #1; # = number of motivations reported)

Category	#	Representative Quotes
Moral obligation	9	• "I have respect for the environment" (L3) • "Because of my religion, I feel I would be doing wrong to abuse the land" (L5) • "We take part in these practices because of this very strong desire we have to preserve this diversity" (L5) • "I try and make amends for the damage I had done" (L3) • "When I'm gone, I want to leave the landscape of the countryside in better shape than I got it in" (L8) • "You have to think about who is downstream from our activities" (L7)
Self-fulfillment	8	• "But also, the greatest beneficiaries are ourselves because we see it, we participate in it, we have that good feeling." (L5) • "It's a feel-good thing, there is no economic advantage, it's all intrinsic."(L7) • "No matter how small the action we take, it has a positive effect upon nature and the personal satisfaction in the knowledge that we can have an impact upon our environment." (L9)

Table 1 continued next page….

Table 1. (Motivations) continued

Category	#	Representative Quotes
Wildlife	7	• "I enjoy hunting and fishing." (L2) • "Not only do I enjoy the birds, but they also keep the pests away." (L3) • "I'm a trapper in the winter, so over the next 50 years there can be an awful lot of muskrats trapped out of that slough!" (L4)
Economic	7	• "We don't have the high input…and equipment…costs that other people do." (L3) • "I had neighbours around me in the drought year, averaging a tonne and a half per cutting. So they got 3 tonnes in the year off their field. I did one cutting and got 8.5 tonnes." (L6)
Future generations	5	• "The future, your kids, they're going to need places…that can grow healthy food …and have healthy soil" (L1) • "I'm not going to be here forever and I'd like to leave it in better shape than when I found it…for future generations" (L4)
Positive reinforcement	4	• "A forage specialist from Alberta Agriculture said to me 'you know, you're doing something that is so far ahead of the old paradigm'" (L3) • "A motivator is the implicit support of one's family." (L8) • "We all…desire for positive reinforcement." (L9)

Table 2. Triggers associated with landowners' biodiversity-friendly farming practices (L1 = landowner #1; # = number of triggers reported)

Category	#	Representative Quotes
Personal concern	10	• "I was triggered, in part, by my job here. I see what people are doing right and wrong and what I want my place to look like." (L8) • "Perhaps our age…we appreciate nature more so than in earlier years. It's my observation that as you get older, you do tend to think differently." (L9) • "I honestly don't know how to answer that question, call it a land ethic." (L6)
Courses	3	• "We took the holistic management course." (L3) • "Some of the things I learned when I was in University." (L1, L8)
Mentors	3	• "Love of nature was instilled in me from a very young age."(L1) • "My dad is a real conservationist, so he's mentored me on lots of different things."(L8)
Economic opportunities	3	• "I was in debt so deep that I knew if I didn't make a change, I would have to sell my farm." (L6) • "I had to start leaning out of the economic model" (L6) • "Initially, there was an economical gain." (L3, L4)

Table 3. Barriers associated with biodiversity-friendly farming practices
(L1 = landowner #1; # = number of barriers reported)

Category	#	Representative Quotes
Financial issues	9	• "It does cost us to do these things. But we're quite willing to pay those costs, to the extent we are, but there's a limit, due to economic necessity" (L5) • "To fence a dugout or something…there's an initial cost of posts and wire." (L4)
Time and knowledge	7	• Self-explanatory
Social issues	6	• "I've walked into coffee shops and experienced ridicule and been laughed at." (L3) • "When I say at the curling rink, "no, I'm not doing this", they say "well, why wouldn't you?" Definitely there is some social pressure…" (L8) • "My neighbours, in all directions, have every tree dozed and I mean you should see the benefits that I give them." (L6) • "There is certainly some resistance in the neighbourhood to my farming practices, but I don't give a damn." (L4)

Discussion

In order to increase participation rates and improve agency programs to promote biodiversity-friendly farming practices, it is important to note that landowners have a variety of motivations, triggers and barriers. Thus, there is no single policy approach to increase participation that will be appropriate for all landowners. As a result, agencies will need to develop flexible and varied programs to attract landowners, overcome their barriers, and maintain their interest.

In terms of motivations, the landowners in this study were interested in biodiversity for many different reasons. By comparison, participants in the Natural Advantage Program of Ducks Unlimited Canada (DUC 2008) were motivated primarily by (using our categories) moral obligation, wildlife and positive reinforcement. In the DUC study, motivations related to self-fulfillment were rare, and motivations related to economics and future generations were not mentioned.

Elsewhere, several studies concluded that money is the most important motivator for conservation efforts by farmers (Wilson and Hart 2000, Kollmuss and Agyeman 2002, Berentsen et al. 2007, Cooper and Signorello 2008). However, many of these studies were conducted in countries where economic incentives from government were common. Participants in our study were not motivated by economics. For Farmar-Bowers and Lane (2009), many farmers take part in conservation efforts solely out of interest without expecting any compensation; however, financial compensation may be necessary to overcome barriers. Herzon and Mikk (2007) found that many farmers were willing to take part in low-cost, simple conservation practices without the expectation of monetary compensation; however, when the farmers were asked to take part in more intensive practices (shrub planting, chemical reductions), they required monetary compensation. This is likely similar to respondents in our study.

The most important triggers for participants in this study related to a landowner's personal concern. Through some process (e.g., awareness, mentor, course or event), landowners suddenly or gradually developed concern for environmental protection. These landowners then translated this concern into action through biodiversity-friendly farming practices. More research is needed to determine the dynamics of these triggers.

Participants in our study faced a few significant barriers to adopting such practices, the most common being financial, logistical (time and knowledge) and social. The Alberta Research Council (ARC 2006) reported that the most common barriers to adopting rural conservation practices had to do with financial (e.g., debt, revenue) or technological considerations (e.g., unsuitability to one's operation or uncertainty about effectiveness). Furthermore, for 15% of respondents, knowledge hindered their ability to engage in conservation practices. Similarly, Rosenberg and Margerum (2008) found time and labour to be the second most important barrier for watershed restoration practices. Hines et al. (1987) found that lack of knowledge, lack of action strategies, locus of control, attitudes, lack of verbal commitment, and a lack of individual sense of responsibility all contribute to barriers to engaging in environmentally-friendly behaviours. One of the most effective ways of promoting responsible environmental behaviour is sharing knowledge of, and skill in, environmental action strategies (Sia et al. 1985). Where social pressure was a barrier, some of our participants ignored those pressures or sought positive reinforcement from others whom they respect.

These results illustrate the important role of personal attitudes and subjective norms as described within the theory of reasoned action (Ajzen and Fishbein 2000). First, personal attitudes of landowners in our study are influenced by past experiences, mentors, courses, insights into moral obligations, self-fulfillment and future generations. Such influences are represented by our landowners' diverse motivations. These attitudes can shape one's feelings about the appropriateness of conserving biodiversity. Most landowners can understand the connections between actions and desired outcomes. Nevertheless, Kollmus and Agyeman (2002) concluded that people often will act only in their self-interest, and some may believe that their actions will not make a difference in the bigger picture. This sense of apathy is critical and can be countered with sound scientific research to document the biodiversity success of beneficial management practices.

Second, subjective norms also play a role in creating intentions to engage in biodiversity-friendly behaviours. For example, landowners are concerned about what others think about biodiversity and about their specific farming practices. Landowners desire positive reinforcement from their peers, management agencies, scientists and the public. Providing this reinforcement can help increase confidence in what they do. On the other hand, landowners are aware of how they are farming differently and notice when their peers make negative comments about those differences. However, most landowners committed to biodiversity-friendly practices have enough independence and conviction to maintain their current actions despite concern from others.

The results of this study and others (ARC 2006; Langpap 2006) show that while financial incentives are important, they are not the only motivator. Program organizers should recognize landowners' other motivations in order to increase program participation. Furthermore, other farm characteristics may be influential. For example, Lambert et al. (2007) found that larger farms are able to spread the fixed and human capital costs of conservation practices over a large land base, making biodiversity-friendly practices more economical. Lastly, Atari et al. (2009) found that livestock farmers implemented conservation efforts at a higher rate than that of crop farmers.

Conclusion

This study sought to determine the range of motivations, triggers and barriers associated with biodiversity-friendly farming practices. The study did not attempt to determine which variables were most or least common; further research is needed in that regard.

Nevertheless, some recommendations are possible. It appears that moral obligations and feelings of self-fulfillment are important motivations for our study participants. These value-based beliefs and motivations are difficult to change and long-lasting (Needham and Rollins 2009). For those without these motivations, education can help develop an interest and concern for biodiversity issues. For example, programs can demonstrate the benefits of biodiversity-friendly practices in order to reduce the potential knowledge and social barriers. In turn, it is possible that the values and beliefs of the landowners may change, prompting them to feel morally obligated to eliminate the practices causing detrimental environmental effects and replace them with practices that are beneficial to the environment. Moreover, these education programs could trigger landowners to engage in such practices and provide for more mentoring relationships.

In addition, recognition programs can positively reinforce landowners' commitment to biodiversity-friendly practices. Such positive reinforcement may help landowners overcome social barriers and trigger other landowners to participate. The majority of the landowners want to do more for biodiversity; however, lack of money, time and knowledge were barriers. In the ARC (2006) study, 32% of respondents did not adopt conservation practices due to lack of financial incentives. Programs offered by government and non-government agencies can address these barriers by providing economic incentives, timely and site-specific information, and support for their proposed practices.

Acknowledgements

We thank our respondents, as well as Sean Moore, Glynnis Hood, and Julie Cook for their information, advice, and support of this project.

Literature Cited

Ajzen, I. and M. Fishbein. 1980. Understanding Attitudes and Predicting Social Behaviour. Prentice Hall, Englewood Cliffs, NJ.

Alberta Research Council (ARC). 2006. Study on Identifying Rural Sociological Barriers to Adoption. Alberta Research Council, Edmonton, AB.

Atari, D.O.A., E.K. Yiridoe, S. Smale and P.N. Duinker. 2009. What motivates farmers to participate in the Nova Scotia environmental farm plan program? Evidence and environmental policy implications. *Journal of Environmental Management* 90: 1269-1279.

Berentsen, P.B.M., A. Hendriksen, W.J.M. Heijman and H.A. van Vlokhoven. 2007. Costs and benefits of on-farm nature conservation. *Ecological Economics* 62: 571-579.

Bjorge, R., J. Schieck, L. George and G. Nieman. 2004. Conservation and status of native vegetation in the Parkland natural region - Central Parkland. Pages 34-36 *in* G.C. Trottier, E. Anderson and M. Steinhilber (eds.), Proceedings of the 7th Prairie Conservation and Endangered Species Conference, Natural History Occasional Paper No. 26. Provincial Museum of Alberta, Edmonton, AB.

Cooper, J.C. and G. Signorello. 2008. Farmer premiums for the voluntary adoption of conservation plans. *Journal of Environmental Planning and Management* 51: 1-14.

Ducks Unlimited Canada (DUC). 2008. Evaluation of the Natural Advantage Program. Ducks Unlimited Canada, Calgary, AB.

Farmar-Bowers, Q. and R. Lane. 2009. Understanding farmers' strategic processes and the implications for biodiversity conservation policy. *Journal of Environmental Management* 90: 1135-1144.

Herzon, I. and M. Mikk. 2007. Farmers' perceptions of biodiversity and their willingness to enhance it through agri-environment schemes: a comparative study from Estonia and Finland. *Journal of Nature Conservation* 15: 10-25.

Hines, J.M., H.R. Hungerford and A.N. Tomera. 1987. Analysis and synthesis of research on responsible environmental behaviour: a meta-analysis. *Journal of Environmental Education* 18(2): 1-8.

Kollmuss, A. and J. Agyeman. 2002. Mind the gap: why do people act environmentally and what are the barriers to pro-environmental behaviour? *Environmental Education Research* 8: 239-260.

Lambert, D.M., P. Sullivan, R. Claassen and L. Foreman. 2007. Profiles of US farm households adopting conservation-compatible practices. *Land Use Policy* 24: 72-88.

Langpap, C. 2006. Conservation of endangered species: can incentives work for private landowners? *Ecological Economics* 57: 558-572.

McLaughlin, A. and P. Mineau. 1995. The impact of agricultural practices on biodiversity. *Agriculture, Ecosystems, and Environment* 55: 201-212.

Needham, M.D. and R. Rollins. 2009. Social science, conservation, and protected areas theory. Pages 135-167 *in* P. Dearden and R. Rollins (eds.), Parks and Protected Areas in Canada: Planning and Management. 3rd ed. Oxford University Press, Don Mills, ON.

Rosenberg, S. and R.D. Margerum. 2008. Landowner motivations for watershed restoration: lessons from five watersheds. *Journal of Environmental Planning and Management* 51: 477-496.

Sia, A.P., H.R. Hungerford and A.N. Tomera. 1985. Selected predictors of responsible environmental behaviour: an analysis. *Journal of Environmental Education* 17(2): 31-40.

van Tighem, K. 1993. Alberta's endangered spaces: keeping the wild in the west. *Borealis* 12: 1-14.

Wilson, G.A. and K. Hart. 2000. Financial imperative or conservation concern? EU farmers' motivations for participation in voluntary agri-environmental schemes. *Environmental Planning A* 32: 2161-2185.

Sandstone Ranch Stewardship Credit Program Pilot Project

Dana Blouin
Nature Conservancy of Canada – Alberta Region

Abstract – The Stewardship Credit Program Pilot Project is being developed by the Nature Conservancy of Canada to maintain and enhance natural capital on the Foothills Fescue grasslands of the Milk River Ridge of southern Alberta. This program, modelled on similar Grassbanking initiatives in the United States, is being developed to create a new conservation tool for use on the agricultural landscapes of Alberta and Canada.

The Nature Conservancy of Canada (NCC), together with the Alberta Conservation Association (ACA), the Alberta Fish and Game Association (AFGA) and the Sandstone Ranch Grazing Co-operative, currently own and manage the 4,200 acre Sandstone Ranch on the North Fork of the Milk River, approximately 75 km south of Lethbridge, Alberta. This property provides an ideal opportunity to implement a pilot project for the Stewardship Credit Program. The Sandstone Ranch Grazing Co-op members will have the opportunity to access grazing on the portion of the ranch owned by NCC, ACA and AFGA at a decreased cost by implementing beneficial management practices that will maintain and increase natural capital on their personal ranches in the vicinity.

The project will enable participating ranchers to reduce their production costs and increase the quality of their beef by providing their cattle with healthy forage, while allowing the opportunity to rest their private land to increase forage production in the long-term. The pilot began in 2008 and will continue until 2011.

Deliverables for this pilot project include detailed assessments of participating ranches, the development of methodology to assign value (credits) to overall ranch land and waterway health, and tools to further enhance the natural capital. A yearly monitoring program will also be developed, and all information gathered from the pilot project will be incorporated into a handbook that can be shared with other conservation and agricultural agencies across Alberta and Canada.

The Value of Sustainably Managed Grasslands: The Mixed Grass Prairie Habitat Stewardship Project

Kathy Murray
Critical Wildlife Habitat Program

Peggy Westhorpe
Manitoba Conservation

Abstract – Manitoba's Critical Wildlife Habitat Program (CWHP) has a goal to identify, preserve and manage the remaining critical habitats in Manitoba, with a particular interest in native grasslands and the species they support. The Mixed Grass Prairie Grazing Project focuses on improving privately owned mixed grass prairie grasslands used as pasture for cattle. Landowners participating in this program sign a voluntary five-year grazing agreement that outlines an agreed-upon stocking rate and requires implementation of a twice-over grazing rotation on the native prairie pasture. The CWHP cost-shares the infrastructure required to create paddocks for the rotation, and offers ongoing technical support. The value of sustainable grazing on native pasture is most clearly demonstrated for producers who participate in having their cattle weighed before and after the grazing season (June 1 to October 15). Weight gains are a meaningful unit of measure for cattle producers; in many cases, measuring weight gains on grazing project pastures has prompted changes in management on other properties, as more pounds of beef equals more dollars. CWHP staff conduct vegetation inventories throughout the five-year agreement to monitor changes in habitat quality, and find that value as wildlife habitat typically improves by at least one grade level, based on the Manitoba Conservation Data Centre's mixed grass prairie grading guidelines.

The majority of the remaining native prairie habitat in Manitoba is privately owned, and is typically used as pasture for cattle. Consequently, it is essential to work with cattle producers to maintain and improve healthy prairie habitat. The Critical Wildlife Habitat Program (CWHP) initiated the Mixed Grass Prairie Habitat Stewardship project to promote conservation practices that benefit wildlife habitat while helping to increase farm family income on native mixed grass prairie pasturelands in Manitoba. The project uses financial incentives to cover a portion of infrastructure costs, as well as extension and ongoing technical support to promote sustainable grazing practices and introduce management techniques that facilitate restoration of degraded prairie habitat. To date, 55 grazing project agreements have been signed, covering 20,600 acres of mixed grass prairie in Manitoba.

The most common management decisions that negatively impact native prairie pastures in Manitoba are overstocking and grazing too early or too late in the growing season. Farm management decisions on stocking rates and grazing schedules are typically adjusted to accommodate winter feed supplies, calving dates, or to reduce labour in the farmyard. The Mixed Grass Prairie Habitat Stewardship Project strives to foster a shift in farm management priorities. The project emphasizes the importance of setting stocking rates based on the forage value of species present on a pasture and the long-term financial and ecological benefits of a grazing schedule that complements native grass biology.

The twice-over rotational grazing system has been documented to enhance grassland habitats by increasing native grass cover and reducing bare ground (Manske 2003). A twice-over rotation also offers the benefit of more consistent cow/calf weight gains throughout the growing season than a traditional season-long grazing strategy (Biondini and Manske 1996). As part of the Mixed Grass Prairie Habitat Stewardship Project, cow/calf producers with a minimum of one quarter section (160 acres, 65 ha) of mixed grass prairie pasture are eligible to enter into a five-year grazing agreement with the CWHP. The landowner agrees to follow a twice-over grazing rotation in exchange for an infrastructure cost-share of up to $1,250 per quarter section. Project staff work with landowners to set up the paddocks for the rotation and negotiate a stocking rate that allows the grassland to improve from a degraded state while providing adequate forage for the duration of the grazing season. Light to moderate forage use is documented as a sustainable practice compatible with maintenance or improvement of range condition (Biondini et al. 1998, Holecheck et al. 1999, Papanastasis 2009). While stocking density is typically reduced on a twice-over grazing system, the grazing season is long (June 1 to October 15) in comparison with typical season-long grazing, which often ends in September.

The perceived success or value of pastureland is traditionally based on the number of cattle that can be sustained on the property for a given period of time. To help demonstrate the value of sustainable grassland management to cattle producers, project staff provide a scale to weigh cattle before and after each grazing season. Examining cow and calf weights over time allows producers to match improved pasture condition to improved cattle performance. Annual records of weight gain on pasture allows producers to calculate the total pounds of beef produced in a single grazing season and translate this to a dollar figure based on market value. Those who participate in the weighing program have found it to be a meaningful measure of the income gained from a particular property and often use the information to change management practices on other properties.

In addition to grazing, other habitat management prescriptions have been introduced to grazing project pastures. Prescribed burning has focused on three grassland management priorities: litter removal in wet meadows, non-native cool-season grass suppression, and suppression of woody encroachment. Landowners have been receptive to the possibility of having their pastures burned, particularly in areas with limited options for management. In pastures with a wet meadow component, cattle typically prefer dry uplands and avoid accumulated litter in low-lying areas. In this type of landscape, landowners find that grazing pressure is more evenly distributed following a burn. Non-native cool-season grass suppression deals primarily with Kentucky Bluegrass on mixed grass prairie grazing project pastures. Kentucky Bluegrass offers little value as forage after flowering in May and June (Moore 2003) and tends to remain ungrazed, accumulating as litter under twice-over rotational grazing management. Burning activities in late April and early May are implemented to damage the early season growth of Kentucky Bluegrass, which helps limit the existing cover and further expansion of this species. Long-term suppression of woody encroachment cannot be achieved with a single burn event, but aboveground stems can be killed when adequate litter is present to maintain a hot fire. Coupled with attention to grazing management, prescribed fire has been a popular and successful tool for restoring native species composition on prairie pastures in southwest Manitoba.

Mowing was initiated in June 2009 on grazing project pastures degraded by invasive shrub encroachment. The most common invasive shrub species on mixed grass prairies in Manitoba are Snowberry (*Symphoricarpos occidentalis*) and Wolf Willow (*Elaeagnus commutata*). Woody encroachment into grassland areas results in loss of plant diversity at a local level (Lett and Knapp 2005) and reduces value for landowners as grazing land (Moss et al. 2008). Grasslands heavily encroached by shrubby growth also offer reduced habitat value for grassland dependent birds such as the Sprague's Pipit (Environment Canada 2008). The goal of the mowing initiative is to demonstrate an effective, non-chemical method for the long-term reduction of woody species on pastureland. Studies show that a single burn or removal treatment is not effective in controlling Snowberry (Romo et al. 1993, Anderson and Bailey 1979), and control treatments for woody vegetation are most effective when applied during the growing season (Richberg 2005).

The Snowberry and Wolf Willow colonies on grazing project pastures are mowed twice each summer, in June and August. Cutting height is six to eight inches, which removes the shrub canopy while leaving grass available for grazing and longer shrub stems to prevent injury to the feet of cattle grazing in these mowed areas. Mowed pastures are monitored to document changes in the vegetative and avian communities. Control sites are also monitored where suitable pastures are available near the mowed sites.

The extension component of the program is focused on two annual events: a spring pasture tour in June and a three-day educational workshop in November. Dr. L. Manske, Range Scientist at North Dakota State University, participates in both events, providing information on grassland ecology, animal nutrition and the twice-over rotational grazing system.

The pasture tour is very popular and has been attended by as many as 40 private land managers. The tour typically features three grazing project stops, including sites in different landscapes and a burned or mowed site if possible. Each tour stop focuses on the landowners, who typically relate the history of management on the property and their experience with twice-over rotational grazing and the Mixed Grass Prairie Habitat Stewardship Project. Tour participants include landowners not currently involved in CWHP programming as well as some who have twice-over grazing systems but would like to learn more about grassland ecology. Participants particularly enjoy the testimonials from landowners involved in the project and the opportunity to walk on the pastures to see the results for themselves.

The November workshop is a three-day event, offering an overview of grassland ecology, native grass biology and an examination of the nutritional requirements of grazing animals. The workshop features presentations by existing grazing project co-operators, who present their cattle weights and relate their experience with the program. The final day of the workshop is an opportunity for participants to create an annual forage plan to facilitate the proper management on native pastures during the growing season. Participants leave the workshop with a more meaningful understanding of the grazing system, how it works, and how it could be applied to their native pastures, as well as background on grassland management and how it contributes to habitat conservation.

To achieve a widespread improvement in the quality of native mixed grass prairie habitat in Manitoba, this project focuses on co-operation with cattle producers. The weigh scale has been an important tool in demonstrating that ecologically sustainable grassland management practices are financially beneficial for cattle producers. The ongoing staff support for each project co-operator is also critical to the long-term success of the project overall; staff spend a great deal of time with co-operators to ensure a thorough understanding of, and compliance with, the twice-over rotational grazing strategy. For cattle producers, the most valuable outcomes from the project are a reliable grazing season from June 1 to October 15 each year, and better-than-average cattle weight gains from their native prairie pasture. Interviews are conducted with grazing project co-operators at the end of the five-year agreement. Most landowners indicate that after following the system through several growing seasons, they see an improvement in the health of the pasture and plan to continue using the twice-over rotational grazing strategy in the future.

Literature Cited

Anderson, M.L. and A.W. Bailey. 1979. Effect of fire on a *Symphoricarpos occidentalis* shrub community in central Alberta. *Canadian Journal of Botany* 57: 2819-2823.

Biondini, M.E. and L. Manske. 1996. Grazing frequency and ecosystem processes in a northern mixed prairie, USA. *Ecological Applications* 6: 239-256.

Biondini, M.E., B.D. Patton and P.E. Nyren. 1998. Grazing intensity and ecosystem processes in a northern mixed-grass prairie, USA. *Ecological Applications* 8: 469-479.

Environment Canada. 2008. Recovery Strategy for the Sprague's Pipit (*Anthus spragueii*) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa, ON.

Holechek, J.L., H. Gomez, F. Molinar and D. Galt. 1999. Grazing studies: What we've learned. *Rangelands* 21: 12-16.

Lett, M.C. and A.K. Knapp. 2005. Woody plant encroachment and removal in mesic grassland: Production and composition responses of herbaceous vegetation. *American Midland Naturalist* 153: 217-231.

Manske, L. 2003. Biologically effective management of grazing lands. North Dakota State University, Dickinson Research Extension Center. http://www.grazinghandbook.com/ Accessed June 23 2010.

Moore, J. 2003. Common native pasture plants of southern Manitoba: A landowner's guide. Critical Wildlife Habitat Program, Manitoba Conservation, Winnipeg, MB.

Moss, R., B. Gardiner, A. Bailey and G. Oliver (eds.). 2008. A guide to integrated brush management on the western Canadian plains. Manitoba Forage Council, Brandon, MB.

Papanastasis, V.P. 2009. Restoration of degraded grazing lands through grazing management: Can it work? *Restoration Ecology* 17: 441-445.

Richburg, J.A. 2005. Timing treatments to the phenology of root carbohydrate reserves to control woody invasive plants. Ph.D. dissertation, University of Massachusetts, Amherst, MA.

Romo, J.T., P.L. Grilz, R.E. Redmann and E.A. Driver. 1993. Standing crop, biomass allocation patterns and soil-plant water relations in *Symphoricarpos occidentalis* (Hook.) following autumn or spring burning. *American Midland Naturalist* 130: 106-115.

Social Components of a Changing Conservation Ethic and its Consequences for Conservation Science in Canada's National Parks

Rafael Otfinowski, Tracy Bowman and Krista Scott
Parks Canada

Abstract – Conservation of natural areas requires scientific expertise as well as social and political support. In fact, local support for conservation remains weak in areas where it is regarded as detached from people's daily needs. As an organization mandated to conserve the integrity of ecosystems, Parks Canada depends on both social and political support for the continuation of its conservation programs. Here, we explore what kind of social conservation ethic may emerge in response to changes in the Canadian population and how this might influence support for conservation science programs in our national parks.

Principal changes in the Canadian population can be captured based on three emerging trends: growing urban centres, an ageing population, and increasing immigration. Using published reports, we review the urbanization of Canadian cities and discuss the projected demographic shifts in the Canadian population. We ask specifically whether increasing urbanization could result in a loss of ecological literacy among Canada's youth, and explore changing perceptions of wilderness travel among the growing older cohort of our population. These trends are further discussed in the context of an increasing number of new Canadians, whose socio-cultural norms contribute new perspectives to our collective conservation ethic.

In order to fulfill its mandate to preserve and restore the integrity of protected areas, Parks Canada must find social and political support for its conservation programs. Our discussion explores links between changing social and demographic trends and an emergent conservation ethic, an ethic that we argue is key to continued support for conservation science programs in the national parks.

CHANGES IN PRAIRIE HEALTH

Do Grassland Songbirds Avoid Natural Gas Wells?

Holly J. Kalyn Bogard and Stephen K. Davis*
Department of Biology, University of Regina
*Canadian Wildlife Service

Abstract – The quantity and quality of remaining grasslands in southwestern Saskatchewan, Canada, are threatened by expansion of natural gas development. The number of natural gas wells has nearly tripled in the past 10 years. Current management strategies do not consider the effect of natural gas development on grassland birds, as the impacts are not known.

We quantified the abundance of grassland birds across a gradient of gas well densities to determine the extent to which natural gas development affects songbird abundance on native grasslands. We conducted 1250 point counts in 105 plots (256 ha) at varying distances from natural gas wells. Well density ranged from 0-16 natural gas wells per 256 ha. We considered the effects of natural gas well density, well distance, and an additive and interactive effect of well density and distance.

We recorded 12 grassland songbird species, including four species of high conservation concern; Sprague's Pipit, McCown's Longspur, Chestnut-collared Longspur, and Baird's Sparrow. Effects of natural gas development varied among species. Both Chestnut-collared Longspur and Baird's Sparrow abundance was positively correlated with distance from natural gas wells in areas with high well density. Sprague's Pipit and McCown's Longspur abundance was not correlated with well density or distance to natural gas wells. This information will allow federal and provincial agencies to make informed decisions regarding wildlife and land-use policies associated with natural gas development on native mixed grass prairie.

Alberta Piping Plover Predator Exclosure and Population Monitoring Program

Lance Engley and Amanda Rezansoff
Alberta Conservation Association

Abstract – The Piping Plover (*Charadrius melodus*) is an endangered shorebird that breeds along the Atlantic Coast, the Great Lakes and the Great Plains in Canada and the US. It nests on gravel beaches often found on waterbodies with fluctuating water levels or highly alkaline conditions. Several factors have led to rapid declines in Piping Plover populations in Alberta and across North America, including habitat damage, increased pressure from predators and human disturbance.

The first Alberta Piping Plover Recovery Plan was released in 2002. Since that time, the Alberta Conservation Association has been leading a Piping Plover program that addresses several of the recovery actions identified in the plan. The two primary objectives of the program are to reduce the number of eggs lost to predators through the application of predator exclosures, and to work with landowners and other agencies to implement stewardship activities that help to enhance Piping Plover habitat in Alberta.

Predator exclosures are small metal cages that are placed over active nests. The mesh used is large enough to allow the incubating adults to pass freely in and out of the exclosure, but small enough that it prevents the primary nest predators (coyotes, foxes, gulls, crows, etc.) from being able to prey on the eggs. The hatching success of nests which are exclosed is nearly double that of nests which are not exclosed.

The habitat enhancement component focuses largely on working with landowners to prevent livestock from damaging habitat and trampling nests during the breeding season. This has been accomplished through the installation of temporary or permanent fencing, off-site watering units and implementation of deferred grazing regimes. In addition, educational and cautionary signage has been erected where ATV use and other human activity is high.

Reducing Crested Wheatgrass Seed Production through Prescribed Burning and Timed Intensive Grazing in Grasslands National Park of Canada

Michael Fitzsimmons, Rafael Otfinowski and Adrian Sturch
Parks Canada

Abstract – Exotic plant invasions pose a growing threat to the endemic diversity and function of ecosystems. In Grasslands National Park of Canada (GNP), Crested Wheatgrass (*Agropyron cristatum* (L.) Gaertn.), a Eurasian species introduced to southwest Saskatchewan to provide spring forage for cattle, continues to invade native prairies from historically seeded areas. Invading plants alter the diversity, structure and standing biomass of prairies, and impact their use by endemic species including Plains Bison and Black-tailed Prairie Dogs. Here, we present ongoing research to restore areas of native prairie invaded by Crested Wheatgrass.

Using a combination of prescribed burning and timed intensive grazing, Parks Canada has been experimenting with methods to reduce seeds produced by the invading plants. In 2009, a 70 ha site near Two Trees Trail in GNP was burned in April and grazed by cattle in June (1.0 AUMs/ha). Ten permanently marked belt transects 1 m by 100 m were used to assess Crested Wheatgrass seed-head production in late summer of 2008 and 2009 – five in a control area and five in the 2009 treatment area. In the absence of grazing and burning, Crested Wheatgrass seed-head production in 2009 exceeded 2008 levels by 190% to 1606%. Mean seed-head densities per transect ranged from 5.3 to 18.9 seed-heads/m^2 in 2009 and from 0.6 to 5.9 seed-heads/m^2 in 2008. In the treatment area, 2009 seed-head production means on transects were 11% to 22% of that observed in 2008. Mean Crested Wheatgrass seed-head densities per transect in the treatment area ranged from 0.2 to 2.1 seed-heads/m^2 for 2009 (after treatment) and from 2.1 to 10.1 seed-heads/m^2 for 2008 (prior to treatment).

Grazing will continue inside the 2009 burn area during 2010 and 2011 in order to further diminish the seed production by Crested Wheatgrass. This initial burning and timed intensive grazing treatment will be followed up by spraying of Crested Wheatgrass and then seeding of native species. Results of our research will contribute to plans to restore other areas invaded by Crested Wheatgrass in Grasslands National Park, as well as provide valuable methods for the restoration of other areas of native prairie throughout western Canada.

Floristic Quality Assessment of the Manitoba Tall Grass Prairie Preserve

Katrina Hamilton
Clayton H. Riddell Faculty of Earth, Environment and Resources, University of Manitoba

Julie Sveinson Pelc
Nature Conservancy of Canada – Manitoba Region

Laura Reeves
Critical Wildlife Habitat Program

Cary Hamel
Nature Conservancy of Canada – Manitoba Region

Abstract – One challenge facing land managers is the current lack of a standardized method of measuring the floristic quality of conservation lands. This project aims to address this by developing a floristic quality assessment system specific to the Manitoba Tall Grass Prairie Preserve. The results of this assessment will allow stakeholders to empirically evaluate site quality based on existing data, monitor changes in site quality over time, and assess the effectiveness of habitat restoration efforts.

The assessment system will be based on a floristic quality index, developed by a panel of experts familiar with the preserve's specific ecological conditions. The index is based on the concept of species conservatism; i.e., the degree of fidelity to a specific habitat type that a species exhibits. Each individual species is assigned a coefficient value between 0 and 10, which represents their fidelity to the habitat type. Non-native species are assigned a weediness value between -1 and -3, indicating their potential to compromise habitat diversity. The end result is an assessment system that evaluates the floristic quality of a site based on richness of conservative taxa and the presence of potentially noxious weeds. This project will involve the development of two separate indices for application in the upland prairie and sedge meadow habitat types. All findings will be tested against long-term vegetation data to determine the usefulness of the indices as a quantitative measure of site quality.

Invasive Species Council of Manitoba: Invasives Awareness

Cheryl Heming
Invasive Species Council of Manitoba

Abstract – Invasive Species have in the past and will in the future continue to invade our prairie landscape. The Invasive Species Council of Manitoba is dedicated to maintaining a healthy biodiverse landscape through the prevention, early detection, education and awareness of invasive alien species management.

Preserving the Cultural and Ecological Integrity of the Mixed Grass Prairies in Grasslands National Park

Sharon Thomson and Rafael Otfinowski
Parks Canada

Abstract – The conservation of ecological integrity is a priority for Canada's National Parks. Traditionally defined as the conservation of species diversity and the processes that support them, conservation goals also extend to cultural resources. People are a part of ecosystems, and in prairies throughout North America, human land use over thousands of years has left a rich cultural resource record that provides an invaluable indication of prairie productivity. Here, we present ongoing research exploring the relationship between restoring grazing to prairie landscapes and potential impacts to the cultural resources of Grasslands National Park (GNP) in Saskatchewan.

Restoring grazing to GNP constitutes an effort to increase the ecological integrity of mixed grass prairies within the Park. Higher standing plant biomass, increased cover of non-native plants, and a decline in the populations of several vertebrate and invertebrate species indicate that grazing disturbance is integral to the conservation of prairie ecosystems. In a multi-scale, multi-year experiment, the Park is quantifying the impacts of grazing disturbance on the structure, function and composition of prairie communities.

In addition to measuring the impact of grazing on the prairie biodiversity, the condition of cultural resources located throughout the experimental units will be similarly examined for the duration of the experiment. The twenty-six cultural sites selected for monitoring range from small lithic scatters to more extensive features, including rock cairns and tipi rings. Sites were selected at varying distances from water, roads and fencelines, in both upland and riparian areas, and were distributed among pastures representing the three classes of grazing intensity. At each location, photographs, sketches and descriptions of the condition of each artifact will serve to quantify changes in the condition of cultural resources.

Cultural resource monitoring sites will be revisited over the 10-year course of the grazing experiment; two times in areas grazed at medium and low intensity, and four times in areas grazed at high intensity. Results of this experiment will help quantify the impacts of grazing on cultural sites in GNP and contribute to calculating optimal stocking rates. More importantly, this study will help incorporate the protection of cultural resources into the restoration of ecological integrity within protected areas throughout the prairies.

CHANGES IN PRAIRIE AND SPECIES CONSERVATION

Seed Bank Project to Conserve Manitoba's Native Orchid Species

Doris Ames and Peggy Bainard Acheson
Native Orchid Conservation Inc.

Abstract – In 2006, we began a new project to conserve native orchid species. This involves the collection of native orchid seed capsules in Manitoba for long-term storage in Canada's national seed-bank in Saskatoon. The seed-bank's formal name is Plant Gene Resources of Canada.

Although we believe that conservation of their habitat is the best way to protect native orchids, we also know that long-term seed storage will improve our ability to respond to rapid environmental changes that may be harmful to them. Since 25% of Canada's vascular plants are considered rare and there are many orchid species among them, we believe it is important to conserve their genetic biodiversity by storing some of their seeds in an appropriate facility.

This poster illustrates some of our activities in seed collection and preparation as well as some of the procedures carried out at Plant Gene Resources of Canada to ensure survival of the orchid seeds during long-term storage.

The Manitoba Breeding Bird Atlas

Christian Artuso
Bird Studies Canada

Abstract – The Manitoba Breeding Bird Atlas is a citizen-science project of many partner organizations, including Bird Studies Canada, Nature Manitoba, The Manitoba Museum, Environment Canada, Manitoba Conservation and others, to engage Manitobans in gathering essential baseline data on the distribution and abundance of all bird species breeding in the province, including special surveys for species at risk. Data will be collected from 2010 to 2014 following standardized protocols. We have a three-phase mission:

(1) to increase and strengthen the pool of active volunteers in ecosystem monitoring;

(2) to produce high-quality data on all species of birds throughout the province; and

(3) to create a state-of-the-art living document (web-based interactive mapping tool, regularly updated and accessible to all, as well as bilingual printed editions) with multiple applications including long-term monitoring and education.

This poster provides information on this ambitious project.

Manitoba Tall Grass Prairie Preserve: Providing Habitat for Protected and Provincially Rare Species

Christie Borkowsky
Critical Wildlife Habitat Program

Abstract – The establishment of the Manitoba Tall Grass Prairie Preserve in 1989 secured some of the highest quality and largest parcels of tall grass prairie remaining in the province. Shortly after securement by either Nature Manitoba (formerly Manitoba Naturalist Society) or Manitoba Habitat Heritage Corporation, seasonal staff began inventory efforts to document the various floral and faunal species in the area. With the addition of the Nature Conservancy of Canada, the Preserve has grown in size (to nearly 5,000 hectares), as has the list of species. To date, over 900 species have been documented for the area, with eleven species protected under the federal *Species at Risk Act* and seven species by Manitoba's *Endangered Species Act*. The Preserve provides refuge for many provincially rare species, some of which have very limited distributions.

Following two years of survey work in the late 1980s by the Manitoba Naturalists Society (now Nature Manitoba), a recommendation was made to establish a tall grass prairie preserve in southeastern Manitoba where some of the largest contiguous and highest quality tall grass prairie remnants remained (M. Latta, pers. commun.). The Critical Wildlife Habitat Program (CWHP) was established in 1989 to administer the Tall Grass Prairie Conservation Project. That year, the first three properties were purchased for what is now known as the Manitoba Tall Grass Prairie Preserve. One of the properties was selected due to the presence of the Western Prairie Fringed-orchid (*Platanthera praeclara*). Presently, all of the land that has been acquired for the Preserve is in the western portion of the Rural Municipality of Stuartburn, about 100 km south of Winnipeg (Fig. 1).

When a parcel of land is acquired, a baseline inventory is completed to document the flora and fauna. Along with confirmed identifications from other knowledgeable prairie enthusiasts, Preserve staff have identified: 356 species of plants (319 native, 37 exotic), 166 species of birds, 6 species of reptiles, 9 species of amphibians, 47 species of mammals and 294 species of butterflies and moths (Critical Wildlife Habitat Program 2005). A recent study of the micro-moths will likely add an additional 20 - 30 species to the list. Among this list of nearly 900 species, eleven are currently listed under the federal *Species At Risk Act*, seven are listed under Manitoba's *Endangered Species Act* and many others are considered to be rare within the province (Table 1).

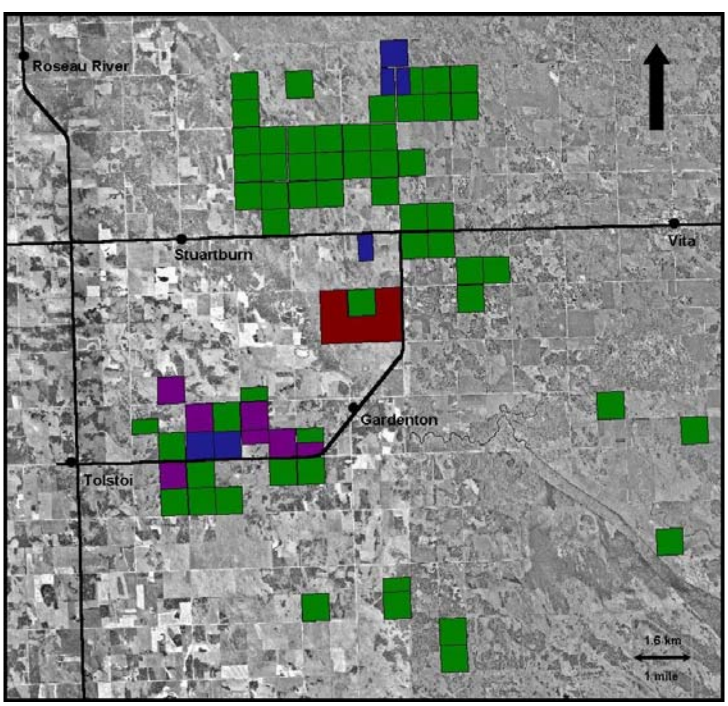


Figure 1. Distribution of the Manitoba Tall Grass Prairie Preserve lands by agency.

This map is for illustration only and may contain omissions or errors. Data Sources: Manitoba Land Initiative (orthophotos, Transportation, Towns, Wildlife Management Area); Nature Conservancy of Canada – Manitoba Regional staff; Nature Manitoba; Manitoba Habitat Heritage Corporation. Projection: NAD 83 UTM Zone 14.

Manitoba Habitat Heritage Corporation
Nature Manitoba
Nature Conservancy of Canada
Stuartburn Wildlife Management Area

Protected and provincially rare species found in or near the Manitoba Tall Grass Prairie Preserve with protection status and provincial rank.

COMMON NAME	SCIENTIFIC NAME	SARA[1]	ESA[2]	COSEWIC[3]	S Rank[4]
Plants					
Cooper's Milkvetch	*Astragalus neglectus* - (Torr. & Gray) Sheldon				S1
Culver's Root	*Veronicastrum virginicum* - (L.) Farw.		TH		S1
Dwarf Huckleberry	*Vaccinium caespitosum* - Michx.				S2
Field Sedge	*Carex conoidea* - Schkuhr ex Willd.				S1
Four-flowered Yellow Loosestrife	*Lysimachia quadreflora* - Sims				S2
Great Plains Ladies'-tresses	*Spiranthes magnicamporum* - Sheviak		EN		S1?
Grooved Yellow Flax	*Linum sulcatum* - Riddell				S3
Northern Adder's-tongue	*Ophioglossum pusillum* - Raf.				S1
Riddell's Goldenrod	*Oligoneuron riddellii* - (Frank ex Riddell) Rydb.	SC	TH	SC	S2
Showy Tick-trefoil	*Desmodium canadense* - (L.) DC.				S2
Slender False Foxglove	*Agalinis tenuifolia* - (Vahl) Raf.				S2S3
Small Sundrops	*Oenothera perennis* - L.				S1S2
Small White Lady's-slipper	*Cypripedium candidum* - Muhl. ex Willd.	EN	EN	EN	S1
Two-flower Dwarf-dandelion	*Krigia biflora* - (Walt.) Blake				S2
Western Prairie Fringed-orchid	*Platanthera praeclara* - Sheviak & Bowles	EN	EN	EN	S1
Western Silvery Aster	*Symphyotrichum sericeum* - (Vent.) Nesom	TH	TH	TH	S2
Wild Crane's-bill	*Geranium maculatum* - L.				S1
Birds					
Red-headed Woodpecker	*Melanerpes erythrocephalus* - (Linnaeus)	TH		TH	S2S3B
Short-eared Owl	*Asio flammeus* - (Pontoppidan)	SC		SC	S3S4B
Whip-poor-will	*Caprimulgus vociferus* – Wilson			TH	S4S5B
Willow Flycatcher	*Empidonax traillii* - (Audubon)				S2S3B
Yellow Rail	*Coturnicops noveboracensis* - (Gmelin)	SC		SC	S3S4
Mammals					
Plains Pocket Gopher	*Geomys bursarius* - (Shaw)				S3
Amphibians					
Northern Leopard Frog (Prairie population)	*Rana pipiens* - Schreber	SC		SC	S4
Butterflies					
Dakota Skipper	*Hesperia dacotae* - (Skinner)	TH	TH	TH	S2S3
Monarch	*Danaus plexippus* - (Linneaus)	SC		SC	S5
Powesheik Skipperling	*Oarisma powesheik* - (Parker)	TH		TH	S2

Codes: EN – Endangered; TH – Threatened; SC – Special Concern; S1 – Very Rare; S2 – Rare; S3 – Uncommon; S4 – Widespread; B – Breeding Status

References: [1] Species at Risk (2009), [2] Manitoba Endangered Species Act (2010), [3] COSEWIC (2009) [4] Manitoba Conservation Data Centre (2010), NatureServe (2009)

The CWHP brought together government and non-government organizations. The first five partners were Nature Manitoba, World Wildlife Fund, Wildlife Habitat Canada, Manitoba Habitat Heritage Corporation and Manitoba Conservation. In 1993 and 1994, respectively, the Nature Conservancy of Canada and Environment Canada (Canadian Wildlife Service) joined in the efforts to protect the remaining tall grass prairie in Manitoba. World Wildlife Fund and Wildlife Habitat Canada are no longer active in this partnership; however, their contributions were vital for the securement of habitat, early inventory work, and development of a long-term management strategy.

In the past 20 years, the Preserve has grown from 193 ha to slightly more than 5,000 ha. Organizations that hold title to the properties that form the Preserve include Nature Manitoba, Manitoba Habitat Heritage Corporation and Nature Conservancy of Canada. Provincial Crown lands within the Stuartburn Wildlife Management Area are also included in the Preserve. Since joining the Program in 1993, the Nature Conservancy of Canada has taken a leadership role in habitat securement and now holds title to a majority of the Preserve property. All partners are involved in the development of annual monitoring and management plans for the Preserve. The goal of these plans is to ensure that all activities are effective in maintaining ecosystem viability and promoting beneficial management practices for tall grass prairie.

Preserve staff complete annual monitoring projects for Small White Lady's-slippers (*Cypripedium candidum*), Western Prairie Fringed-orchid and Great Plains Ladies'-tresses (*Spiranthes magnicamporum*). Site visits are made to check on other protected and rare species occurring in the area. Over 35 research projects have taken place at the Preserve, and several have featured protected species such as the Powesheik Skipperling (*Oarisma powesheik*), Western Prairie Fringed-orchid and Small White Lady's-slipper.

Acknowledgements

Thank you to Peggy Westhorpe (Manitoba Conservation), Laura Reeves (Critical Wildlife Habitat Program) and Chris Friesen (Manitoba Conservation Data Centre) for their assistance.

Literature Cited

COSEWIC. 2009. Database of wildlife species assessed by COSEWIC. Government of Canada website. http://www.cosewic.gc.ca/eng/sct5/index_e.cfm Accessed February 19 2010.

Criticial Wildlife Habitat Program. 2005. Manitoba Tall Grass Prairie Preserve Species Checklist. Winnipeg, MB.

Manitoba Conservation Data Centre. 2010. MBCDC Species of Conservation Concern. Manitoba Conservation website, Government of Manitoba. http://www.gov.mb.ca/conservation/cdc/consranks.html Accessed February 19 2010.

Manitoba Endangered Species Act. 2010. The Endangered Species Act. Manitoba Laws website, Government of Manitoba. http://web2.gov.mb.ca/laws/statutes/ccsm/e111e.php Accessed February 19 2010.

NatureServe. 2009. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, VA. http://www.natureserve.org/explorer Accessed February 19 2010.

Species at Risk. 2009. Species at Risk Public Registry. Species at Risk website, Government of Canada. http://www.sararegistry.gc.ca Accessed February 19 2010.

The Genus *Allium*: Conservation Status in the Canadian Prairie Provinces

Hyeok Jae Choi
Korea National Arboretum; Department of Biology, University of Saskatchewan

J. Hugo Cota-Sánchez
Department of Biology and W. P. Fraser Herbarium (SASK), University of Saskatchewan

Abstract – A revision of the taxonomy of *Allium* in the Canadian Prairie Provinces (CPP) is presented based on observations of herbarium specimens and fieldwork. The focus of this study is on the rarity and conservation status of the species investigated. A key to species and a brief discussion of the taxonomic treatment along with distribution maps, illustrations, information on nomenclatural types, and ecological data are also provided. Five species are recognized: *A. schoenoprasum*, *A. geyeri* var. *tenerum*, *A. textile*, *A.cernuum*, and *A. stellatum*. In this study *A. geyeri* var. *geyeri* and *A. tricoccum* are excluded from the CPP's flora. The rarity and conservation status of *Allium* in the CPP are as follows:

1. *schoenoprasum*, listed as S2 in Saskatchewan, is also rare in Manitoba but its rarity status has not been formally assessed in the province
2. *geyeri* var. *tenerum* is the rarest *Allium* taxon with distribution restricted to the Waterton National Park area of Alberta, and currently listed as S2. The change to rarity rank S1 is recommended; and
3. the status of *A. cernuum* was reassessed and is recommended as a S1S2 rare species in Saskatchewan, an assessment based on its current distribution in southwestern habitats.

Introduction

With over 700 species, *Allium* is widely distributed in the northern hemisphere, especially in the temperate regions of Eurasia, but it is also found in the southern hemisphere in regions of Africa and Central and South America. Approximately one-sixth of the world's *Allium* diversity is represented in North America; i.e., about 96 species, 12 of which are known in Canada (McNeal 1992, McNeal and Jacobsen 2002). There is general agreement regarding the number of species in the Canadian Prairie Provinces (CPP); however, a formal taxonomic treatment is lacking. Here, we have combined quantitative investigations with qualitative and specimen-based observations of vegetative, floral and seed characters to address the taxonomy of *Allium* in the CPP. The goals of this study are:

1. to expand the current knowledge on morphology and distribution;
2. to address taxonomic issues, clarify the identity of nomenclatural types, and provide a taxonomic treatment with new illustrations of the species; and
3. to review the rarity and conservation status of *Allium* in the CPP.

Materials and Methods

This revision is based on 716 herbarium specimens of 508 collection numbers from the following herbaria: University of Alberta (ALTA), Agriculture and Agri-Food Canada, Ottawa (DAO), Linnean Society of London (LINN), Missouri Botanical Garden (MO), New York Botanical Garden (NY), University of Saskatchewan (SASK), and University of Manitoba (WIN).

General morphology: Observations and photographing of specimens were made using a TESSOVAR Photomacrographic Zoom System with Nikon D100.

Microstructures: Plant tissues were fixed in 70% ethanol, washed twice with 0.1M phosphate buffer (pH 6.8), refixed in 2.5% glutaraldehyde, and dehydrated in ethanol-acetone series. Then the tissues were critical-point dried with Polaron E3000 Series II, mounted on stubs, and coated with gold in an ion sputter coater, Edwards S150B. The samples were observed and photographed with a Philips 505 (1983) scanning electron microscope (SEM).

Map of geographic distribution: Distributional maps were generated using a customized map development tool especially designed and based on the open-source code Google™ Maps API on-line development tool.

Results and Discussion

Taxonomic Characters

Macromorphological characters: Several vegetative and morphological parts provided useful taxonomic characters at the specific level. Among these are the shape and development of rhizome, texture and sculpture of the bulb's outer tunica, shape and structure of leaf and scape in cross-section, number of leaves, the growing pattern of scape, bulblet development, and shape and size of some reproductive traits.

Microstructures of leaf epidermis and seed testa: The leaf epidermal cells of the *Allium* species investigated are usually rectangular to linear in shape (Fig. 1A–H). *A. schoenoprasum* exhibits only cells of the linear type (Fig. 1A, E). The cuticular cell sculpture pattern is smooth (Fig. 1B, C, F, G) or ridged (Fig. 1A, D, E, H). *A. stellatum* is characteristically distinguished by the prominent ridged walls. This feature is particularly useful in distinguishing *A. cernuum* from its close relative *A. stellatum*. The periclinal walls of the seed coat can be divided into three types: minutely roughened, granulate, and verrucate (Fig. 1I–P). The minutely roughened type is an attribute of *A. stellatum* (Fig. 1L, P), and the granulate type is characteristic of *A. schoenoprasum* and *A. textile* (Fig. 1I, J, M, N). The verrucate type in the seed coat is seen in *A. cernuum* (Fig. 1K, O) and *A. geyeri* (Fig. 19 of Kruse 1988). Our data demonstrate that seed testa sculpture is a source of valuable traits in *Allium* taxonomy as these provide key characters to distinguish closely related species; e.g., *A. geyeri* from *A. textile*, and *A. cernuum* from *A. stellatum*.

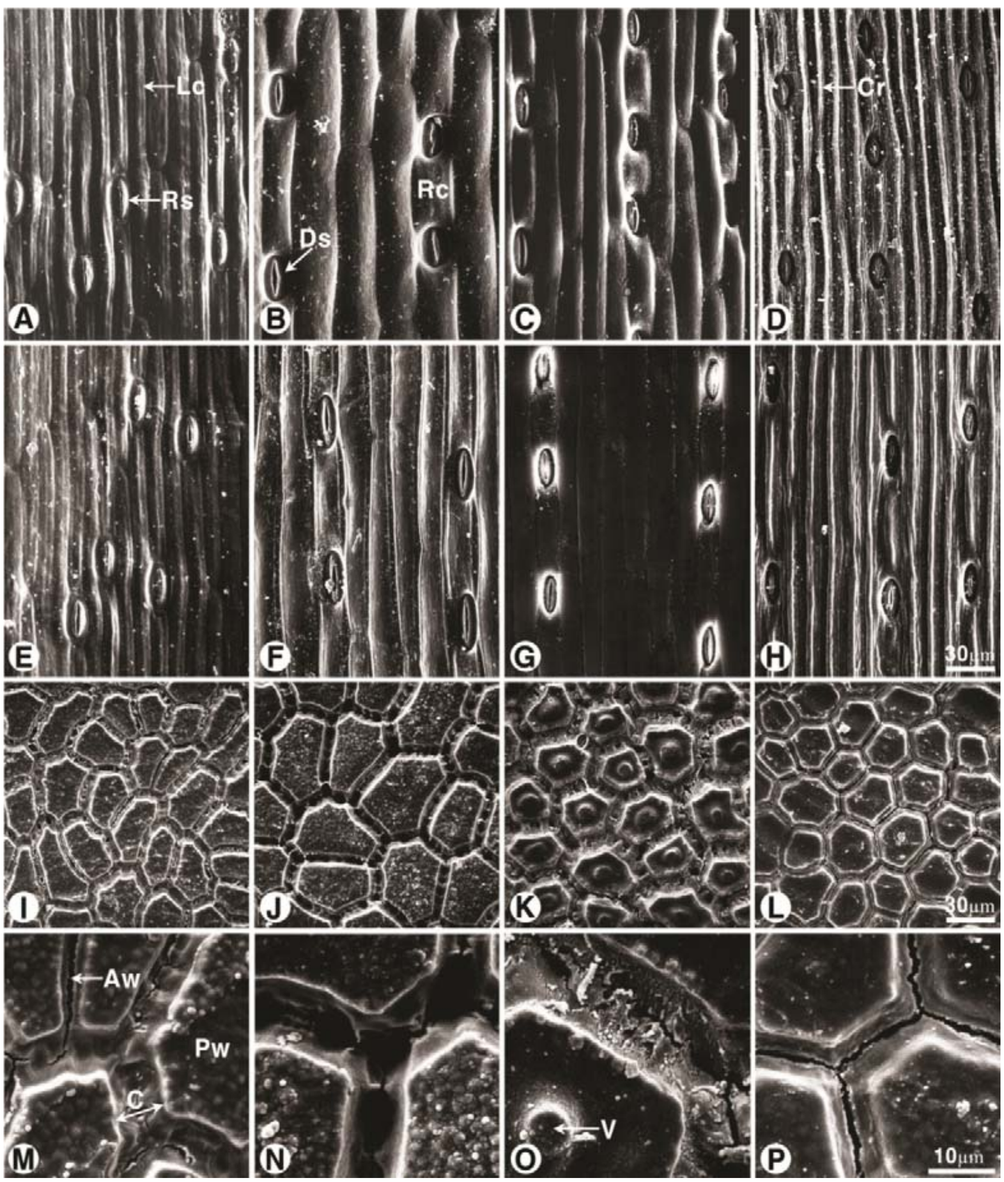


Figure 1. Epidermal cells of leaf (A–H) and seed testa (I–P) in *Allium* of the Canadian Prairie Provinces.

From the left to right:
A. schoenoprasum
A. textile
A. cernuum
A. stellatum

A–D: Adaxial view
E–H: Abaxial view

Lc: linear cell
Rc: rectangular cell
Cr: ridged cuticle
Rs: raised stomata
Ds: depressed stomata
Pw: periclinal wall
Aw: anticlinal wall
C: channel
V: verruca

Taxonomic Treatment

Allium L., Sp. Pl. 1: 294, 1753.

TYPE: *A. sativum* L. (lectotype).

REMARKS: In this revision of the CCP species, we recognize five species, namely: *A. schoenoprasum*, *A. geyeri* var. *tenerum*, *A. textile*, *A. cernuum*, and *A. stellatum* (Table 1). We conclude that the existing records of *A. geyeri* var. *geyeri* in the CPP are due to the misidentification of herbarium specimens. In fact, we verified the identity of these voucher specimens as *A. textile*. Therefore, despite the fact that *A. geyeri* var. *geyeri* is listed as S1 (five or fewer occurrences) in Saskatchewan (Harms 2003) and as S2 (6 to 20 occurrences) in Alberta (Kershaw et al. 2001), we recommend the exclusion of this species from the rare list in these provinces as well as the Canadian flora. In addition, we have excluded *A. tricoccum* from this study because there is no substantial evidence of its present occurrence in Manitoba, where it was previously reported. Currently, only one specimen of *A. tricoccum* (DAO 157082), collected by W.R. Leslie in 1923 in Morden, about 100 km southwest of Winnipeg, exists on record (Scoggan 1957). However, Lowe (1943) does not mention *A. tricoccum* in his list of Manitoba plants, and neither does Marshall (1989) in the Pembina Hills flora. We suspect that the only voucher specimen (DAO 157082) may have come from a cultivated plant (annotated by W.G. Dore in 1971).

Table 1. A comparison of the past and present *Allium* classification views in the Canadian Prairie Provinces (AB = Alberta, SK = Saskatchewan, MB = Manitoba, dash = not recognized, • = recognized).

Taxonomic view Taxon	Scoggan 1957 (MB)	Moss 1959 (AB)	Harms 2003 (SK)	McNeal and Jacobsen 2002	This study
1. *A. schoenoprasum* var. *schoenoprasum*	–	–	–	• (AB, SK, MB)	• (AB, SK, MB)
2. *A. schoenoprasum* var. *sibiricum*	•	•	•	synonym of 1	synonym of 1
3. *A. geyeri* var. *geyeri*	–	•	•	• (AB, SK)	–
4. *A. geyeri* var. *tenerum*	–	•	–	• (AB)	• (AB)
5. *A. textile*	•	•	•	• (AB, SK, MB)	• (AB, SK, MB)
6. *A. cernuum*	•	•	•	• (AB, SK)	• (AB, SK)
7. *A. stellatum*	•	–	•	• (SK, MB)	• (SK, MB)
8. *A. tricoccum*	•	–	–	–	–

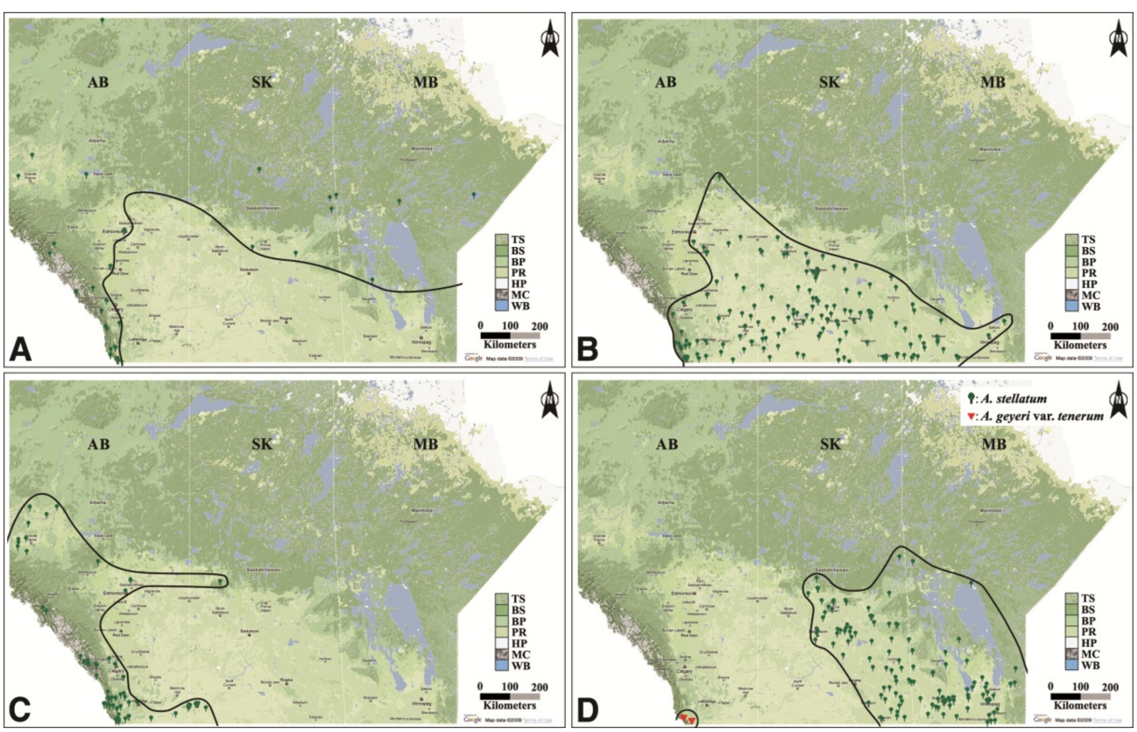


Figure 2. Geographic distribution and estimated edge (—) of *Allium* species in the Canadian Prairie Provinces.

A: *A. schoenoprasum*
B: *A. textile*
C: *A. cernuum*
D: *A. geyeri* var. *tenerum* (AB) and *A. stellatum* (SK and MB)

AB: Alberta
SK: Saskatchewan
MB: Manitoba
TS: Taiga Shield
BS: Boreal Shield
BP: Boreal Plain
PR: Prairie
HP: Hudson Plain
MC: Mountain Cordillera
WB: Water body

Key to the Allium Species of the Canadian Prairie Provinces

1. Leaf blades terete, with 2 rows of vascular bundles and hollow in cross-section, epidermal cells linear; scapes hollow in cross-section; tepals 10.0-15.0 mm long; ovary ellipsoid, with hood-like appendages at base; capsules ellipsoid; seeds elliptical, angular in cross-section.………………………………………………….…1. *A. schoenoprasum*

1. Leaf blades flat, channelled, semiterete, or V-shaped, with 1 row of vascular bundles and solid in cross-section, epidermal cells rectangular to linear; scapes solid in cross-section; tepals 3.8-8.8 mm long; ovary subglobose, without appendages or with crest-like appendage at apex; capsules cordiform; seeds oval to broadly oval, semiterete in cross-section.

   2. Rhizomes obsolete, erect, 0.5-2.7 mm long; tunicas of bulbs fibrous, reticulate; outer filaments non-exserted; styles non-exserted; seeds broadly oval.

      3. Leaves usually 3 or 4; umbels with 8-20 bulblets; perianth pink; ovary with crest-like appendages at apex; seed testa with verrucate periclinal cell walls………… ……………………………………………………..2. *A. geyeri* var. *tenerum*

      3. Leaves usually 2; umbels without bulblets; perianth white; ovary without appendages at apex; seed testa with granulate periclinal cell walls………..3. *A. textile*

   2. Rhizomes condensed, oblique, 2.0-7.7 mm long; tunicas of bulbs membranous, smooth; outer filaments exserted; styles exserted; seeds oval.

      4. Leaf blades nearly flat in cross-section; scapes recurved at the upper parts before and after anthesis; perianth campanulate, pink to white, with greenish midveins, inner tepals ovate, 5.0-6.7 mm long, 3.0-4.3 mm wide; outer tepals oval to orbicular, subrounded at apex, 3.8-4.8 mm long, 3.1-4.2 mm wide; inner filaments exserted; seed testa with verrucate or rarely minutely roughened periclinal cell walls……………………………….………4. *A. cernuum*

      4. Leaf blades nearly channelled to V-shaped in cross-section; scapes recurved at the upper parts before anthesis and becoming erect during flowering; perianth stellate, deep pink, with reddish midveins, inner tepals elliptical-lanceolate, 7.2-7.7 mm long, 2.3–3.5 mm wide; outer tepals elliptical, acute at apex, 6.0-6.2 mm long, 2.8-3.0 mm wide; inner filaments non-exserted; seed testa with minutely roughened periclinal cell walls…………………………5. *A. stellatum*

1. *Allium schoenoprasum* L., Sp. Pl. 1: 301, 1753 (Fig. 3).

LECTOTYPE: SIBERIA and BALTIC REGION. *LINN 419.37* (LINN photo!).

CPP: Wet meadows, rocky or gravelly mountain slopes, stream banks and lake shores of Alberta, Saskatchewan and Manitoba (Fig. 2A).

CONSERVATION STATUS: This species has been listed as a rare plant in Saskatchewan. It is ranked as S2 by the Saskatchewan Conservation Data Centre (SCDC 2009). In turn, Harms (2003) includes this species in the threatened category, i.e., an imperilled species that, due to its rarity, is likely to become endangered. Our distribution map confirms the rare status of this species as evidenced by the existence of few collections in Saskatchewan and Manitoba, with five and four localities, respectively (Fig. 2A). To our knowledge, there is no designation record about this plant's rarity status in Manitoba, and we recommend a more thorough survey to evaluate its distribution and demography in order to accurately determine the rarity status of this species.

2. *Allium geyeri* S. Watson var. *tenerum* M.E. Jones, Contr. W. Bot. 10: 28, 1902 (Fig. 4B–F).

HOLOTYPE: UNITED STATES. Idaho, Washington. 15 Jul 1899. *M.E. Jones 6597* (?: isotypes: MO!; NY photo!).

CPP: Meadows and damp places along streams in mountainous areas of southwesternmost Alberta (Fig. 2D).

CONSERVATION STATUS: This variety has been listed as S2 together with var. *geyeri* in Alberta (Kershaw et al. 2001). Although field population studies are lacking, herbarium records indicate that *A. geyeri* var. *tenerum* is the rarest *Allium* species in the CPP. Its distribution is restricted to the Waterton National Park area of Alberta (Fig. 2D). We recommend changing its provincial rarity ranking to S1 (five or fewer occurrences, or very few remaining individuals below 1000), considering the limited number (five) of herbarium collections available and the narrow distribution range (Fig. 2D). The rarity of this taxon in Canada may be correlated with its being at its northernmost range limit, as it is a relatively common species in the U.S. (McNeal and Jacobsen 2002). Regardless of this distributional pattern, proactive research such as population monitoring should be implemented to protect this species in the Canadian localities.

3. *Allium textile* A. Nelson & J.F. Macbride, Bot. Gaz. 56: 470, 1913 (Fig. 5).

HOLOTYPE: UNITED STATES. Missouri. *Plate No. 1840* (Bot. Mag.!).

CPP: Dry grasslands, hills and riversides of Alberta, Saskatchewan, and Manitoba (Fig. 2B).

REMARKS: *A. textile* is the most widespread species of the genus in the CPP (Fig. 2B). This species exhibits extreme variability in plant length, leaf number and floral size. Although the number of leaves is generally two, some specimens may have three or four leaves. Our field observations indicate that individuals with three or four leaves tend to develop longer perianth than those individuals with two leaves. Specimens of *A. textile* with more than three leaves have been misidentified as *A. geyeri* var. *geyeri* in various Canadian herbaria, but the former is easily distinguished by its white perianth (vs. pink) and absence of crest-like appendage in the ovary (vs. distinct appendage), as well as longer pedicel and shorter scape (Figs. 4A, 5).

4. *Allium cernuum* Roth, Arch. Bot. (Leipzig) 1: 40, 1798 (Fig. 6).

NEOTYPE: (Jacobsen 1980, p. 151) CANADA. British Columbia. 2 Jul 1941. *W.A. Weber 2248* (WS; isoneotype: GH, UC, MO, WTU, NY photo!).

CPP: Dry hills and arid slopes of Alberta and Saskatchewan (Fig. 2C).

CONSERVATION STATUS: *A. cernuum* is quite rare in Saskatchewan and is listed as S1S2 by the SCDC. Similarly, Harms (2003) includes this species in the vulnerable category, i.e., a species at risk because of declining numbers and typically found in 16 to 25 sites, which are reasons for special concern. Our data for the southwestern population are encouraging in terms of population demographic numbers, suggesting that this species might not be well categorized within the S1S2 rank. Harms' (2003) vulnerable status may be more appropriate as this species is locally abundant. However, considering that the existence of the Meadow Lake population is questionable, we recommend maintaining the rank of this species as S1S2 until wide-ranging surveys of the Meadow Lake and the Cypress Hills populations are conducted (Choi and Cota-Sánchez 2009).

5. *Allium stellatum* Ker Gawler, Bot. Mag. 38: 1576, 1813 (Fig. 7).

HOLOTYPE: UNITED STATES. Missouri. Collected by Nuttall. *Plate No. 1576* (Bot. Mag.!).

CPP: Open plains and wooded areas of Saskatchewan and Manitoba (Fig. 2D).

REMARKS: This species is widely distributed and relatively common in the prairie and adjacent boreal plains of southeastern Saskatchewan and southern Manitoba. Its closely related species, *A. cernuum,* occurs allopatrically in the mountainous and boreal shield areas of western Alberta and two isolated parts (Meadow Lake and Cypress Hills) of Saskatchewan (Fig. 2C, D).

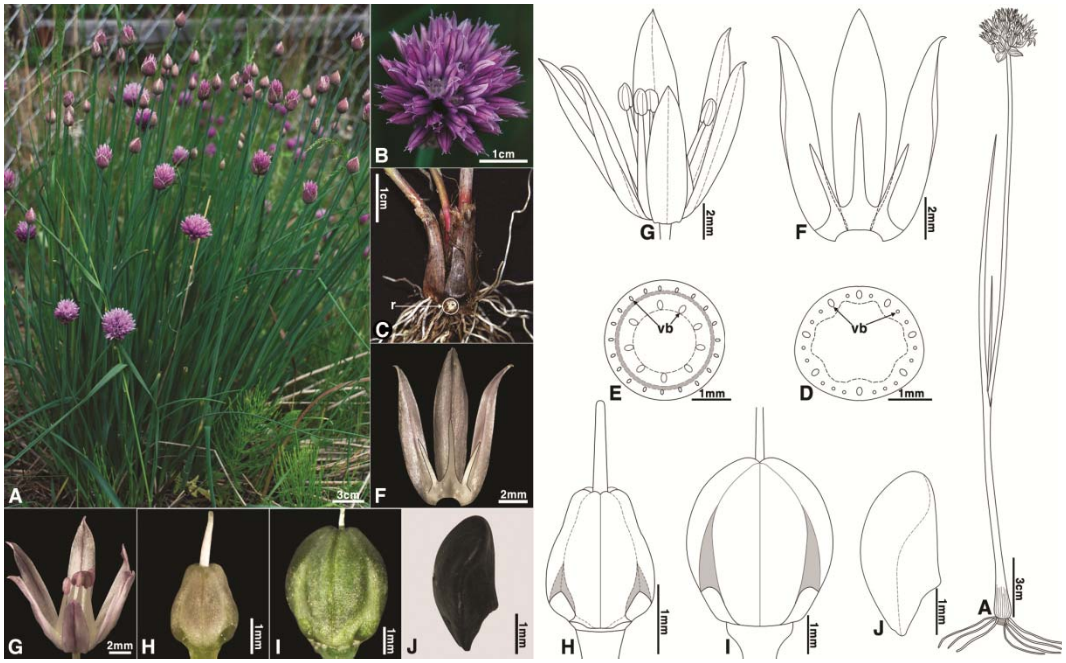


Figure 3. *Alllium schoenoprasum*

A: Habit
B: Inflorescence
C: Underground structure (r = rhizome)
D: Shape of leaf in cross-section (vb = vascular bundles)
E: Shape of scape in cross-section (dark area = fiber)
F: Tepal and filament arrangement
G: Perianth
H: Pistil (dark area = hood-like appendage)
I: Capsule (dark area = hood-like appendage)
J: Seed.

Figure 4. *Alllium geyeri*

A: var. *geyeri* (from Colorado, each number of individuals represents leaf count)

B–F: var. *tenerum*

B: Habit
C: Inflorescence (b = bulblet, r = bract)
D: Outer tunica of bulb
E: Tepal and filament arrangement
F: Pistil (dark area = crest-like appendage)

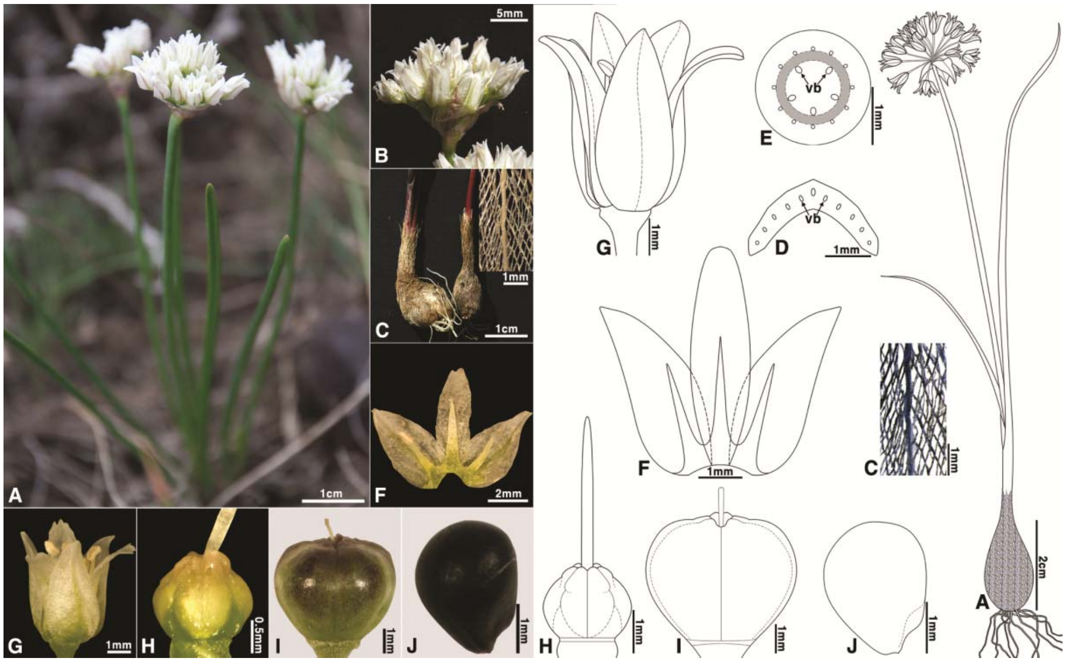


Figure 5. *Alllium textile*

A: Habit
B: Inflorescence
C: Underground structure and outer tunica of bulb
D: Shape of leaf in cross-section (vb = vascular bundles)
E: Shape of scape in cross-section (dark area = fiber)
F: Tepal and filament arrangement
G: Perianth
H: Pistil
I: Capsule
J: Seed

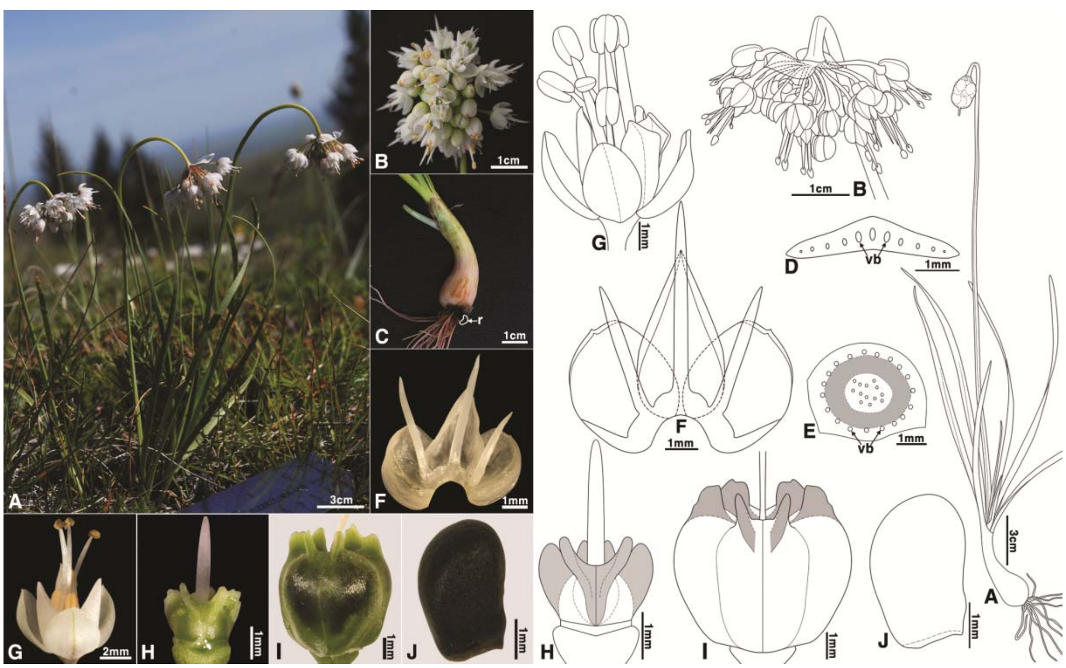


Figure 6. *Alllium cernuum*

A: Habit
B: Inflorescence
C: Underground structure (r = rhizome)
D: Shape of leaf in cross-section (vb = vascular bundles)
E: Shape of scape in cross-section (dark area = fiber)
F: Tepal and filament arrangement
G: Perianth
H: Pistil (dark area = crest-like appendage)
I: Capsule (dark area = crest-like appendage)
J: Seed

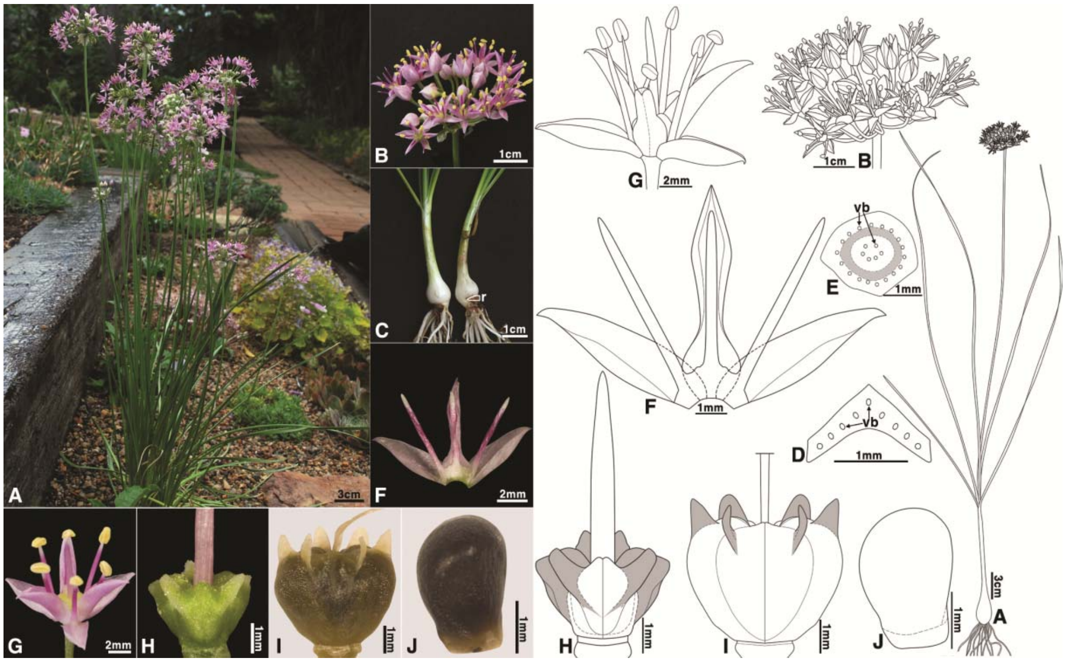


Figure 7. *Alllium stellatum*

A: Habit
B: Inflorescence
C: Underground structure (r = rhizome)
D: Shape of leaf in cross-section (vb = vascular bundles)
E: Shape of scape in cross-section (dark area = fiber)
F: Tepal and filament arrangement
G: Perianth
H: Pistil (dark area = crest-like appendage)
I: Capsule (dark area = crest-like appendage)
J: Seed

Acknowledgements

We thank V. Harms and D. Litwiller for comments on early drafts of the manuscript. C. Peters and D. Peters provided assistance in the mapping process. We also thank E. Punter for helping us to track *A. triccoccum* in Manitoba, the curators of ALTA, DAO, and WIN for lending material for study, and to SASK personnel for their assistance and for facilitating the loan of material. This research was partially supported by the Flora of Saskatchewan Association and the Korea Research Foundation in 2006 (Project No. C00659).

Literature Cited

Choi, H.J. and J.H. Cota-Sánchez. 2009. Nodding onion (*Allium cernuum*), a rare plant in Saskatchewan. *Blue Jay* 67: 249-252.

Harms, V.L. 2003. Checklist of the vascular plants of Saskatchewan and the provincially and nationally rare native plants of Saskatchewan. University Extension Press, University of Saskatchewan, Saskatoon, SK.

Kershaw, L., J. Gould, D. Johnson and J. Lancaster. 2001. Rare vascular plants of Alberta. The University of Alberta Press and the Canadian Forest Service, Edmonton, AB.

Kruse, J. 1988. Rasterelektronenmikroskopische Untersuchungen an Samen der Gattung *Allium* L. III. *Kulturpflanze* 36: 355-368.

Lowe, C.W. 1943. List of the flowering plants, ferns, club mosses, mosses and liverworts of Manitoba. Natural History Society of Manitoba, Winnipeg, MB.

Marshall, H.H. 1989. Pembina Hills flora. Morden and District Museum, Morden, MB.

McNeal, D.W. 1992. Taxonomy of North American species of *Allium*. Pages 195-204 *in* P. Hanelt, K. Hammer, and H. Knupffer (eds.), The Genus *Allium* - Taxonomic Problems and Genetic Resources. Proceedings of an International Symposium, Gatersleben, Germany, 11–13 June 1991.

McNeal, D.W. and T.D. Jacobsen. 2002. *Allium* L. Pages 224-276 *in* Flora of North America Editorial Committee (eds.), Flora of North America North of Mexico. Vol. 26. NYBG Press, New York, NY.

Saskatchewan Conservation Data Centre (SCDC). 2009. Vascular Plant Species List. Regina, SK. http://www.biodiversity.sk.ca/Docs/vasc.pdf Accessed July 19 2009.

Scoggan, H.J. 1957. Pages 206-207 *in* Flora of Manitoba. National Museum of Canada, Ottawa, ON.

Influential Variables in Ferruginous Hawk Nest Site Selection

Brad Downey and Paul Jones
Alberta Conservation Association

Abstract – The Ferruginous Hawk (*Buteo regalis*) is a bird of the open prairies that has experienced population declines over the last 20 years. Ferruginous Hawks are considered endangered in Alberta and listed as threatened by COSEWIC in Canada. Several factors may influence nest site selection and thus impact their population, such as disturbance, number of suitable nesting sites, competition, loss of native prairie, or abundance of prey. Surveys conducted in southern Alberta in 2004 and 2005 collected information on variables within seventy-two 6.4 by 6.4 km blocks in order to determine which were the most influential on nest site selection. Poisson regression was used to analyze eight priori candidate models. These models were selected based on limiting factors identified in the report, "Status of the Ferruginous Hawk (*Buteo regalis*) in Alberta: update 2006". Forage models consisting of Richardson's Ground Squirrels (Model 1) and Richardson's Ground Squirrels and native prairie (Model 2) had positive impacts on nesting, and were found to be the most influential models in nest site selection. The identification of forage as the most limiting factor for nest site selection by Ferruginous Hawks highlights the need for continued maintenance of native grasslands with an abundant Richardson's Ground Squirrel component.

The Prairie & Parkland Marsh Monitoring Program

Kiel Drake
Bird Studies Canada

Abstract – Efforts to protect birds and their habitats are being carried out in each country of North America, but significant gaps still exist and many bird populations continue to decline. The Prairie Habitat Joint Venture (PHJV) Implementation Plan 2007-2012 affirms that we lack the ability to set habitat conservation objectives for waterbirds, landbirds and shorebirds because of a lack of information on species distribution and habitat associations. In prairie Canada, we currently lack the ability to establish population objectives that are explicitly linked to habitat. This project seeks to link the occurrence of wetland-associated migratory birds to habitat characteristics at varying levels of spatial scale (i.e., marsh-specific to landscape-level habitat attributes), with the overall goal being to enable the development of spatially-explicit Decision Support System (DSS) models that will serve efforts to conserve and manage habitats for wetland-associated birds within the PHJV delivery area. During summer 2009, bird and habitat data were collected at over 450 marshes located within 27 study sites (AB 19, MB 5, SK 3). To date, fieldwork has been delivered by employing seasonal technicians, but we aspire to deploy a delivery model that includes efforts from volunteers who will assist with data collection. The current phase of this project is planned to continue with field-based data collection in spring and summer 2010-2012. This habitat-based study also serves as the initial step in developing a sustainable long-term monitoring program for wetland-associated birds within the PHJV area.

Native versus Hay: Effects of Grassland Type on Survival of Juvenile Sprague's Pipits

Ryan J. Fisher and Stephen K. Davis*
Department of Biology, University of Regina
*Canadian Wildlife Service

Abstract – There is little information concerning survival during the post-fledging period (i.e., the period between leaving the nest and migration) for many avian species. Consequently, this lack of information hinders management strategies for species recovery, especially for many declining grassland songbirds. Sprague's Pipit (*Anthus spragueii*), a threatened grassland songbird, prefers to breed in grazed native grasslands, but will also nest in planted hay fields. Whether differences in habitat quality between native grasslands and hay fields could lead to different survival rates of juvenile pipits remains unknown.

I initiated a radio-telemetry study in 2004 to document survival of Sprague's Pipit juveniles (n=55) in the Last Mountain Lake National Wildlife Area and Nokomis PFRA in Saskatchewan. My objectives were to describe post-fledgling survival in relation to nesting habitat (native grassland and planted hay field), date of fledging, age of the juvenile, body mass, ambient temperature and daily precipitation. Survival was highest for pipits that fledged from late broods in native grassland and lowest for individuals reared in early broods from both native grasslands and hay fields. In general, daily survival probability (DSP) of pipits in native grasslands was higher than in hay fields (DSPnative = 0.971, DSP hay = 0.857). Age of the fledgling, body mass, ambient temperature and precipitation had marginal effects on survival. Low post-fledging survival coupled with low nesting success of this species raise concerns regarding the viability of pipits in North America. My study also raises concerns regarding the demographic consequences of pipits nesting in planted hay fields.

Crossing the Medicine Line Network

Steve Forrest
World Wildlife Fund

Pat Fargey
Parks Canada

Brian Martin
The Nature Conservancy

John Carlson
Bureau of Land Management

Sue Michalsky
Crossing the Medicine Line

Abstract – Many agencies, conservation organizations, landowners and land managers recognize the ecological importance of the Northern Great Plains ecoregion and the unique suite of natural biodiversity it supports. Spanning some 250,000 square miles, the prairies of the northern United States and southern Canada represent North America's most expansive tract of natural grassland habitat, and as such, is the last best hope for survival for many imperilled and endemic grassland species.

In recent years there has been increasing recognition of the power of the international boundary between Canada and the U.S. to shape ecosystems and determine the fate of species and natural biological communities. Considerable cooperation now exists among government agencies and conservation groups in the U.S. and Canada, and an integrated international approach is needed if we are to restore and conserve the habitats, species and ecological processes of the North American prairie.

In 2006, several of the partners involved in the Northern Mixed Grass Transboundary Conservation Initiative formed the Crossing the Medicine Line Network. The goals of the Crossing the Medicine Line Network are:

- To build a broader awareness and forge a deeper commitment to conserve the region's native biodiversity through the engagement of stakeholders, clarification of conservation priorities and stakeholder interests, development of trans-boundary partnerships, and coordinated program delivery;
- To develop a collaborative environment that effectively balances conservation with the needs of human communities; and,
- To ensure that important conservation advances occur through the action of staff and strategic investments made by the Crossing the Medicine Line Network partners.

Cooperative transboundary initiatives being implemented by Crossing the Medicine Line Network partners include, but are not limited to, regional conservation planning, invasive species management, species at risk management and recovery, grassland bird management and Pronghorn migration.

Small White Lady’s-slipper Stewardship Summary: Information for Landowners and Managers

Chris Friesen
Manitoba Conservation Data Centre

Nicole Firlotte and Jason Greenall
Manitoba Conservation

Abstract – Small White Lady’s-slipper (*Cypripedium candidum*) is a nationally and provincially endangered plant. Threats include habitat loss, shrub and invasive species encroachment, thatch accumulation and changes in soil hydrology. At many sites, the disruption of natural ecological processes makes active management necessary to maintain suitable habitat. When applied at the appropriate time, management techniques such as mowing/haying and prescribed burning can assist in mitigating threats to this species. This poster highlights efforts that the Manitoba Conservation Data Centre is making to provide information to owners and managers of lands supporting Small White Lady’s-slippers to assist them in developing appropriate management and mitigation strategies.

Recent Successes in Maximizing Piping Plover Productivity in Manitoba

Alexandra Froese and Ken De Smet
Manitoba Conservation

Abstract – Piping Plover populations in Manitoba have declined from more than 130 adults in the 1980s to under 15 adult detections in recent years. Breeding habitat conditions have deteriorated due to flooding (high water levels exacerbated by high winds) and vegetation encroachment at former nesting sites on Lake Manitoba and Lake Winnipeg. Other threats to nesting plovers in Manitoba include human disturbance (pedestrian and ATV traffic).

The National Recovery plan has specific objectives for each province. Prairie population criteria requires each province to maintain a median chick fledging rate of greater than 1.25 chicks/pair/year to achieve minimum provincial population targets. In Manitoba, the targeted population level is 120 plovers, a level that equates to known populations from the mid-1980s.

Due to sharp declines throughout Manitoba, a Piping Plover Recovery Implementation Group (PPRIG) and Piping Plover Stewardship Program (PPSP) were formed in 2002. These groups strive to protect the provincial adult Piping Plover population and maximize plover productivity in Manitoba. Specific tasks overseen by these groups include: a) monitoring and research; b) habitat management and protection; c) productivity enhancement; and d) increased communication and public/volunteer participation. In recent years, Manitoba’s Piping Plover productivity has increased substantially, with four of the last five years surpassing the national fledgling rate goal. Other highlights include increased chick survival rates and nesting activity at restored habitat sites, and increased volunteer involvement. Ongoing evaluation of project objectives by both PPRIG and PPSP has positively contributed to project improvements and increased success in meeting productivity targets for Piping Plovers in Manitoba.

Is Livestock Production for the Birds? Grassland Songbird Conservation through Grazing Management

Allison E. Henderson and Stephen K. Davis*
School of Environment and Sustainability, University of Saskatchewan
*Canadian Wildlife Service

Abstract – In Saskatchewan, remaining native prairie supports livestock production and provides important habitat for many grassland songbirds, including those listed under the *Species at Risk Act*, such as Sprague's Pipit (*Anthus spragueii*) and McCown's Longspur (*Calcarius mccownii*). Native prairie management, in particular grazing management, plays an important role in securing grassland songbird habitat and preventing its further loss and degradation. In our research, we examine how the grazing management decisions that livestock producers make influence grassland songbird habitat and abundance. Our goals are

1. to identify socioeconomic and ecological factors that influence grazing management decisions;
2. to examine ecological relationships between rangeland health and songbird abundance; and,
3. to identify options for engaging livestock producers in songbird recovery and conservation.

We use vegetation measures to assign indices of range health, point count surveys to estimate grassland songbird abundance, and personal face-to-face interviews to gather information from livestock producers. Our research will provide insight into how livestock producers contribute to grassland songbird recovery in southwestern Saskatchewan through their grazing management decisions.

Annual Dispersal and Implications for Conservation of Burrowing Owls in Canada

Geoffrey L. Holroyd
Environment Canada

Jason Duxbury
Stantec Consulting

Helen Trefry
Environment Canada

Abstract – In Canada, the western Burrowing Owl (*Athene cunicularia hypugaea*) is endangered and its numbers are reduced to fewer than 1000 pairs in Canada. The number of breeding pairs declined at about 22% per year through the 1990s even though over 700 landowners voluntarily protected over 37,000 hectares of grassland habitat. Burrowing Owl populations are also in decline in other parts of western North America. One of the factors implicated in the Burrowing Owl's decline is its apparent low recruitment. Return rates for banded birds are about 6% for hatch-year owls and 30% for breeding owls. However, banding studies are limited by the ability of observers to detect bands away from study sites. Stable-isotope analysis provides a technique to investigate annual dispersal.

We compared the stable-isotope signature of feathers collected from breeding adults to those collected from nestlings across western North America. Annual breeding dispersal distance for owls was approximately 400 km, indicating that many owls were dispersing beyond the boundaries of study areas where owls were banded. Our comparison of the origin of owls breeding in the Canadian Great Plains with those in adjacent northern states indicated that net emigration of owls from Canada approximates the decline of the Canadian population. High rates of dispersal may be an evolutionary response to dynamic prairie ecology, or to the advent of irrigated agriculture as postulated by U.S. researchers.

The implications of these findings on Burrowing Owl conservation is discussed. We also recommend implementation of the Commission for Environmental Cooperation's Conservation Action Plan for the Burrowing Owl through future of cooperation of agencies in Mexico, U.S. and Canada.

Winter Destinations and Ecology of 'Canadian' Burrowing Owls in a Changing Landscape

Geoffrey L. Holroyd and Helen Trefry
Environment Canada

Héctor E. Valdez-Gómez
Universidad Autónoma de Nuevo León

Jason Duxbury
Stantec Consulting

Abstract – The winter destination and ecology of Burrowing Owls (*Athene cunicularia*) that breed in Canada was unknown when this study was initiated. We identified the winter locations of owls using three methods: 1) aerial telemetry searches of south Texas and the Gulf Coast lowlands and central Mexico for signals from VHF transmitters that were attached to Burrowing Owls in Canada; 2) stable isotope analysis; and 3) light data loggers. We have combined these records with all band recoveries to provide an up-to-date picture of what is known about winter distribution of 'Canadian' Burrowing Owls. We studied the over-winter survival, diet and habitat of the owls in one study area in south Texas, and two in central Mexico. The winter daytime roosts used by the owls included vegetation, natural burrows, arroyos and wood piles. Winter habitats around roosts were also highly variable; they were much less open than breeding habitat in Canada, but always included at least 35% low vegetation within 1 km of roosts. In the winter, predators included Barn Owls and Short-Eared Owls; one owl died due to earth-moving equipment. The return rate of owls with attached data loggers was very low but the one that was recovered indicated that Alberta nesting owls may migrate further west than owls from Saskatchewan and Manitoba.

Habitat Loss and the Conservation of Burrowing Owls in Canada

Geoffrey L. Holroyd and Helen E. Trefry
Environment Canada

Abstract – Early agricultural settlement policies in Canada resulted in the cultivation of about 80% of the uplands of the Canadian portion of the Great Plains. Burrowing Owl (*Athene cunicularia)* numbers in Canada have continued to decline despite the reduction in the rate of cultivation of upland prairie. In the 1990s the Burrowing Owl population in Canada declined at about 22% per year. Canadian wildlife conservation policies and legislation cover the classification of species at risk, formation of recovery teams, protection of critical habitat and a habitat stewardship program. A focus of these programs is to conserve habitat. Since Burrowing Owl populations have declined faster than habitat loss, habitat loss cannot be the sole cause of the decline. More collaboration is needed between Canada, U.S. and Mexico to determine the cause(s) of the decline and to implement appropriate conservation actions.

Introduction

The recovery of endangered species is a high profile subject in public policy. Specific national and provincial or state laws have been passed to protect and recover species at risk in Canada and the U.S. The U.S. *Endangered Species Act* (1973) contains very strong penalties and has been very controversial (Smith and Smith 1997). Canada did not have a national act to conserve endangered species until June 2003. Conservation of species at risk in Canada has evolved over the past 30 years without formal direction from the Canadian parliament. Canada's species at risk program was developed through agreements of wildlife directors under the *Canada Wildlife Act* (CWA). The CWA is enabling legislation with no mandatory actions to initiate, and no direct funding for species at risk conservation. The conservation of species at risk in Canada has been based on cooperative agreements.

The Burrowing Owl is a species at risk over much of its range in western North America (Holroyd et al. 2001). The Burrowing Owl has been in decline in Canada for over 30 years (Wedgewood 1978), and likely since agriculture and European settlement began. Historically, Burrowing Owls nested in Canada on the northern Great Plains and in the southern valleys of British Columbia (Wedgewood 1978). Both of these regions are intensively used by agriculture, industry and urbanization, and habitat loss has been listed as a cause of this species' decline in Canada (Wellicome and Haug 1995). These regions are also at the northern edge of the Burrowing Owl range. In Canada, the Burrowing Owl was classified as threatened in 1978 (Wedgewood 1978) and then endangered in 1995 (Wellicome and Haug 1995).

Habitat loss has been considered a primary cause of endangerment of wildlife in Canada and elsewhere (Kerr and Cihlar 2004, Ehrlich and Ehrlich 1981). The rationale is simple: wildlife need habitat to survive and reproduce; without habitat, populations decline and ultimately species are at risk of extinction. However, habitat loss is only one cause, as many other factors can cause declines, such as over-exploitation, toxic chemicals, exotic species, predation, etc. (see Erlich and Erlich 1981).

We will explore the history of public agricultural policies in Canada as they have affected Burrowing Owl habitat and, together with information on Burrowing Owl declines, demonstrate that habitat loss is not the current cause of the decline. We will also review Canada's *Species at Risk Act* to determine its possible effects on Burrowing Owl conservation.

Agricultural Policies and Land Use

Past agricultural policies had a major effect on land use in prairie Canada and, consequently, on Burrowing Owl habitat. In the late 1800s, Canada needed to assert its sovereignty on the Canadian prairies north of the 49^{th} parallel (Reimer 2003). Settlers were offered 160 acres of deeded land free if they would cultivate the land and build a residence. At about the same time, the Canadian National Railway was completed from coast to coast to appease western Canadians who felt isolated from the political power in eastern Canada. Despite the completion of the railway and the offer of free land, the Canadian prairies did not have the expected influx of settlers. The new railroad needed business to be financially viable, therefore the federal *Crow's Nest Pass Act* was created in 1897 to subsidize the freight of grain from the prairies to eastern markets. Settlers were attracted by this subsidy, travelled to the prairies and began to break the prairie land. For the next 100 years, farmers paid only a portion of freight costs to send grain east. Federal legislation stated that homestead rights were revoked if land was allowed to go wild. Thus, cultivation of grassland was mandatory for the homesteader to gain a deed to the land. "Grain production received increased government support until the early 1990s while the livestock sector was essentially unsubsidized" (Reimer 2003). Thus no incentives were given to landowners to maintain native grassland for grazing.

Due to these policies of initial settlement and agricultural subsidies, the area of cultivated land in the Canadian prairies increased to over 10 million hectares by 1920, and 30 million hectares by 2001 (Reimer 2003). Additional grasslands were cultivated as the area of forage crops increased to feed the growing population of cattle. By 1989, less than 20% of the Canadian prairies were still uncultivated (WWFC 1989). With over 80% of the upland cultivated, many grassland species were in decline across the prairies. The North American Waterfowl Management Plan was created due to concern over declining waterfowl populations in the 1980s, when 45% of wetlands had been drained and cultivated, but no plan or policy was in place to conserve the remaining 20% of upland prairie.

Decline of Burrowing Owls in Canada

Although no historical information on the distribution and abundance of Burrowing Owls prior to European settlement is available, the grasslands north to Saskatoon and Edmonton comprised the historic range of Burrowing Owls (Wedgewood 1978), and are at the northern limit of the Great Plains. The cultivation of 80% of the upland would have resulted in a dramatic loss of native habitat for this prairie owl.

Currently, Burrowing Owls occur in Canada at very low densities. In Alberta, only two have been recorded annually on 35 Breeding Bird Survey (BBS) routes, and in Saskatchewan, only one on 41 BBS routes between 1968 and 2006. Thus BBS is not a valid technique to monitor Burrowing Owl populations in Canada.

For almost two decades, Burrowing Owls have been monitored through public activities and research projects in Canada. The two public extension programs, Nature Saskatachewan's Operation Burrowing Owl and Operation Grassland Community (OGC) of the Alberta Fish and Game Association, were started in 1987 and 1989, respectively. In Saskatchewan, the number of owls estimated by OBO members increased to 1100 pairs of owls in the first two years of the program as the number of member landowners increased. Then, despite a period of growing membership followed by relatively stable membership at about 550, the number of reported owls declined dramatically to 53 pairs in 2001 (Skeel et al. 2001, unpubl. data). The OGC program showed the same trends in Alberta, with 240 pairs in 1991, declining to 23 pairs in 2001 (unpubl. data). Recent increases in funding from the federal Habitat Stewardship Program for Species At Risk (see below) have allowed the two organizations running these programs to hire additional staff, increase personal contacts with landowners, and recruit new members. New members are typically recruited only if they have owls. Consequently, the number of owls has increased slightly since 2001 (OBO and OGC, unpubl. data).

Researchers in Manitoba tracked the decline of Burrowing Owls in that province from 76 pairs in 1982 to none in 2004 (De Smet 1997). As the species disappeared in the late 1990s, increased researcher effort failed to locate any additional pairs and releases of owls failed to reverse the trend. It was considered an apparently extirpated species in that province. Since 2005, Burrowing Owls have been found nesting in the southwestern corner of Manitoba, giving some hope that the species will continue to nest there (K. De Smet, pers. commun.).

In British Columbia, the species was declared extirpated when the first national status report was completed (Wedgewood 1978). A reintroduction program in the Okanagan Valley of southern BC was discontinued after about 10 years with no success (Dyer 1991). A more recent ongoing effort to captive-breed and reintroduce Burrowing Owls near Kamloops has met with small successes but the population is apparently not self-sustaining (Leupin and Low 2001, unpubl. updates).

Burrowing Owls have been monitored and studied since 1987 in a large study area in the Regina Plain in Saskatchewan by a series of researchers (James et al. 1991, Wellicome 2000, Todd et al. 2003). The number of owls in the original study area declined from 78 pairs in 1987 to none in 2001. The size of the study area was increased twice to increase the sample size for studies where a continued decline was observed. A few pairs have been recorded in this original study area since 2001 (R. Poulin, pers. commun.).

Since the early 1990s in Alberta, Burrowing Owls have been monitored in two regions using a standardized point count and playback technique (Shyry et al. 2001). In the Hanna trend blocks, the number of owl pairs per 100 km^2 declined from 32.6 in 1991 to a low of 2.8 in 1997, with 4.1 in 2000. In the more southerly Brooks trend blocks, the number of owls varied initially between 1.9 and 13.5 per 100 km^2 in 1993 and 1997, respectively, then declined to 8.7 nests per 100 km^2 in 2000 (Shyry et al. 2001), and have continued to decline since (A. Todd, unpubl. data). These standardized surveys reflected the same declining trend reported by studies of Burrowing Owls in the Hanna area by Schmutz (1997).

All of the above surveys have been in native grasslands where owls primarily use badger holes to nest. Canada's only colonies of Black-tailed Prairie Dogs occur in and adjacent to Grasslands National Park (GNP) in Saskatchewan. Another monitoring program in Canada consists of complete counts of Burrowing Owls in most of these prairie dog colonies. The number of pairs of owls fluctuated between 11 and 30 during the period 1998-2000, then increased for 4 years to 58 pairs in 2005, but have declined since then (unpubl. data).

The average rate of decline of Burrowing Owls in Canada in the 1990s was about 22% per year, not including the Brooks trend blocks and GNP area (Holroyd et al. 2001). Consequently, the Burrowing Owl was classified as endangered in Canada in 1995 (Wellicome and Haug 1995). But was this decline due to habitat loss? We will inspect habitat changes in Canada for evidence that habitat loss should not be used to explain current Burrowing Owl declines.

Habitat Loss as the Cause of Burrowing Owl Decline

Habitat loss and fragmentation is often cited as the reason for the decline of endangered species, both globally and locally (Ehrlich and Ehrlich 1981, H.R.H. Prince Philip 1988). Over 80% of Canada's native grasslands are cultivated and, as burrows are rare in cultivated fields, cropland is rarely used for nest sites by Burrowing Owls (Haug and Oliphant 1990). The absolute amount of native habitat loss over the past 100 years must have had a negative effect on the Burrowing Owl population. But can the loss of grassland explain population declines of 22% per year in Canada in the 1990s?

Land cultivation did not expand at 22% per year through the 1990s (Reimer 2003). Most of the cultivation was initiated prior to the recent rapid decline of Burrowing Owls. Wellicome and Haug (1995) summarized information on the loss of pastureland in the Canadian prairies. Between 1966 and 1991, Agriculture Canada statistics show pastureland declined a total of 8% in Alberta and 6% in Saskatchewan. The rate of pasture conversion as a portion of the pasture that existed in 1966 was 0.6% per year in Alberta and 0.8% in Saskatchewan. Most of this conversion occurred between 1976 and 1986 when wheat prices were high.

This rate of land conversion may not reflect loss of Burrowing Owl habitat as pastureland includes large blocks of land unsuitable both for agriculture and owls. Some areas are rocky, hilly, riparian or wetland, and are used less by burrowing mammals and Burrowing Owls than their preferred habitats on lacustrine and solonetzic soils (Harris and Lamont 1985). These soils are also more intensively used for agriculture. Warnock and Skeel (2004) found that habitat loss from 1986 to 1993 was about 6% per year, quoting two similar studies in Saskatchewan that found rates of grassland loss of 5.7 and 6.2%. These declines were documented on private cultivated lands that were on prime agricultural soils and suitable Burrowing Owl habitat. The rate of habitat loss likely lies between the extremes of 0.6-0.8% and 5.7-6.2% per year, but far less than the population decline of 22% per year. Therefore, overall, the decline of Burrowing Owls is much greater than the rate of loss of native prairie, and the rate of habitat loss alone cannot explain the severe decline of Burrowing Owls in Canada**.**

Legal Status of the Burrowing Owl in Canada

Canada's *Migratory Bird Convention Act* (1917) was enacted to protect and conserve migratory birds in Canada. However, the 1916 Canada-U.S. Migratory Bird Convention does not include raptors; consequently, neither does the 1917 Canadian federal act. Thus other wildlife, including raptors, are managed and protected by provincial wildlife legislation. In Canada, Burrowing Owl management is the responsibility of the provincial governments where they occur: British Columbia, Alberta, Saskatchewan and Manitoba. The Burrowing Owl is protected on federal lands such as National Parks and National Wildlife Areas. However, most owls nest on private and provincial public lands where the birds and burrows are protected but their habitats are not.

The U.S. *Migratory Bird Treaty Act* was amended in 1972 to conserve raptors after a treaty was signed with Mexico. Consequently, raptors are under federal jurisdiction in those two countries. Canada and Mexico do not have a formal convention to jointly protect migratory birds.

Prior to 2003, endangered species conservation had its history in federal-provincial cooperation. The federal government is responsible for international wildlife issues, wildlife toxicology, and "order and good government". Under these mandates, Canada created the *Canada Wildlife Act* (CWA). This act did not directly change the status of Burrowing Owl management. It did allow the federal Canadian Wildlife Service to enter into joint wildlife management agreements, but the act was not funded for such agreements and no agreements were made that directly affected the Burrowing Owl. Under the CWA, the federal, provincial and territorial governments did agree to list species at risk through COSEWIC, the Committee on the Status of Endangered Wildlife in Canada, formed in 1977 with a mandate to designate species at risk. COSEWIC is comprised of representatives from governments, universities and non-government organizations and is supported by taxonomic/species-group subcommittees. However, COSEWIC has no responsibility for recovery efforts.

In the 1980s, discussions focused on recovery. GLH was part of a task force in the mid-1980s to consider a national recovery program. The first recovery teams to meet formally were for Whooping Cranes and Peregrine Falcons, as these species already had active recovery efforts underway. The first meeting of Burrowing Owl conservationists was in Edmonton in 1986 at the Prairie Endangered Species Workshop (Holroyd et al. 1987). The Canadian Burrowing Owl recovery team was formed in 1989 after the second Endangered Species and Prairie Conservation Workshop in Regina (Holroyd et al. 1991).

Ultimately, a RENEW (REcovery of National Endangered Wildlife) committee was created to coordinate recovery efforts in Canada. However, the Burrowing Owl team, like other teams, was not directly funded. Recovery efforts were strictly up to the partners in the teams, with no core funding. Typically, team chairs and members take ideas from team meetings and find partners to implement them. For example, Operation Burrowing Owl (OBO) was initiated by the Burrowing Owl recovery team, and a World Wildlife Fund Canada (WWFC) program called Wild West was created after team chair Dale Hjertaas conceived of the need for a landowner stewardship program. Operation Grassland Community (OGC) was started in Alberta two years later through the follow-up WWFC program called Prairie for Tomorrow. The OBO and OGC programs, both delivered by non-government agencies, became the precursors of other stewardship programs, such as the Habitat Stewardship Program for Species at Risk (HSPSAR) that is part of the federal government's species at risk strategy.

Canada's Species at Risk Strategy

The federal species at risk initiative has three prongs: a National Accord, the *Species At Risk Act* (SARA) and the Habitat Stewardship Program for Species At Risk (HSPSAR). We will review the effect of each of these programs on Burrowing Owl conservation in Canada.

The Accord for the Protection of Species at Risk was signed in 1996 and updated in 1999 by the federal, provincial and territorial wildlife ministers. Three federal departments signed the Accord: Environment Canada, Fisheries and Ocean Canada, and Canadian Heritage (National Parks). The two-page Accord reaffirmed participation in COSEWIC, and committed the governments to "complementary legislation and programs that provide for effective protection of species of risk throughout Canada". The Accord also formed the Canadian Endangered Species Conservation Council, which is made up of the elected ministers of the above agencies. The Council is to coordinate conservation activities, provide general direction for assessment, and coordinate recovery efforts, but it has not met since its formation in 1996.

The 2003 *Species at Risk Act* is the federal component of the third commitment under the Accord. The Habitat Stewardship Program for Species at Risk (HSPSAR) is the federal program to encourage landowners to be wildlife stewards of their land.

Canada's *Species at Risk Act* (SARA)

The *Species at Risk Act* (SARA) exists for three purposes (SARA 2003, section 6):

1. "to *prevent* wildlife from becoming extinct" in Canada;
2. "to provide for the *recovery* of wildlife species that are extirpated, endangered or threatened";
3. "to *manage* special concern species to prevent them from becoming" further at risk.

The Act applies to wildlife species that are nationally at risk and their critical habitats over all lands and waters in Canada. However, it applies broadly only to species that are listed in the *Migratory Bird Convention Act* and conditionally to non-federal species (i.e., provincial species) and species on non-federal lands; i.e., SARA does *not* apply to Burrowing Owls off federal lands except for the 'safety net' (see below).

SARA provides prohibitions for listed species at risk. Aquatic species and migratory birds are protected on all lands, but other species such as listed mammals, invertebrates, plants and birds that are not listed in the *Migratory Bird Convention Act* are only protected on federal lands. For listed extirpated, endangered, and threatened species, no one can kill, harm, harass, capture or take an individual; no one can possess, collect, buy, sell or trade an individual or its parts; and no one can damage or destroy the residence of one or more individuals. Provincial wildlife acts protect both the nest site and the individual owl on all lands. In this respect, SARA duplicates the provincial protection in many situations.

The relative effectiveness of SARA enforcement remains to be seen. Since there are far more provincial than federal enforcement officers, it may appear that the provincial legislation would more likely be enforced than the federal legislation. For example, in April 2005, Alberta had 127 enforcement officers compared to three in the federal wildlife agency in Alberta. However, two incidents of wilful destruction of Burrowing Owl nests in the past ten years, one in Alberta and one in Saskatchewan, did not result in any charges under provincial legislation.

Critical Habitat

A key provision in SARA provides for the protection of "critical habitat", defined in Section 2(1) as "habitat that is necessary for the survival or recovery of a listed wildlife species…". The process of protection starts with identification of critical habitat in the recovery strategy. The recovery strategy for a species such as Burrowing Owl identifies critical habitat, or the studies that need to be conducted to identify critical habitat in a subsequent document called an action plan.

Under Section 58(1) "…no person shall destroy any part of the critical habitat of any listed endangered species…if

(a) the critical habitat is on federal land…
(b) the listed species is an aquatic species
(c) the listed species is a species of migratory birds protected by the Migratory Birds Convention Act, 1994."

Thus, this provision only applies to the Burrowing Owl under (a), on federal land.

The preferred protection approach in the federal program is through stewardship. Protection is required on federal lands and for aquatic species, and must occur within 180 days after identification in the recovery strategy or action plan. As stated above, this does not apply to Burrowing Owl habitat except on federal land, unless the 'safety net' is invoked.

Under section 61, the 'safety net' provides authority for prohibitions that protect critical habitat for Burrowing Owls on private and provincial lands. However, a federal Cabinet order is required before SARA prohibitions can apply. The Cabinet order will be initiated only after the appropriate provincial and territorial ministers have had an opportunity to act and provide input, on the recommendation of the provincial minister or the Canadian Endangered Species Conservation Council, or if there is no other legal protection under federal or provincial statutes. Thus a somewhat bureaucratic process needs to be followed to provide protection for Burrowing Owl habitat that is not on federal lands. On the positive side, the above options provide several ways that critical habitat can be protected. It remains to be seen if such a high level Cabinet order would ever be issued for Burrowing Owl habitat, especially if it cannot be proven that habitat is critical to the recovery of the species. Since habitat loss does not appear to be causing the species' decline, critical habitat may not be implicated in its recovery.

Stewardship

One objective of the Canadian federal strategy is to ensure the protection of endangered species' habitats on federal, provincial and private land. The intent is to cooperate with stewards of the habitat, i.e., landowners and land managers, in order to maintain the suitability of the habitat for each species.

A major new federal initiative to conserve Species at Risk that has benefited Burrowing Owls is the Habitat Stewardship Program for Species at Risk (HSPSAR). The intent is to support and encourage stewardship; that is, landowners take voluntary conservation actions to prevent species from becoming further at risk. Public literature from the federal government states "We all share the challenge of protecting Canada's wildlife species at risk". Cooperation is the key to the effective implementation of the HSPSAR. The federal government agencies stated their desire to partner through agreements with landowners, local governments or non-profit organizations in order to protect species at risk and their habitats, and to implement recovery strategies and actions. The focus is on cooperation, but the program can include financial incentives through an annual budget of $10 million allocated to grants and contributions.

A summary of the HSPSAR for 2001/02 Prairie and Northern Region (unpubl. 2002) includes:

- 19,067 acres of habitat secured through conservation easements;
- 26,478 acres of habitat secured through new voluntary stewardship agreements
- 70,000 acres of habitat secured through previous agreements
- 29,558 acres of habitat improvement projects
- education and conservation programs presented to 18,435 prairie residents
- 1406 landowners informed.

While most of the securement projects do not overlap with the Burrowing Owl's range, many voluntary agreements and education projects are for stewards of nesting habitat. OBO and OGC have about 700 members that voluntarily agree not to cultivate, for five years, native habitat where Burrowing Owls have nested. Some landowners have been members for 15 years or more since the programs began.

Warnock and Skeel (2004) reviewed the effectiveness of the voluntary habitat stewardship program in Saskatchewan. They determined that OBO program members had retained 66% of sites in native vegetation compared to 49% of random non-member sites. While the OBO program had not totally prevented cultivation of native prairie, the program had slowed the rate of conversion to cultivated crops. Most OBO members own small patches of native habitat. The rate of loss of native vegetation is lower than the rate of loss of Burrowing Owls across the prairies.

City of Moose Jaw

An excellent example of a stewardship plan was prepared and approved for the city of Moose Jaw, Saskatchewan (Anonymous 2002). The plan was initiated due to conflicts between Burrowing Owl nesting sites and urban development plans within the city, i.e., risk of habitat loss. The plan proposed habitat modification of two tracts of city land to improve their suitability for nesting owls by maintaining short grass (<10 cm) through mowing or grazing, maintaining a captive prairie dog colony as potential nesting habitat, removing trees from areas adjacent to potential nesting habitat, and supporting a captive breeding and release program. In addition, the city would encourage the restricting of construction near nest sites to the non-breeding season, avoid the use of insecticides and rodenticides within 250 m of active nests, facilitate the installation of artificial nest burrows, erect road signs to decrease traffic speed near nest sites, and expand local education of Burrowing Owl conservation programs. The agreement was stimulated by the *Saskatchewan Environmental Assessment Act*, and predates SARA. Although the document does not appear to have saved Burrowing Owls nesting in the city, it did encourage the maintenance of their nesting habitat.

Landowner Reaction to SARA

While the intent of the federal program is to cooperate with landowners, not all landowners seemed to appreciate this government involvement in the management of their land. Some landowners interpreted the program as giving notice that those who are doing the right thing and had Burrowing Owls on their land could be penalized if any changes in their land-use actions were detrimental to species at risk. However, for many species, we do not know the critical land-use actions that are needed to maintain or create critical habitat.

Is it then any surprise that many landowners and their industry representatives publicly opposed SARA before it was enacted into law? The cover of *Alberta Report* magazine (February 24, 1997 issue) stated "Endangered Species – Ranchers decry Ottawa's new wildlife protection law as an assault on property rights". Inside was the quote "Rancher Norm Ward sees big trouble on the environmental horizon". Other articles in this issue began "Endangered species overkill – Ottawa's proposed wildlife grab threatens property owners with huge fines, years in jail, and loss of land" and "Who's endangering whom? Ottawa's Species at Risk Act shows disturbing parallels to its draconian U.S. equivalent". The Western Stock Growers issued a release that began "Urgent Action Needed!! We need your help to stop Ottawa from shutting down agriculture. Without you Endangered Species Legislation endangers us all!" Clearly, some sectors of society were not enamoured with the proposed legislation.

"SAVE HABITAT" is a rallying cry for conservation groups concerned about the decline of wildlife, especially endangered species. "An insult" says Tim, a Saskatchewan ranch owner who is proud of his native prairie that is home to many species of wildlife, but tired of being painted as the bad guy in discussions of conservation issues. Environmental groups typically talk about "protecting" and "saving" endangered species habitat. If the habitat is on private land, who or what are they protecting or saving the habitat from, asks Tim? What message are we delivering to the land owner? Who is the enemy? Why is this an insult? Think about it – many landowners take great pride and enjoyment in the wildlife on their land. Wildlife are on their land because of the way that they manage their land. If wildlife is on their land, the manager of that land is doing something right. The rallying cry should be "SUPPORT LANDOWNERS' MANAGEMENT OF HABITAT". The landowners who are doing the right thing are threatened by our conservation messages. We need to support landowners who have endangered species. Their land management practices have created habitat for Burrowing Owls, yet their reward is to appear the villain in some conservation messages.

Despite these and other negative comments, the OBO and OGC programs have grown slightly with help from the HSPSAR program. At least some landowners have not seen SARA as a threat.

Conclusions

While native habitat has been lost over the past 20 years, the rate of decline of Burrowing Owl populations in Canada was much greater than habitat loss. The 95% decline of Burrowing Owls cannot be explained solely by the loss of habitat. Thus habitat protection should not be the sole method used to save the species.

A major focus of the federal species at risk strategy is to protect the habitats of endangered species. But such protection has alienated some landowners and may not benefit some species such as Burrowing Owl that are not limited solely by habitat availability. The North American Waterfowl Management Plan was implemented to conserve waterfowl and wetlands, but no equivalent plan or policy has been implemented to conserve uplands.

The operative question here is: Is legislation an effective mechanism to conserve a declining and endangered species, and what issues should be addressed in legislation? Before we can answer the question, we should know the causes of the species decline, and then determine the most effective means to correct these causes.

We must determine the ultimate causes of the decline, not just the proximate causes (Mayr 1961). Proximate causes are typically those aspects of the species' life history that are problematic, as shown by the species population dynamics. The life history parameters that are cause for concern must then be studied to determine the ultimate causes. For example, the proximate cause of Peregrine Falcon (*Falco peregrinus*) declines was lack of productivity. The ultimate cause was found to be DDT accumulation that interfered with calcium deposition at egg formation, causing the eggs to break under the weight of incubating adults. The conservation action that resolved the ultimate cause was to ban DDT in North America.

One conclusion from the conservation of Peregrine Falcons and Burrowing Owls is that legislation will not prevent the decline of a species or provide for its recovery. Legislation may be needed to enact a conservation issue, such as banning DDT. Although Burrowing Owls need habitat, their decline does not appear to be caused by the direct loss of nesting habitat, and legislation to protect habitat will not recover the species. The decline of the Burrowing Owl appears to be complex. A detailed understanding of the owl's life history throughout the year, and dispersal from year to year, is required in order to determine the proximate and ultimate factors that are driving the decline.

Conservation of western Burrowing Owl populations will require action in all three countries where the species occurs: Canada, U.S. and Mexico. The future of the species will be determined by local actions, but only those that address the ultimate causes of decline. Since the Burrowing Owl is not part of the Migratory Bird Convention between Canada and the U.S., another mechanism is needed to address tri-national conservation. Burrowing Owls require implementation of North American conservation initiatives. This species has been the focus of much research, and much has been learned. The ultimate causes of the Burrowing Owl's decline in Canada appear complex and partially reliant on factors outside of our borders. This is not surprising, as both the Great Plains and the wintering grounds are under ever-increasing pressures, reflected in the increasing list of species at risk on the prairies. More socio-economic research is needed to find ways to support landowners who are doing the right thing. Conservation action then must be implemented to resolve the ultimate causes of the decline.

An international agreement may be required for the three national wildlife agencies to commit to the conservation of this species. Holroyd (1993, 1995) suggested that an international agreement was needed to conserve raptors; such an agreement would also conserve Burrowing Owls. However, the conservation of Peregrine Falcons was accomplished by parallel action in Canada and the U.S. without any formal agreement, showing that appropriate action in the two countries does not require an international agreement.

"Governments sign international agreements to gain prestige, be part of the international community and avoid criticism" (Sutherland 2000: 162). However, an international agreement may not be possible for Burrowing Owls. The Commission for Environmental Cooperation (involving Canada, U.S. and Mexico) did complete a multi-year tri-national planning process for the Burrowing Owl and five other species in 2005. The North American Conservation Action Plan for Burrowing Owls (Holroyd 2005) is an attempt to bring the three countries closer to conservation action. Only through collaborative research and action will this species become common again throughout its range.

"A failure to diagnose what is wrong is at the heart of much unsuccessful conservation" (Sutherland 2000: 111). Habitat loss is not likely the sole factor causing declines in Burrowing Owl populations, nor the ultimate cause. Research is needed to determine the ultimate causes of Burrowing Owl decline and how to mitigate them.

Acknowledgements

We thank the Canadian Burrowing Recovery Team and all the people who have cooperated in the conservation of the Burrowing Owl. We thank the landowners and land managers of native grasslands where Burrowing Owls nest in Canada. We appreciate the comments of Richard Knapton, Dave Duncan and Dave Ingstrup who reviewed earlier drafts of this manuscript.

Literature Cited

Anonymous. 2002. Burrowing Owl Conservation Plan. City of Moose Jaw, SK.

De Smet, K.D. 1997. Burrowing Owl (*Speotyto cunicularia*) monitoring and management activities in Manitoba, 1987-1996. Pages 123-130 *in* J.R. Duncan, D.H. Johnson, and T.H. Nicholls (eds.), Biology and conservation of owls of the northern hemisphere: 2nd International Symposium. USDA General Technical Report NC-190, St. Paul, MN.

Dyer, O.N. 1991. Reintroductions of Burrowing Owls (*Athene cunicularia*) to the south Okanagan Valley, British Columbia (1983 to 1988). Pages 231-235 *in* G.L. Holroyd, G. Burns and H.C. Smith (eds.), Proceedings of the Second Endangered Species and Prairie Conservation Workshop, Natural History Occasional Paper No. 15. Provincial Museum of Alberta, Edmonton, AB.

Ehrlich, P.R. and A.H. Ehrlich. 1981. Extinction: the causes and consequences of the disappearance of species. Ballintine Books, New York.

Harris, W.C. and S.M. Lamont. 1985. Saskatchewan Burrowing Owls: Breeding Distribution and Habitat Utilization. Report by Prairie Environmental Services Inc, Raymore, SK for Saskatchewan Natural History Society and Saskatchewan Parks and Renewable Resources, Regina, SK.

Haug, E.A. and L.W. Oliphant. 1990. Movements, activity patterns, and habitat use of Burrowing Owls in Saskatchewan. *Journal of Wildlife Management* 54: 27-35.

Holroyd, G.L. 1993. A Raptor Conservation Strategy for Canada. Page 384 *in* G.L. Holroyd, H.L. Dickson, M. Regnier, and H. Smith (eds.), Proceedings of the Third Prairie Conservation and Endangered Species Workshop, Natural History Occasional Paper No. 19. Provincial Museum of Alberta, Edmonton, AB.

Holroyd, G.L. 1995. Conservation of Prairie Raptors. Pages 173-180 *in* Proceedings of the 60th North American Wildlife and Natural Resources Conference. Wildlife Management Institute, Washington, DC.

Holroyd, G.L. (ed.). 2005. North American Conservation Action Plan for Burrowing Owl. Commission for Environmental Cooperation, Montreal, QC.

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

Holroyd, G.L., G. Burns, and H.C. Smith. 1991. Proceedings of the Second Endangered Species and Prairie Conservation Workshop, Natural History Occasional Paper No. 15. Provincial Museum of Alberta, Edmonton, AB.

Holroyd, G.L., R. Rodriquez-Estrella, and S.R. Sheffield. 2001. Conservation of the Burrowing Owl in Western North America: Issues, Challenges, and Recommendations. *Journal of Raptor Research* 35: 399-407.

H.R.H. Prince Philip. 1988. Down to Earth. W. Collins Sons & Co. Ltd, Glasgow.

James, P.C., T.J. Ethier, G.A. Fox and M. Todd. 1991. New Aspects of Burrowing Owl Biology. Pages 226-227 *in* G.L. Holroyd, G. Burns and H.C. Smith (eds.), Proceedings of the Second Endangered Species and Prairie Conservation Workshop, Natural History Occasional Paper No. 15. Provincial Museum of Alberta, Edmonton, AB.

Kerr, J.T. and J. Cihlar. 2004. Patterns and Causes of Species Endangerment in Canada. *Ecological Applications* 14: 743-753.

Leupin, E.E. and D.J. Low. 2001. Burrowing Owl reintroduction efforts in the Thompson-Nicola region of British Columbia. *Journal of Raptor Research* 35: 392-398.

Mayr, E. 1961. Cause and effect in biology. *Science* 134: 1501-1506.

Reimer, G. 2003. The effects of land use policies on the landscape in Saskatchewan and the ramifications on stewardship and waterfowl conservation. *In* C.D.A. Rubec (ed.), Proceedings of Wetland Stewardship in Canada. North American Wetland Conservation Council Canada, Ottawa, ON.

Schmutz, J.K. 1997. Selected microhabitat variables near nests of Burrowing Owls compared to unoccupied sites in Alberta. *Journal of Raptor Research* 9: 80-83.

Shyry, D.T., T.I. Wellicome, J.K. Schmutz, G.L. Erickson, D.I. Scobie, R.F. Russell and R.G. Martin. 2001. Burrowing Owl Population-Trend Surveys in southern Alberta: 1991-2000. *Journal of Raptor Research* 35: 310-315.

Skeel, M.A., J. Keith and C.S. Palaschuk. 2001. A population decline recorded by Operation Burrowing Owl in Saskatchewan. *Journal of Raptor Research* 35: 371-377.

Smith, R.J. and M.D. Smith. 1997. Endangered Species Protection: Lesson Canada should learn from the United States Endangered Species Act. *Property Rights Journal* 1: 1-36.

Species at Risk Act (SARA). 2003. An Act respecting the protection of wildlife species at risk in Canada. Ottawa, ON.

Sutherland, W.J. 2000. The Conservation Handbook – Research, Management and Policy. Blackwell Sciences Ltd., Oxford, UK.

Todd, L.D., R.G. Poulin, T.I. Wellicome and R.M. Brigham. 2003. Post-fledging survival of Burrowing Owls in Saskatchewan. *Journal of Wildlife Management* 67: 512-519.

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.

Wedgewood, J.A. 1978. The status of the Burrowing Owl in Canada. Committee on the Status of Endangered Wildlife in Canada, Canadian Wildlife Service, Ottawa, ON.

Wellicome, T.I. 2000. Effects of food on reproduction in Burrowing Owls (*Athene cunicularia*) during three stages of the breeding season. Ph.D. Dissertation, University of Alberta, Edmonton, AB.

Wellicome, T.I. and E.A. Haug. 1995. Second update of status report on the Burrowing Owl *Speotyto cunicularia*. Committee on the Status of Endangered Wildlife in Canada, Canadian Wildlife Service, Ottawa, ON.

World Wildlife Fund Canada (WWFC). 1988. Prairie Conservation Action Plan. WWFC, Toronto, ON.

Habitat Suitability Model for the Hognose Snake in Manitoba

Chelsea Jaeger and Pamela Rutherford
Department of Biology, Brandon University

Dion Wiseman
Department of Geography, Brandon University

Abstract – The distribution of the Western Hognose Snake (*Heterodon nasicus nasicus*) in Manitoba is not well defined. Manitoba is the most northern and eastern portion of its range, yet due to its secretive nature the overall distribution is unknown. It is known that this species shows a preference for sandy soils where native grasslands remain, which allow them to burrow and find prey, and is found close to water. Conversion of these habitats to cultivation and the expansion of aspen parkland (as a consequence of fire suppression) has contributed to a significant decline in available habitat for this species. The purpose of this project is to use a GIS model to determine the distribution of suitable habitat for the Western Hognose Snake in Manitoba. The suitability model is based on the known habitat requirements of this species from other areas of its range. The model considered two habitat features: soil type and land use. GPS locations of captured snakes were gathered from field captures (2006 to 2009) and historic records from the Manitoba Conservation Data Centre. The model was validated by comparing observed and expected number of captures using a chi-square test. The model indicates that Western Hognose Snakes select grassland, mixed-wood forest and wildfire areas, with sandy or loamy soils. There is no preference for proximity to water. This model will assist in the determination of conservation status and future protection of the Western Hognose Snake.

Introduction

Western Hognose Snakes (*Heterodon nasicus nasicus*) are a medium-bodied secretive snake with a poorly defined distribution in Manitoba (Platt 1969, Leavesley 1987). Manitoba is the most northern and eastern portion of their range (COSEWIC 2007). They show a preference for open prairies with sandy or loose soils where they can burrow (Platt 1969; Leavesley 1987), although knowledge about their habitat preferences is limited due to their secretive behaviour. They prey mainly upon amphibians (Platt 1969).

A major hurdle facing conservation efforts of secretive species is defining areas of suitable habitat (Dayton and Fitzgerald 2006, Santos et al. 2006). GIS (geographic information system) technology is a powerful tool for predicting suitable habitat areas because it allows the complex spatial distribution of multiple criteria to be analyzed and combined in a single model (Roth 2005). The advantage of a GIS is that it is capable of analyzing a large amount of geospatial data efficiently and produces accurate, replicable results.

The objective of this project was to build a habitat suitability model for the Western Hognose Snake using a GIS. The model was developed for the southwestern portion of Manitoba but, in the future can be applied to other locations. The model was built using habitat criteria based on expert knowledge of their habitat requirements (Platt 1969, Leavesley 1987, COSEWIC 2007). The model was validated by comparing the observed number of captures in suitable habitat to the expected number of captures (based on availability) using a chi-square test.

Methods

Study Area

The north, east, south and west boundaries of the study area are: Hwy 16, Hwy 13, the U.S. border and the Saskatchewan border, respectively (Fig. 1). The boundaries are located in the extremes of the known species range to ensure that all potential suitable habitat is considered in the analysis.

Data

Habitat requirements were determined through literature review and knowledge of the species based on field observations. The model considered two habitat features: soil texture and land use. Geospatial data for these criteria were obtained from the Manitoba Land Initiative (MLI) website and were in vector data format. Land use data were downloaded for five regions: Birtle, Brandon, Minnedosa, Virden and Winnipeg. Soil texture data were obtained for the 55 rural municipalities (RMs) within the study area using the Agricultural Interpretation Database (SoilAID) files. The data obtained

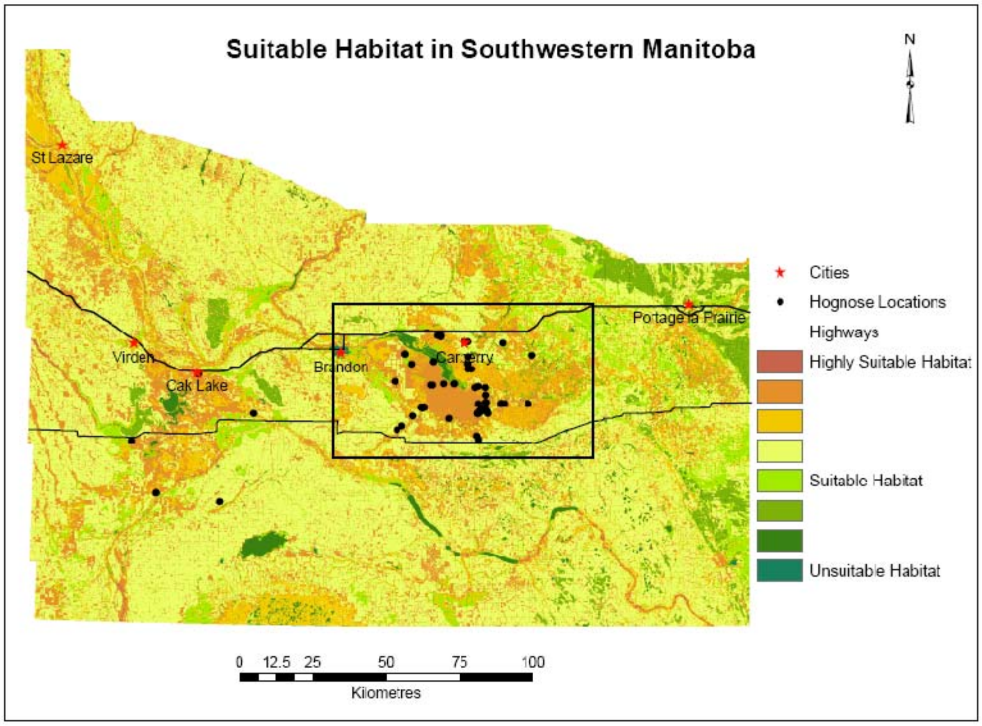


Figure 1. Predicted areas of suitable habitat in southwestern Manitoba. The smaller area in the rectangle is shown in Figure 3.

from the MLI were all projected in UTM NAD 83, zone 14N. The hognose snake locations were created using GPS data supplied by P. Rutherford and historical captures from the Manitoba Conservation Data Centre. The recent GPS points were collected using Garmin GPS-60® hand-held receivers. Four assumptions were made regarding the data and subsequent analysis: 1) the data layers are accurate and the most recent available were used, 2) the sample size of known hognose snake locations is large enough to draw adequate conclusions, 3) juvenile and adult snakes use the same habitats, and 4) snakes show equal preference for north- and south-facing slopes.

Analysis

A spatial model of habitat suitability was created using ArcGIS 9.3. Briefly, the steps were: 1) convert the land-use and soil vector data layers to rasters with a 30 m resolution, 2) reclassify the raster grid cells, and then 3) use the raster calculator to produce a discrete raster that represents the areas of suitable habitat (Fig. 2).

The data layers representing each criteria were reclassified using a scheme of unsuitable (0), somewhat suitable (1), suitable (2), and highly suitable (3) (Table 1). The hydrology layer was reclassified such that areas located within 350 m of water were considered to be somewhat suitable (1) and distances beyond that were unsuitable (0).

The model was validated by comparing the observed number of captures in areas determined to be of suitable habitat to the expected number of captures (based on availability) using a chi-square test. Expected numbers of captures was calculated by the following equation: (area of suitability value/total area) * total GPS points. A chi-square test was performed for each data layer and the overall output to determine the accuracy to which the model predicts areas of suitable habitat. Significance and accuracy is determined for values of $p<0.05$.

Table 1. The suitability classifications of data layers used in the model.

Layer	Unsuitable (0)	Somewhat suitable (1)	Suitable (2)	Highly Suitable (3)
Land use	“Treed rock”, “coniferous forest”, “cultural features”, “roads/trails”	“Ag. Cropland”, “water bodies”, “marsh”, “bogs”, “forage crops”	“Deciduous forest”, “open deciduous forest/shrub”	“Grassland/rangeland”, “mixed-wood forest”, “wildfire areas”
Soil Texture	“Rock”, “organic”, “unclassified”, “water”	“Clayey”, “marsh”	“Coarse sands”, “coarse loamy”, “eroded slopes”	“Sands”, “loamy”
Water	> 350 m to water	Within 350 m of water		

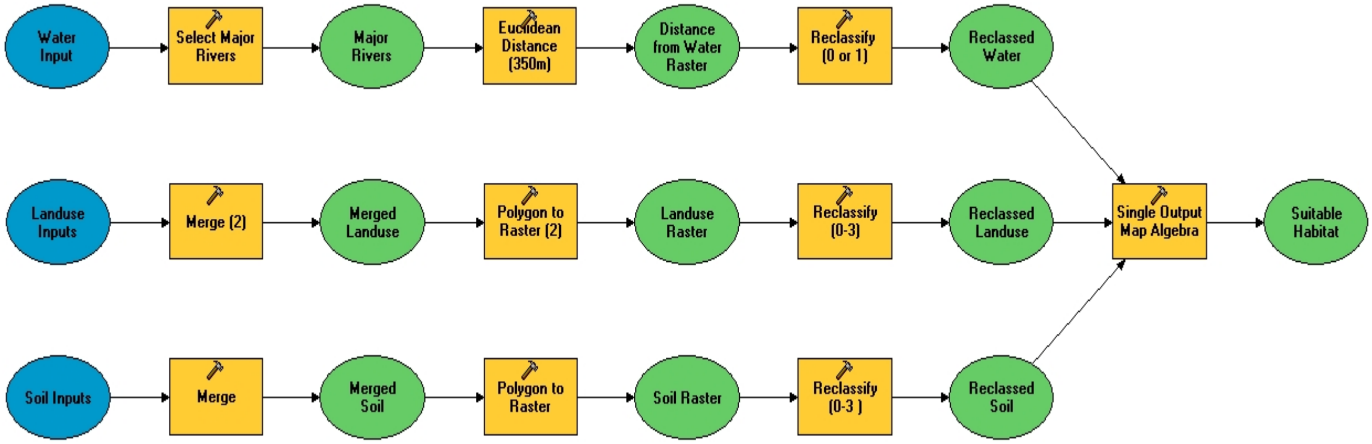


Figure 2. Annotated flowchart of the steps involved in the data analysis and creation of the model.

Results and Discussion

There were two main areas in southwestern Manitoba identified as suitable habitat for the hognose snake: the Carberry Sandhills east of Brandon, and the Lauder Sandhills southwest of Oak Lake (Fig. 1). Both areas contain open sand dunes with access to water and some mixed-wood forests, and are where the vast majority of hognose snakes have been captured. The largest number of hognose snakes have been captured in the Carberry Sandhills (Fig. 3), partly attributed to greater search effort in this area as part of field research on Northern Prairie Skinks (*Plestiodon septentrionalis*). The occurrence of these two disjunct sites of suitable habitat, in addition to field captures in those areas, may indicate that there are two separate populations in Manitoba. Leavesley (1987) identified a population in the Carberry Sandhills, however, she did not do research in the Oak Lake region.

The model produced very accurate results; only one captured individual was located in unsuitable habitat and it was a historical record. The two highest suitability levels (6 and 7) contained 68.97% of all known captures. Snakes were found significantly more often in grassland/rangeland, mixed-wood forest and wildfire areas, compared to other land-use types ($X^2 = 155.43$, df = 3, $p < 0.001$). Snakes were found significantly more often in sands and loamy soils, compared to other soil textures

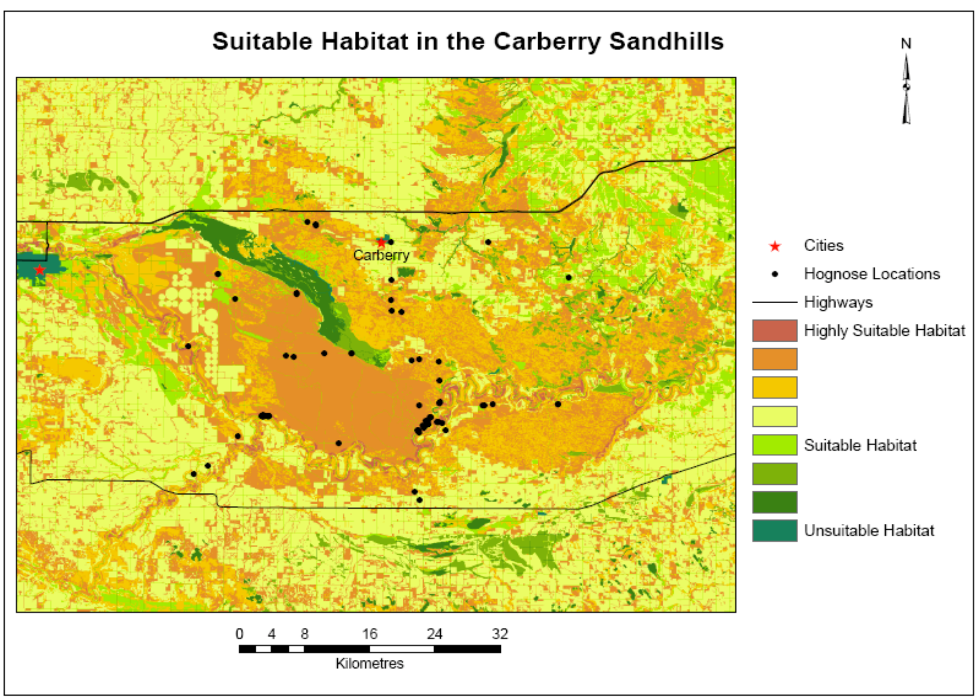


Figure 3. A closer look (inset from Fig. 1) at the areas of suitable habitat in the Carberry Sandhills.

($X^2 = 8.72$, df = 3, $p < 0.05$). A large number of snakes (60) were found at distances greater than 350 m from water compared to only 27 snakes that were located within 350 m of water. The chi-square value shows significance ($X^2 = 268.39$, df = 1, $p < 0.001$), which indicates that the snakes are selecting areas that are greater than 350 m from water. This does not match what is known about the habitat requirements of this species (Platt 1969, Leavesley 1987). It is possible to correct this by performing a chi-square test with a larger number of known GPS locations, or by applying the model to smaller water bodies instead of only major rivers. This also may be evidence that water itself does not play a role in habitat selection for this species as it is not considered aquatic or semi-aquatic (Roth 2005). The combined model ($X^2 = 1244.24$, df = 7, $p < 0.001$) was significant and therefore can be considered as an accurate prediction of suitable habitat.

Based on existing capture locations the model accurately identifies areas of suitable habitat. Future improvements could consider the habitat requirements of adults and juveniles separately, as these are known to differ. Juveniles are born in mixed-wood forests and then move into open prairie while adults remain in prairie habitats where burrows are available (Leavesley 1987). In addition, the model could explore whether Western Hognose Snakes prefer south- or north-facing slopes by incorporating a DEM (digital elevation model) that allows for discrimination of slope or aspect.

Conclusions

The secretive nature of Western Hognose Snakes makes conservation efforts very difficult. One of the major problems facing the conservation of a secretive species is the ability to define suitable habitat (Dayton and Fitzgerald 2006, Santos et al. 2006). The use of a GIS model is helpful in overcoming this hurdle because of its ability to combine and analyze multiple habitat criteria. The model created here indicates that Western Hognose Snakes select grassland, mixed-wood forest and wildfire areas, with sandy or loamy soils, although there is no preference for proximity to water. This model can be used to define the habitat usage of this species in any area of its range and to help direct conservation and research efforts.

Acknowledgements

Thanks to N. Cairns, A. Dransfield, N. Gushulak, J. Larkin, J. Frykas, A. Krause Danielsen, and W. McFadden for field data. N. Cairns and A. Dransfield provided suggestions for the GIS model. Funding was provided by World Wildlife Fund Canada, Manitoba Conservation, Chambers-Colomb, and Brandon University.

Literature Cited

COSEWIC. 2007. COSEWIC assessment and update status report on the Eastern Hog-nosed Snake *Heterodon platirhinos* in Canada. Committee on the Status of Endangered Wildlife in Canada, Ottawa, ON.

Dayton, G.H. and L.A. Fitzgerald. 2006. Habitat suitability models for desert amphibians. *Biological Conservation* 132: 40-49.

Leavesley, L.K. 1987. Natural history and thermal relations of the Western Hognose snake (*Heterodon nasicus nasicus*) in Southwestern Manitoba. Unpublished M.Sc. thesis, University of Manitoba, Winnipeg, MB.

Platt, D. 1969. Natural history of the hognose snakes, *Heterodon platyrhinos* and *Heterodon nasicus*. *University of Kansas Publications, Museum of Natural History* 18: 253-420.

Roth, E.D. 2005. Buffer zone applications in snake ecology: a case study using cottonmouths. *Copeia* 2005: 399-402.

Santos, X., J.C. Brito, N. Sillero, J.M. Pleguzuelos, G.A. Llorente, S. Fahd and X. Parellada. 2006. Inferring habitat-suitability areas with ecological modelling techniques and GIS: a contribution to assess the conservation status of *Vipera latastei*. *Biological Conservation* 130: 416-425.

Operation Burrowing Owl and Shrubs For Shrikes: Habitat Conservation through Landowner Stewardship in Saskatchewan

Carolyn A. Gaudet, Andrea L. Kotylak and Margaret A. Skeel
Nature Saskatchewan

Abstract – The stewardship program Operation Burrowing Owl (OBO) was launched in 1987 in response to declining grasslands and Burrowing Owl numbers in southern Saskatchewan. A study of OBO from 1987-1994 demonstrated that voluntary stewardship was effective in conserving habitat and retaining participants. Thus, the longevity and success of OBO in engaging rural landowners in stewardship prompted the initiation of Shrubs For Shrikes (SFS) in 2003 for the Prairie Loggerhead Shrike. Working closely with landowners, these programs conserve grassland and shrub habitat and monitor these species' populations on lands of participants who had owls/shrikes at the time of joining. Landowners sign a voluntary agreement to maintain habitat by not cultivating land or destroying shrubs or shelterbelts, and they annually report owl/shrike numbers on their land. Since 1988, OBO has documented an owl population decline of 92% based on landowner reports, with an average annual decline rate of 12%. Participants receive an annual newsletter, an attractive gate sign in recognition of their commitment, and a toolbox of information. While visiting landowners, best management practices for species at risk are discussed, and site-specific management plans are developed with interested landowners to suggest practices that would benefit both the species at risk and the producers' operations. Funding assistance is available to qualifying landowners to enhance and restore grasslands to improve habitat for Burrowing Owls and Loggerhead Shrikes by enlarging pastures to increase grassland patch size and reduce fragmentation. Since 2000, 121 enhancement projects have resulted in 15,254 acres of cropland seeded to grassland, 55.08 miles of strategic fencing, and 12 watering sites established. Landowners who undertake a project join OBO/SFS and participate in owl/shrike monitoring. A pilot evaluation of the habitat enhancement program and its value to owls and grassland birds occurred in 2007 with encouraging results. Currently, 503 landowners participate in OBO and SFS, conserving 159,000 acres of prairie.

Introduction

The prairie region, as well as its biological diversity, is one of our most endangered landscapes. It is estimated that only 24% of grasslands of the Prairies Ecozone in Saskatchewan remain intact (Gauthier and Wiken 2003). As most arable land in the Canadian prairies is privately owned, landowner interest and cooperation are vital to species at risk conservation. Nature Saskatchewan's Operation Burrowing Owl (OBO) is a prairie stewardship program launched in 1987 to preserve Burrowing Owl habitat in Saskatchewan from cultivation. The Burrowing Owl (*Athene cunicularia*), a small raptor that nests in underground burrows, was classified as endangered in 1995 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (Wellicome and Haug 1995). Following the success of Operation Burrowing Owl, it was recognized that a similar program directed at landowners could serve to raise awareness about the Loggerhead Shrike and conserve its habitat. Shrubs For Shrikes (SFS) was launched in 2003 to conserve disappearing prairie and shrub habitat for the threatened Prairie Loggerhead Shrike (*Lanius ludovicianus*), whose population has declined more than 80% over the last few decades.

The objectives of Operation Burrowing Owl and Shrubs For Shrikes are to:

(1) conserve prairie habitat, focusing on areas inhabited by Burrowing Owls and/or Loggerhead Shrikes, through voluntary habitat stewardship actions and agreements and informed private land stewardship;

(2) identify the locations of Burrowing Owls and Loggerhead Shrikes, and monitor their population numbers and distribution changes through an annual census at Operation Burrowing Owl or Shrubs For Shrikes sites in order to evaluate the success of conservation actions in maintaining and increasing population numbers;

(3) provide information to producers and urban and rural residents about Burrowing Owls, Loggerhead Shrikes and other prairie species, in order to increase awareness about their natural history and habitat needs, and the importance of conserving prairie habitat and species diversity (both species have been widely promoted using a variety of media, including newsletters,

brochures, advertisements in rural newspapers and presentations to schools and landowners);

(4) assist landowners with grassland habitat enhancement and restoration through seeding cropland to grassland in order to enlarge pastures and reduce habitat fragmentation. Strategic fencing and water developments for livestock are also supported in order to preserve newly planted and existing prairie.

Methods

Voluntary Agreements and Stewardship

Operation Burrowing Owl and Shrubs For Shrikes enlist rural landowners in conserving habitat around active and former Burrowing Owl or Loggerhead Shrike nest sites by signing a voluntary handshake agreement with them to maintain the nesting area (or former nesting area) by not cultivating the land, removing the shrubs or altering the nest site. This voluntary agreement is not legally binding and is indefinite, and can be cancelled by the participant at any time. Participating landowners report the number of Burrowing Owls or Loggerhead Shrikes on their site(s) annually. All landowners are encouraged to continue to participate in OBO or SFS by reporting the presence or absence of owls or shrikes and by conserving habitat, even if owls or shrikes do not return to breed on their land. In recognition of their participation, landowners receive either a certificate or an OBO/SFS gate sign with their name. Also, participants are sent educational information, including a newsletter, brochures, fact sheets and booklets each year. After every 5 years of participation, landowners receive a certificate of recognition for the number of years they have been enrolled.

A number of landowners are visited each year, including most new participants. A toolkit of information, focusing on species at risk and conservation practices and options, is discussed and left with the landowner for future reference. A brief site-specific management plan is often developed with the landowner, outlining beneficial management practices that are currently being used, or could be adopted, to benefit species at risk and the landowner's operation.

Annual Census

To determine the number of owls or shrikes on each site, census cards are mailed to all OBO and SFS participants every June. If the participant does not reply using the census card, they are contacted by phone for the information.

Some participants often failed to respond to our annual mail-outs requesting information on the number of owl pairs per enrolled site. To estimate the total number of pairs per year on all OBO sites combined, we assumed that participants from whom we did not obtain owl counts ("Unknowns") had the same mean number of owls per site as participants from whom we obtained counts ("Knowns"). Skeel et al. (2001) tested this assumption through follow-ups and concluded that attributing the same number of pairs per site to non-responding "Unknowns" as to "Knowns" seemed reasonable.

As there are fewer participants in SFS and the percentage of participants reporting is generally much higher than OBO participants, it is unnecessary to estimate the total number of shrike pairs at this time.

Habitat Enhancement

Nature Saskatchewan delivers a habitat enhancement program initiated in 2000. The goal of the program is to increase and improve habitat for the Burrowing Owl and Loggerhead Shrike and reduce grassland fragmentation by enlarging pastures and grassland patches. Nature Saskatchewan provides funding assistance to landowners to seed cultivated land adjacent to grassland back to permanent cover, erect strategic fencing and develop alternate water sites for livestock.

Project sites had to meet the following criteria: 1) within 5 km of pastures that currently or previously supported Burrowing Owls in the past 22 years or Loggerhead Shrikes in the past 7 years, with priority given to those that supported owls or shrikes in the last 3 years; and 2) adjacent or close to existing tame or native pasture. The agreement for seeding, fencing and water developments was a 50% cost share of materials and labour, with landowners contributing labour and equipment costs up to a predetermined maximum. Fencing and water development could be included where these maintained the integrity and health of newly seeded and planted areas. Until 2008, to protect and encourage native prairie plant species, landowners agreed not to sow seven invasive tame species including Smooth Brome (*Bromus inermis*), and to limit alfalfa (*Medicago sativa* L.) to less than 10% of the sowing mix; starting in 2009, approved seed mixtures are 100% native mixes of at least two grass species. These restrictions also benefited owls, as an earlier habitat survey indicated that Burrowing Owls preferred to nest in grassland other than stands of alfalfa and brome grass (Hjertaas 1989). Landowners approved for a habitat enhancement project signed a 10-year agreement to maintain their land as pasture and were enrolled in the OBO program to participate in monitoring for owls and to receive educational materials.

Results and Discussion

Voluntary Stewardship Protects Habitat

Voluntary habitat stewardship through a program that provides recognition and information is an effective and cost-efficient means of conserving wildlife lands. An evaluation in 2000 of the effectiveness of the Operation Burrowing Owl program during its initial period (1987-1994) demonstrated that OBO had a significant impact on conservation (retention) of grassland habitat at enrolled sites, even during an era of accelerated habitat loss (Warnock and Skeel 2004). In 1986 (just prior to the formal launch of the program in 1987), a comparison of 108 grassland sites on the Regina Plain enrolled in OBO because they supported owls (treatment sample), to 98 randomly selected sites in nearby grassland that were not enrolled because they did not support owls (control sample), revealed that the amount of grassland remaining in 1994 compared to 1986 was significantly higher (66%) on sites enrolled in OBO than at random sites (48%) (Table 1, adapted from Warnock and Skeel 2004). Approximately 12.6% of landowners across southern Saskatchewan invited to enrol in OBO in 1986 declined for various reasons (calculated from Hjertaas and Lyons 1987). This may introduce a bias towards more conservation-minded landowners joining OBO in 1986, although it is not likely to explain entirely the highly significant difference. The study strongly suggested that voluntary habitat stewardship, where no legally binding agreement is signed, can be a highly effective strategy to conserve habitat.

Table 1. Grassland retention (1986-1994) compared between grassland sites with Burrowing Owls and enrolled in Operation Burrowing Owl (OBO), and random grassland sites without Burrowing Owls and not enrolled in OBO. Significant comparisons are in bold (P<0.001) or underlined (P<0.1), Kolmogorov-Smirnov test.

	Sites in grassland with Burrowing Owls in 1986 and enrolled in OBO*		Randomly-selected sites in grassland in 1986 and not enrolled in OBO	
	Grassland Retention	Number of Sites	Grassland Retention	Number of Sites
Overall	**66%**	108	**49%**	98
Parcel Size				
<2 ha	**69%**	25	**23%**	29
2 – 12 ha	62%	36	38%	36
> 12 ha	68%	47	82%	33
Agricultural Soil Suitability				
Excellent	**54%**	34	**25%**	33
Average	**76%**	52	**49%**	41
Poorest	63%	22	80%	24

* Approx. 12.6% of sites did not enroll in OBO for various reasons (calculated from Hjertaas and Lyon 1987).

Voluntary Stewardship Retains Participants

The OBO program began with 293 landowners in 1987 and continued to grow (Skeel et al. 2001). The number of participants in OBO has gradually declined since a high of 501 in 1991, dropping to a low of 421 in 2009 (including participants in habitat enhancement programs but who are not included in our annual owl population monitoring, up to approximately 40 participants). As of 2009, most participants were private landowners (96% in 2009), and the remainder were stewards of public lands. Each year, new participants join the program while others leave, resulting in a relatively stable membership from year to year. New participants are gained from publicity efforts that encourage individuals to report owl sightings to OBO's advertised toll-free number.

Landowners leaving the OBO program usually did so because they decided to cultivate formerly protected areas or they no longer owned the land. Although not having owls for several years caused some landowners to leave the program, most continued to participate. Of the 675 individuals who joined the OBO program in the 8 years between 1987 and 1994, 504 (75%) were still enrolled 5 years after joining, even though about 70% of them no longer had owls (Skeel et al. 2001). This was also examined for the next 10-year period: of the 79 participants that joined the program between 1995 and 2004, all 79 were still enrolled 5 years later, even though 89% of them no longer had owls. In addition, participants that remained in the program for 5 years tended to remain in the program to at least 1999 for the first time interval, and to at least 2009 for the latter time interval (<2% dropped out after 5 years). The proportion of participants that remained in the program was notably greater in recent years. This likely reflects differences in government policies and farming economics, with a climate that was more favourable to cultivating land in the earlier years and to retaining pastures in recent years.

Population Trend

Although the number of OBO participants grew during the initial four years of the program and declined slightly thereafter, the known number of Burrowing Owls on OBO sites declined at an alarming rate. In 2009, 421 OBO participants reported a total of 82 pairs (corrected for non-reporting participants; 79 actual pairs reported by 42 participants at 52 sites), considerably fewer than the 681 pairs reported by 352 participants in 1988. The total estimated number of pairs declined a dramatic 92.1% from 1988 (1032 pairs) to 2009 (82 pairs), a mean population decline of 11.3% per year (Fig. 1). When the population trend was first published in 2001, the mean population decline from 1988 to 2000 was 21.5% per year (Skeel et al. 2001). The population declined steeply from 1988 to 1994 at 26.9% per year, was less severe from 1995 to 2000 at 19% per year, and has shown a small upward trend of 5.8% from 2001 to 2009. When the percent annual decline estimated from OBO data (2001-08) was compared with the percent annual decline measured by biologists on the Regina Plain, no difference was found, supporting the reliability of the data sets (paired *t*-test, $P = 0.47$; R. Poulin, unpubl. data).

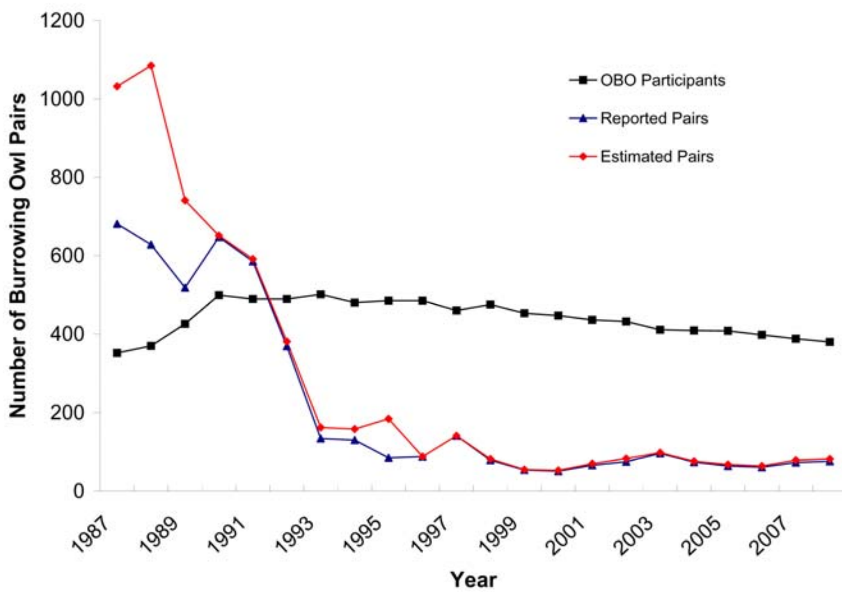


Figure 1. Operation Burrowing Owl population trend from 1988-2009.

The Shrubs For Shrikes census monitors Loggerhead Shrikes at SFS sites annually (Table 2). The number of SFS participants has been steadily increasing since the program was initiated in 2003, albeit at a slower pace than the OBO program. More participants are needed for meaningful population monitoring. SFS also monitors shrike ecology, including habitat preferences and the re-use of nest locations by returning pairs.

Table 2. Shrubs For Shrikes annual census results.

Year	No. of SFS Participants	% of Participants Reporting	No. of Reported Pairs	No. of Sites with Shrikes
2004	4	100%	6	4
2005	14	100%	7	4
2006	26	96%	13	11
2007	39	100%	19	23
2008	47	87%	20	28
2009	58	86%	28	38

Trends in Pairs per Site

Before 1993, sites with ≥5 pairs of Burrowing Owls were fairly common (6-16% of OBO sites); however, almost all sites since 1993 supported <5 pairs of owls. No sites had ≥11 pairs after 1993 whereas at least 1% had that many before 1993. In 1988, the year after OBO was initiated, only 19% of sites had no owls, but 43% of sites had >1 pair of owls. By comparison, in 2009 there were no owls at 89% of sites and only 25% of sites had >1 pair of owls.

Habitat Enhancement

Since 2000, Nature Saskatchewan has funded 121 habitat enhancement projects resulting in 15,254 acres of cropland seeded back to grassland, 55 miles of strategic fence installed and 12 watering sites established.

In 2007, a study to determine if Burrowing Owls were using habitat enhancement project sites was conducted (Kotylak and Skeel 2009). Burrowing Owls were found on 6 of the 28 sites surveyed (3 habitat enhancement sites and 3 adjacent sites); sites surveyed included 10 habitat enhancement sites and 18 adjacent quarter sections that were in pasture. In 2008, 14 pairs of Burrowing Owls were reported on habitat enhancement sites or adjacent to these sites on the same quarter section. In 2009, three pairs and one single Burrowing Owl were reported on habitat enhancement sites. These results provide encouragement that enhanced sites will more likely be used by owls as they become established. Further study of enhancement projects may reveal their importance in the recovery of Burrowing Owls in Saskatchewan.

Sources of Error

The decline rates calculated from OBO data are approximate, as miscounting of owls, annual movement of owls, and changes in number of sites being monitored from year to year could lead to inaccuracies. The decline documented by Operation Burrowing Owl may result from other factors, such as year-to-year movements of owls from OBO sites to previously unoccupied sites (Rich 1984, Hjertaas 1997). This bias is at least partially offset by enrollment of landowners who report owls for the first time (Wellicome and Haug 1995).

Conclusion

As habitat loss and fragmentation are major causes of population decline for Burrowing Owls and Loggerhead Shrikes, voluntary land stewardship is a highly effective strategy to conserve habitat.

Literature Cited

Gauthier, D.A. and E.B. Wiken. 2003. Monitoring the conservation of grassland habitats, Prairie Ecozone, Canada. *Environmental Monitoring and Assessment* 88: 343-364.

Hjertaas, D.G. 1989. Operation Burrowing Owl (1987 and 1988) completion report. Unpublished Report. Saskatchewan Parks and Renewable Resources, Regina, SK.

Hjertaas, D.G. 1997. Operation Burrowing Owl in Saskatchewan. Pages 112-116 *in* J.L. Lincer and K. Steenhof (eds.), The Burrowing Owl, its biology and management, including the proceedings of the first international Burrowing Owl symposium. *Journal of Raptor Research. Report 9.*

Hjertaas, D.G. and W. Lyon. 1987. A stratified random survey for Burrowing Owls on the Weyburn (62E) and Regina (72I) Map areas. Saskatchewan Parks, Recreation and Culture, Wildlife Technical Report 87-2, Regina, SK.

Kotylak, A. and M.A. Skeel. 2009. Are Burrowing Owls Using Enhanced Habitat? *Blue Jay* 67: 231-234.

Rich, T. 1984. Monitoring Burrowing Owl populations: implications of burrow re-use. *Wildife Society Bulletin* 12: 178-180.

Skeel, M.A., J. Keith and C.S. Palaschuk. 2001. Population decline recorded by Operation Burrowing Owl in Saskatchewan. *Journal of Raptor Research* 35: 371-377.

Warnock, R. and M.A. Skeel. 2004. The Effectiveness of Voluntary Habitat Stewardship in Conserving Grassland: Case of Operation Burrowing Owl in Saskatchewan. *Environmental Management* 33: 306-317.

Wellicome, T.I. and E.A. Haug. 1995. Second update of status report on the Burrowing Owl *Speotyto cunicularia* in Canada. Committee on the Status of Endangered Wildlife in Canada (COSEWIC), Ottawa, ON. http://www.cosewic.gc.ca

Skink Watch: Involving Landowners in Skink Monitoring on Private Land in Southwestern Manitoba

Allison Krause Danielsen
Natural Resources Institute, University of Manitoba

Pamela Rutherford
Department of Biology, University of Brandon

Nicola Koper
Natural Resources Institute, University of Manitoba

Abstract – Southwestern Manitoba is home to six squamate reptile species (Red-bellied Snake, Smooth Green Snake, Red-sided Garter Snake, Plains Garter Snake, Western Hognose Snake and Northern Prairie Skink). The northern prairie skink is of conservation concern and was listed as endangered by COSEWIC in 2004. There is limited data in Manitoba for the skink, and for several of the other snake species. Northern Prairie Skinks and Western Hognose Snakes are limited to sandy habitats, much of which is in Spruce Woods Provincial Park and on the Canadian Forces military base at Shilo. There is potential, however, for all squamate reptile species to occur in extensive habitat on lands outside the park and the military base, such as privately owned land, land purchased by NGOs such as Nature Conservancy of Canada, and First Nations land. Valuable information on the distribution of these species can be gained through the monitoring of reptiles by landowners on their own properties, particularly as land-owners and other groups have shown great interest in skinks and often take the lead in stewardship. Protocols were developed that are appropriate for different target audiences [e.g. general public, field biologists, website material (SOS website and Herp Atlas), Centre for Indigenous Environmental Resources (CIER), Nature Conservancy of Canada (NCC)].

The monitoring protocol will enable groups to take ownership of monitoring reptiles on their own land and, in turn, will provide more information to researchers for recovery of species at risk. During the summer of 2009, researchers worked with private landowners and NGOs to test and refine the protocol and gain some idea of its usefulness in a practical setting. The protocol project is a preliminary step in research on reptile distribution on private land and landowner stewardship of reptile species at risk.

Managing Transmission Lines for Prairie Plants and Animals

Lionel Leston and Nicola Koper
Natural Resources Institute, University of Manitoba

Abstract – Transmission lines could be managed to provide habitat for native prairie species (plants, butterflies, grassland birds, etc.) whose original habitat has been severely reduced. From 2007 to 2009, we conducted abundance surveys of prairie plants, arthropods and birds along 51 half-km sections of transmission lines within 200 km of Winnipeg, as well as at three urban remnant prairies of similar area. These study sites varied in their annual management (mowing and spraying frequency 0 to 2 times per year) and in surrounding land uses, all of which are hypothesized to influence the abundance and richness of species that colonize and persist in a given site.

For example, in 2007-2008, butterfly species richness was most strongly and positively correlated with the amount of wooded land within 400 m of transects, whereas prairie birds like Savannah Sparrows and Western Meadowlarks were most strongly and negatively correlated with that landscape feature. Other prairie birds (Bobolink, Le Conte's Sparrow, Sedge Wren, Wilson's Snipe) were found at fewer sites with more grassland and little-to-no urban land within 400 m. Savannah sparrows were also more abundant at hayed sites, which had more grasshoppers, suggesting that some grassland birds may settle in grassland fragments with more arthropod prey. Native plant species richness was most strongly and negatively correlated to urban land within 400 m, whereas native plant cover was most strongly and negatively correlated to agricultural land within 400 m.

Management and land use appear to influence prairie plants and animals in different ways. Thus, multiple transmission line sections with more grassland and less urban land nearby should be managed for prairie species, each varying in management to benefit different species. With these data, I will identify the urban transmission line sections with the highest priority for active restoration and management for prairie wildlife.

An Assessment of Recovery Efforts and Outcomes for the Peregrine Falcon (*Falco peregrinus*) in Manitoba

Isabel Martinez-Welgan and Richard Baydack
Clayton H. Riddell Faculty of Environment, Earth, and Resources, University of Manitoba

Abstract – The Peregrine Falcon (*Falco peregrinus*) is a migratory raptor considered to be endangered in Manitoba and threatened nationally. Low productivity due to eggshell thinning linked to chlorinated hydrocarbons caused a precipitous decline in Peregrine Falcon populations beginning in the 1950s. By the 1970s, the *anatum* subspecies of the Peregrine Falcon had been extirpated from most areas south of 60°N and east of the Rocky Mountains.

Provincial conservation efforts initiated in 1981 were focused primarily on hack-and-release programs from various urban sites in Manitoba. These programs were successful in releasing Peregrine Falcons; more than 170 as of 2007/08. Data from 2007 confirm that three breeding pairs were identified in Manitoba that year, two in Winnipeg and one in Brandon. In 2000, a captive breeding facility was constructed, with the first release taking place in 2005. Approximately 15 Peregrine Falcons have been released to date from the Parkland Mews facility, located south of Winnipeg.

The monitoring of dispersed Peregrine Falcons is dependent on actual physical evidence through leg-band identifications. Consequently, it is impossible to know the exact number of dispersed falcons which survive to return to potential nesting areas the next year. Although researchers in other regions have determined that falcons will return to the same type of area (urban or rural) from which they were released, they may be located a significant distance from the original dispersal site.

Future research needs include satellite tracking to enable detailed assessments of dispersal and first-year survival of Peregrine Falcons produced in Manitoba, and the acquisition of data related to migration and locations of wintering grounds. Long-term monitoring is necessary to assess the success of current conservation efforts, to achieve a change in status from endangered under the *Endangered Species Act* to protected under the *Wildlife Act*.

Introduction

Manitoba's Peregrine Falcon recovery effort began in 1981 with provincial support for a federal program involving the intentional placement of captive-bred chicks on high-rise buildings in various locations throughout southern Manitoba. The national recovery plan (Western Raptor Technical Committee 1988) produced for the *Anatum* Peregrine Falcon in 1988 formalized the regional objective to establish ten nesting pairs in Manitoba, Saskatchewan, and Alberta.

In 1992, the Province of Manitoba listed the Peregrine Falcon as endangered by regulation under Manitoba's *Endangered Species Act*. In compliance with the legislation, the Province put forward a plan and strategy in 2003 (Wheeldon 2003) designed to follow up and complement the national recovery plan. The objective of the plan was to develop a solution for establishing additional nesting pairs of Peregrine Falcons in Manitoba in order to achieve a change in status from Endangered under the *Endangered Species Act* to Protected under the *Wildlife Act*.

Background

Data for the provincial Peregrine Falcon recovery effort were obtained for 1981-2009 from the Peregrine Falcon Recovery Project, Manitoba (Manitoba Project Coordinator, T. Maconachie). Parkland Mews Falconry and Bird of Prey Education Centre provided additional data regarding Peregrine Falcons released from that facility (Director, R. Wheeldon). The data were compiled and summarized to assess the outcomes of the recovery effort in Manitoba.

Recovery Outcomes

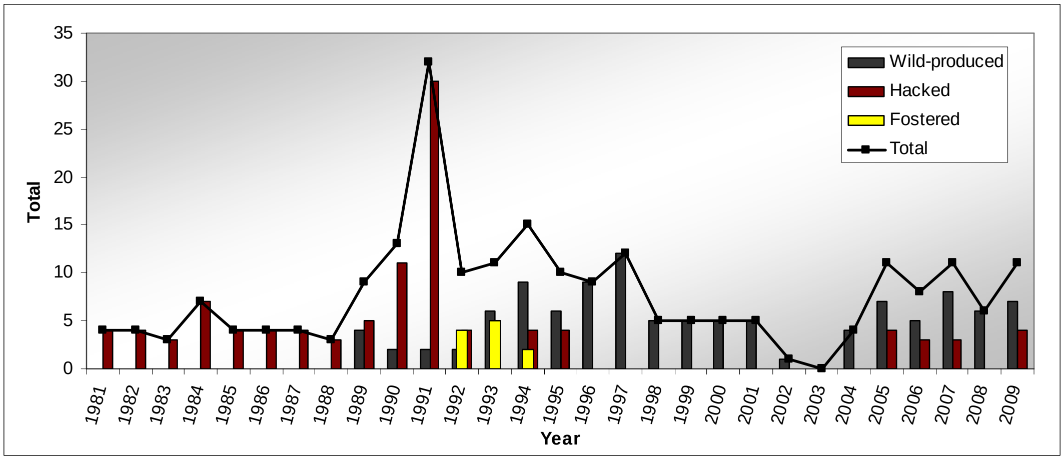


Figure 1. Peregrine Falcons in Manitoba, 1981-2009.

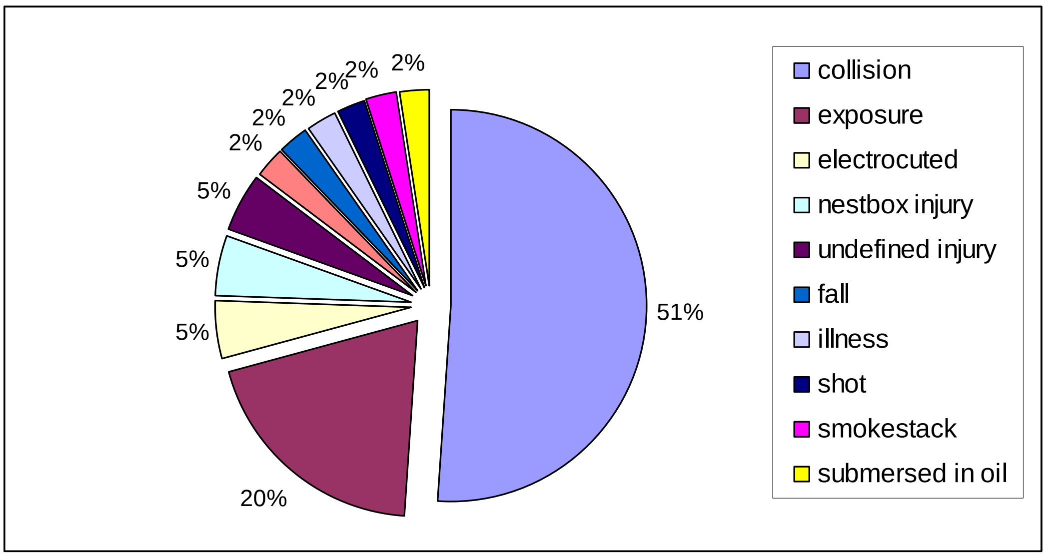


Figure 2. Mortality factors encountered in Manitoba (n=41).

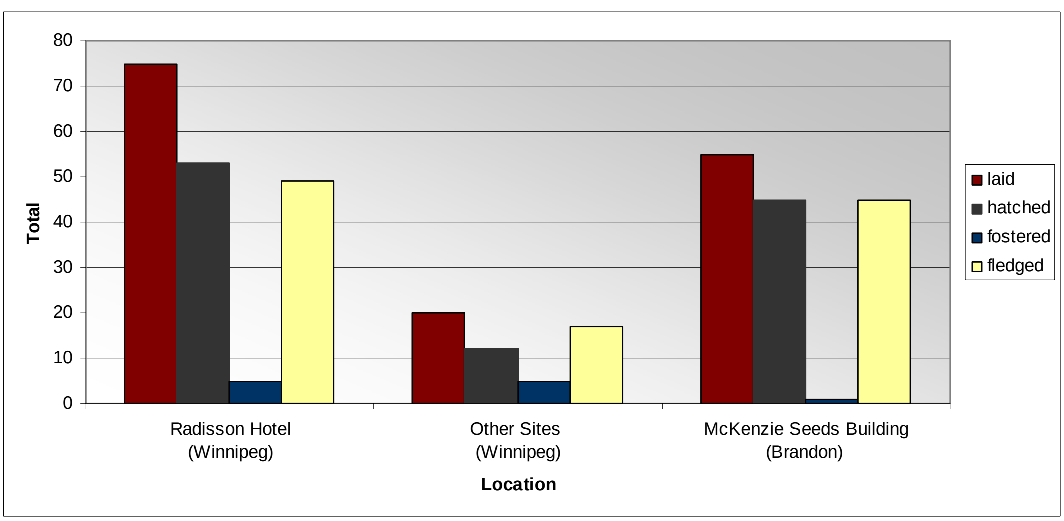


Figure 3. Breeding summary for Peregrine Falcons wild-reared in Manitoba.

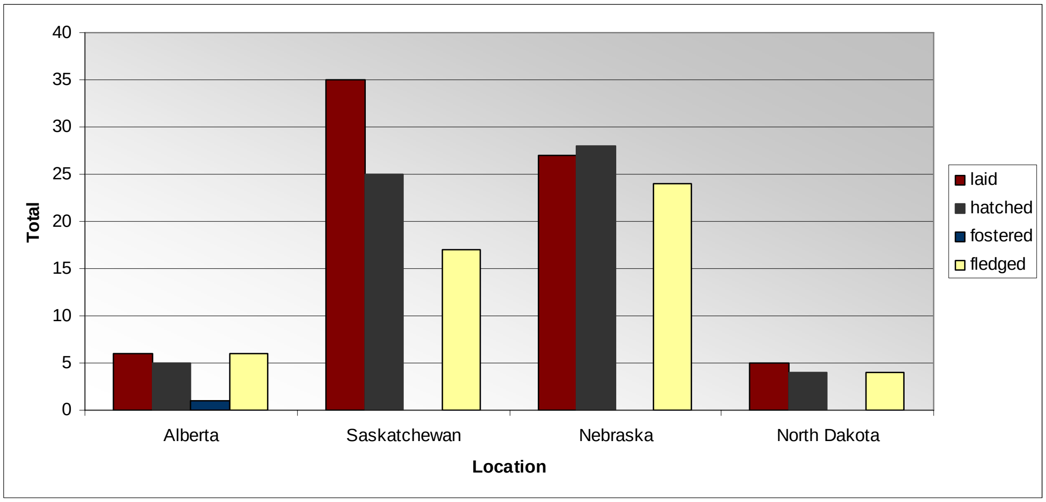


Figure 4. Breeding summary for Peregrine Falcons wild-reared outside of Manitoba (incomplete data).

Summary

- Manitoba's recovery effort has succeeded in introducing a large number of Peregrine Falcons into Manitoba. Since 1981, a total of 226 falcons have been hacked, fostered, or wild-produced (Fig. 1).
- Mortality was confirmed for 49 Peregrine Falcons. Cause of death was determined for 41, including both juveniles and adults. Collisions with artificial structures accounted for approximately half of all deaths (Fig. 2).
- Fifteen Peregrine Falcons returned to breed in Manitoba, beginning in 1989. Of 44 nesting attempts, 150 eggs were produced. A total of 111 young were fledged (including 11 fostered chicks), primarily from the Radisson Hotel (formerly Delta Hotel) in Winnipeg and the McKenzie Seeds Building in Brandon (Fig. 3).
- Although Peregrine Falcons have returned to natal areas in Manitoba, dispersal to other regions is confirmed. Manitoba Peregrines have emigrated to other Prairie Provinces and to several cities in the mid-western U.S. Peregrine Falcons from Manitoba have also been found in Brazil, Cuba, Dominican Republic and Mexico during the non-breeding season.
- Thirty-one nesting attempts were recorded for 12 Peregrine Falcons that dispersed outside of Manitoba. At least 73 eggs were laid, and a minimum of 51 young fledged (Fig. 4).
- Wild production of Peregrine Falcons in Manitoba is currently limited to a small number of fertile and experienced nesting pairs. Successful new nesting territories are not being established, suggesting that the limiting factor for the urban Peregrine Falcon population in Manitoba is the availability of suitable nesting sites.
- Future research needs include satellite tracking to address data gaps regarding migration, survivorship and mortality, wintering grounds, and the possible existence of additional nesting territories.

Acknowledgments

Dr. J. Duncan (Manitoba Conservation, Wildlife & Ecosystem Protection Branch)
T. Maconachie (Peregrine Falcon Recovery Project, Manitoba Project Coordinator)
R. Wheeldon (Founding Director, Parkland Mews Falconry & Bird of Prey Education Centre)

Literature Cited

Western Raptor Technical Committee. 1988. *Anatum* Peregrine Falcon Recovery Plan. Catalogue No. CW-66-97/1988E. Canadian Wildlife Service, Edmonton, AB.

Wheeldon, R. 2003. A Recovery Plan and Strategy for the Peregrine Falcon in Manitoba. A Parkland Mews-Manitoba Conservation Partnership Project, Winnipeg, MB.

A New Technology to Determine Burrowing Owl Critical Foraging Habitat

Alan Marsh, Erin M. Bayne and Troy I. Wellicome*
Department of Biological Sciences, University of Alberta
*Canadian Wildlife Service

Abstract – The Burrowing Owl has been listed as endangered in Canada since 1995. Efforts to increase the population focus, in part, on creating habitats with tall grass because these habitats support high abundances of the small mammal species consistently eaten by Burrowing Owls. However, high prey abundance does not necessarily translate into optimal foraging habitat if the vegetative structure precludes prey detection or capture. Previous research focused on identifying the habitats in which owls forage. However, data acquisition was via the use of radio telemetry or data loggers, both of which acquired single locations at largely-spaced intervals. Conclusions about the owls' use of, and behaviour at, these points (e.g., flying, perching, roosting, foraging, etc.) are assumed, as conclusions about behaviour cannot be inferred from a single location. Thus, links between behaviour and habitat, or habitat conditions, are ambiguous.

My research focuses on identifying precisely where Burrowing Owls capture their prey. I use new data loggers that acquire a location, accurate to <5 m, every second, allowing me to follow a foraging owl's precise paths. Used in conjunction with Digital Video Recorders (DVRs), which film prey deliveries at the nests, I can pinpoint where the owl captured the species being delivered. I can then determine the habitat type and conditions at the capture site. To date, 41 small mammal capture sites have been located. Preliminary analysis indicates owls are capturing prey in a variety of vegetation types, but consistently in areas of low vegetative height/density, which contradicts the reasoning behind current vegetation enhancement strategies. Further analysis is needed to understand the relationship between height of grass and the effect this has on prey sources, as well as on prey capture.

Yellow Rail Habitat Selection in Southeastern Manitoba

Kristen Martin and Nicola Koper
Natural Resources Institute, University of Manitoba

Abstract – Yellow Rail (*Coturnicops noveboracensis*) populations continue to be threatened by extensive wetland loss on both their breeding and wintering grounds. Yellow Rails are often found in wetlands dominated by sedges and with low water levels, but the influence of other structural habitat factors, such as wetland size, amount of cattails or woody vegetation, and surrounding land use, is not well understood. In 2010-2011, I will conduct a multi-scale habitat analysis to evaluate Yellow Rail habitat at the local and landscape levels in southeastern Manitoba. I will conduct call-playback surveys for Yellow Rails at 200 wetlands. In 2010, study wetlands will consist of randomly selected wetlands in addition to all known sites within the study area at which Yellow Rails have been previously detected. Local wetland habitat characteristics will be evaluated through measurements of water depth, maximum vegetation height, canopy density, overall wetland size, and vegetation species community. Landscape level habitat will be evaluated through measurements of land cover types (e.g., amount of wetlands, trees) and land-use types (e.g., grazed, cropland) within 3 km^2 of each study wetland, using GIS. Data will be analyzed using generalized linear mixed models, and the best-fitting model will be selected using Akaike's Information Criterion. In the second year, we will test the efficiency and accuracy of our model by selecting wetlands in the same study area based on suitable and non-suitable wetland habitat according to the best-fitting model. The habitat suitability model developed in this study will be useful for identifying new Yellow Rail habitat and predicting critical Yellow Rail habitat on which conservation efforts should be focused in southeastern Manitoba.

Habitat Selection of the Eastern Yellow-bellied Racer (*Coluber constrictor*) and Bullsnake (*Pituophis catenifer*) in Southern Saskatchewan

Jessica Martino
Department of Biology, University of Regina

Ray G. Poulin
Royal Saskatchewan Museum

Christopher M. Somers
Department of Biology, University of Regina

Abstract – Understanding the habitat requirements of a species is vital for developing an effective recovery or management strategy. The Eastern Yellow-bellied Racer (*Coluber constrictor*) is a threatened species in Canada, primarily because its range is restricted to a small area around Grasslands National Park in southern Saskatchewan. There have been no studies published on the ecology of this species in the Canadian prairies, and thus there is little detailed information from which to draft a recovery strategy. The Bullsnake (*Pituophis catenifer*) shares habitat and hibernacula with the racer. The geographic range of the Bullsnake is larger than that of the racer, but again, no ecological studies have been published on this species in Canada and as a consequence, its conservation status is designated as “data deficient”.

We used radio-telemetry to begin identifying important ecological parameters of these two snake species, including habitat selection, movement patterns and den locations. Over two years we tracked 20 racers and 16 Bullsnakes from 5 den sites in the Grasslands National Park area. We measured a wide range of habitat features selected by snakes (percent vegetation, maximum vegetation height, distance to nearest burrow, etc.) and these measures will be incorporated into a multi-variate habitat selection model. There appears to be a general trend of racers spending their summer in proximity to the Frenchman River as opposed to inhabiting the upland pasture areas. Bullsnakes showed a similar trend, spending time along waterways, but also seemed to prefer habitat in roadside ditches. All snakes avoided Black-tailed Prairie Dog colonies. When completed, the results of this project will be used to inform recovery strategies and help identify critical habitat for these species.

Understanding Urban White-tailed Deer Movement within the Greater Winnipeg Area

Erin McCance, Richard Baydack and David Walker
Department of Environment and Geography, University of Manitoba

Rick Riewe
Department of Biological Sciences, University of Manitoba

Michael Campbell
Faculty of Kinesiology and Recreation Management, University of Manitoba

Abstract – The urban white-tailed deer (WTD) population in the Greater Winnipeg Area (GWA) has grown substantially over the last three decades. Increasing WTD populations in heavily human-populated areas have led to human-deer conflict and represent a significant human health and safety concern. There has been a substantial increase in the number of deer-vehicle collisions within the GWA; WTD host a number of diseases transmittable to humans and other wildlife; and WTD cause significant property damage. Despite these problems, residents of the GWA view the urban WTD population as a valuable resource. This poster presents research using GPS and reflector collars to track WTD population movement within the GWA.

Gaining a better understanding of urban WTD movement patterns, corridor use and habitat choices will provide community leaders with information that will provide an understanding of the importance of urban wildlife corridors to conserving the deer population and the biodiversity required to support urban wildlife species. GIA analysis of land use by deer promises to have a major impact on how we manage the population, design roadways, and proactively plan for urban development and infrastructure.

Throughout the 20th century, urbanization and capital expansion have progressively engulfed undeveloped land, and yet, today, there is recognition of the implications of this development and a growing concern for the environment, habitat loss and reduction of global biodiversity. The importance of acknowledging ecosystem integrity is becoming increasingly apparent in what Jennifer Wolch (in *Animal Geographies*) calls the "zoopolis" – the contemporary metropolis that is populated by both humans and animals, and that must be designed for their co-existence. Since human responsibility to non-human animals can no longer be avoided, it is necessary to develop co-existence principles that recognize this responsibility, and that translate into feasible, future-oriented practices in contemporary urban settings.

Effects of Grazing Intensity and Years Grazed on Songbird Nesting Success in Northern Mixed Grass Prairies

Emily Pipher and Nicola Koper
Natural Resources Institute, University of Manitoba

Abstract – Prairie songbirds are declining due to loss of habitat and the removal of natural grassland processes such as historical grazing by bison. Nesting success of songbirds is influenced by vegetation, which can be affected by grazing. Cattle were introduced into Grasslands National Park of Canada using an adaptive management experiment. We used hand-dragging to find nests in 26 plots (each 300m²) in pastures with grazing intensities ranging from 0-70% biomass removal, and which were grazed for 0, 2 or >15 years. We monitored nests of seven songbird species, and present analysis for three. Modified logistic regression indicated a nonlinear effect of grazing intensity on nesting success of Sprague's Pipits, which had lowest success at low grazing intensities, but highest success at moderate intensities. There was a negative correlation between years grazed and nesting success for Chestnut-collared Longspurs, but a positive correlation with grazing intensity. Nesting success of Vesper Sparrows, and all species combined, was not influenced by grazing. If the management objective is to maintain songbird diversity, grazing does not influence the quality of nesting habitat. However, if management is aimed toward increasing threatened Sprague's Pipit populations, certain grazing regimes may reduce nesting success, while others may increase it.

Sprague's Pipit and Vesper Sparrow Breeding Success during Pipeline Construction and Clean-up Activity

Lois Pittaway and Janice Skiffington
Tera Environmental Consultants

Glenn Sutter
Royal Saskatchewan Museum

Stephen K. Davis
Canadian Wildlife Service

Abstract – Understanding the effects of industrial activity on grassland birds is necessary to ensure that effective protection measures are implemented. Currently, federal and provincial guidelines are in place that recommend restricted activity periods and setback distances for species at risk, including the threatened Sprague's Pipit. In spring and summer 2009, we studied the appropriateness of the recommended setback distance for Sprague's Pipit, which recommends that industrial activity not occur within 200-250 m of an active nest. Nesting success of Vesper Sparrow was also monitored for comparative purposes, as these birds occupy similar types of habitat. Fieldwork focused on construction and clean-up activities associated with an Enbridge pipeline that crosses Alberta, Saskatchewan and Manitoba and traverses the northern edge of the Sprague's Pipit breeding range. Treatment and control plots were established at locations where pipits were detected during pre-construction surveys, with treatment plots being adjacent to the pipeline right-of-way and control plots being 600 m away in similar habitat. In both types of plots, Sprague's Pipit and Vesper Sparrow nests were located using rope drags and monitored to estimate survivorship. The locations of singing Sprague's Pipit males were mapped to document changes in the size and location of breeding territories. Ambient noise levels were also recorded before, during and after pipeline activities and compared to the frequency spectra of Sprague's Pipit and Vesper Sparrow breeding calls. A summary of the results is presented and discussed.

The Effects of Twice-over Rotation Grazing on the Abundances of Grassland Birds

Cristina Ranellucci and Nicola Koper
Natural Resources Institute, University of Manitoba

Abstract – The mixed grass prairie region of southwestern Manitoba is a hotspot for many endangered grassland birds. Once covering approximately 6,000,000 ha, this region has been degraded to less than a quarter of the historical amounts. Presently, the remaining prairie is primarily used for livestock grazing. We evaluated the potential role of sustainable land management practices, such as rotational grazing, for aiding in conservation of the regional avian community. We surveyed a total of 45 sites to compare the effects of land management regimes on the abundances of grassland birds (22 twice-over rotation grazed pastures, 15 continuously grazed pastures, and 8 ungrazed fields). Bird surveys were conducted using 100 m fixed-radius point count plots. In 2008, twice-over rotation grazed pastures had higher species richness per plot than continuously grazed pastures, while ungrazed fields had the lowest species richness. An ANOVA indicated a significant difference among treatments ($p=0.08$). However, a Fisher's post-hoc test did not indicate a significant difference between the two grazing regimes, but did indicate a significant difference between grazed and ungrazed sites ($\alpha=0.1$). Future analysis will include evaluating the effects of vegetation structure on the occurrences of grassland bird species, and the use of generalized linear mixed-models to accommodate for non-normal and clustered distributions of species within pastures.

Does Buffalograss Need Buffalo?

Diana Bizecki Robson
The Manitoba Museum

Vernon Harms
Department of Biology, University of Saskatchewan

Darcy C. Henderson and Candace Neufeld
Canadian Wildlife Service

Chris Friesen
Manitoba Conservation Data Centre

Abstract – Buffalograss (*Buchloë dactyloides*) was designated a threatened species in 2001 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This species is rare, and is found only along the Souris River Valley in southeastern Saskatchewan, and the Souris and Blind River Valleys in southwestern Manitoba. Buffalograss occurs on relatively infertile, clayey, somewhat sodic soils in shallow coulees and valley floors. As Buffalograss is a poor competitor with tall grasses, it is generally restricted to areas being grazed. Recent survey work suggests that there are between 1 and 4.2 million Buffalograss clones occupying approximately 0.032 km^2 in Saskatchewan and 4.07 km^2 in Manitoba. Threats to this species include coal strip mining, invasive exotic species, lack of grazing and/or fire, flooding, cultivation, road construction or upgrades, urban expansion and clay pit mining.

Ecology of the Rare Western Silvery Aster

Diana Bizecki Robson
The Manitoba Museum

Abstract – Western Silvery Aster (*Symphyotrichum sericeum*) is a nationally threatened plant found in southern Manitoba and Ontario. Preliminary research indicated that low seed production might be negatively affecting this species. Research was conducted in 2008 and 2009 to (a) determine the frequency and constancy of insect visitors, (b) determine if pollen is limiting seed production, and (c) determine if clipping and/or fertilizing can be used to stimulate flower production. Insect visitation rates to Western Silvery Aster and the more common co-flowering plant Showy Goldenrod (*Solidago nemoralis*) were similar but the constancy of the visitors was lower to the former species. In a pollination experiment, seed production was significantly higher when flowers were pollinated by hand. None of the treatments applied (e.g. clipping, fertilizing with nitrogen and both), significantly increased height, the number of capitula per stem, or seed production over the control; clipping actually decreased height and capitula production. In summary, pollen limitation and possibly low overall soil nutrient levels, but not light, are hampering seed production.

Population Connectivity as a Critical Factor in Prairie-Chicken Sustainability

Jen Ruch
University of Manitoba

John Toepfer
Society Tympanuchus Cupido Pinnatus Ltd.

Abstract – The purpose of this poster is to encourage new and insightful discussion around the biggest threat to prairie-chicken conservation – the loss of grassland habitat, which disconnects local populations, threatening the species as a whole. Connective corridors that enable the birds to move meaningful distances and distribute their genes are of critical demographic importance in the long-term viability of this species; by long-term, we mean over the course of centuries. It follows that the preservation of strategically located habitat is the primary challenge in prairie-chicken conservation.

Research indicates that local populations tend toward extirpation when habitat quality is reduced and predation increases. Although these and other limiting factors contribute to overall species decline, the critical limiting factor for species extinction – the ultimate extirpation – appears to be loss of usable space, or habitat quantity. This is further illustrated in geologic time where random and unpredictable natural events have extirpated a species locally, and yet it continues to persist by way of recolonization.

It should follow that effectual concern for a local population is only reasonable if that population has the opportunity to ultimately sustain itself via the natural movement of birds and their genes. Which leads us to ask: how can we assist – or at the very least, not inhibit – the chickens in their movement? The answer is likely by maintaining functional habitat corridors that offer, and lead to, usable space.

The Greater Prairie-Chicken is capable of choosing usable space, and its distribution is only limited by our grassland management strategies. At what point will we begin to use our foresight, predictions and logic to prevent dangerous declines in numbers so that a species might be able to “save itself”?

Large-scale Abiotic Influences on Burrowing Owl Home-range Habitat Selection in the Canadian Prairies

A.F. Joy Manalo Stevens, **Erin M. Bayne and Troy I. Wellicome***
Department of Biological Sciences, University of Alberta
*Canadian Wildlife Service

Abstract – Understanding species-environment relationships through the use of statistical habitat models is important for developing wildlife conservation strategies. Such studies are typically conducted on a small geographic scale (hundreds of square kilometres) resulting in a relatively small range in environmental variation. Models from local studies are often used to predict the suitability of other unsampled regions. However, without considering the large-scale processes that structure spatial patterns in the species distribution, the value of these models can be questionable.

We examined home-range habitat selection by Burrowing Owls across the entire mixed prairie grassland region of western Canada to determine whether selection for biotic factors changes across abiotic gradients. Specifically, we classified 37 explanatory variables into five categories (geography, land use, grassland fragmentation, soil and climate), created models for each set of variables, and evaluated the predictive ability of each model. We then examined interaction effects to determine if the relationship between vegetation variables and the probability of owl home-range selection varied within large-scale abiotic criteria. Our results show that soil and climate produce the most predictive models of Burrowing Owl home-range selection at this scale, and create unique habitat conditions for owls that are independent of vegetation. This study provides new insight into Burrowing Owl habitat requirements, and strengthens the case for consideration of large-scale geographic gradients when prioritizing areas for conservation.

Pronghorn Habitat Selection and Movement in the Northern Sagebrush Steppe

Mike Suitor
University of Calgary

Mike Grue
Alberta Conservation Association

Cormack Gates
University of Calgary

Dale Eslinger and Kim Morton
Alberta Fish and Wildlife

Darren Bender
University of Calgary

Abstract – Among the diversity of prairie wildlife, Pronghorn (*Antilocapra americana*) are the most specialized and representative large mammal in the grasslands of North America. They are not typically found in any other natural regions of Alberta and are considered to be an obligate grassland species. In 2000, the Alberta Conservation Association (ACA) sought to bring issues surrounding Pronghorn conservation to the forefront, which resulted in the formation of a Pronghorn working group and the initiation of a collaborative research program between ACA, University of Calgary, and Alberta Fish and Wildlife.

Seventy-four female Pronghorn were captured between December 2003 and March 2006 and fitted with a Lotek GPS collar. Using habitat associations in the fawning period we classified Pronghorn into one of three groups: Native Prairie, Agriculture or Mixed. Approximately 41% of our animals used native landscapes year round, 11% used cultivated landscapes year round, while the remainder used a mixture of native and cultivation. Approximately 38% of our collared animals were migratory; on average, moving 450 km (round trip) annually. One collared female moved 830 km in a 6-month period, the longest recorded migration for the species. Our research also documented the negative impacts of barbed-wire fences on Pronghorn, such as barrier effects, hair removal and tissue scaring. The above research and management actions have catalyzed further research in Saskatchewan and Montana to describe movement corridors, barriers, and the effect of various land uses on seasonal requirements of Pronghorn throughout the Northern Sagebrush Steppe.

Rare Plant Rescue: Identifying and Conserving Habitat for Rare Plants in Saskatchewan

Sarah Vinge
Nature Saskatchewan

Abstract – Rare Plant Rescue (RPR) is a land stewardship program that works with landowners for the conservation of plant species at risk and their habitat. Most of the rarest Saskatchewan plants are found on the province's remaining natural grasslands, a great deal of which is privately owned and managed. RPR contacts private landowners with suitable habitat for permission to conduct targeted searches for rare plants. Searches are generally focused in areas having historical records of species occurrences, but other areas with suitable habitat are also searched. Landowners with suitable habitat are invited to join RPR, and when a new occurrence is found, RPR maintains a working relationship with the landowner to monitor the population. Both searches and monitoring are conducted following standardized methodology refined in 2008.

Participating landowners sign a voluntary agreement to conserve the habitat; this is a first step toward legal protection, and landowners are encouraged to consider a conservation easement. RPR landowners are educated about species at risk, beneficial management practices, and threats to the land, and receive recognition for their stewardship through an annual *Stewards of Saskatchewan* newsletter and personalized gate sign (those with species occurrences) or certificate (those with habitat but no occurrences).

In 2008 and 2009, RPR staff visited over 40 landowners (15 have joined the program so far) and located 22 previously unknown sites having plant species at risk: 7 with Small-flowered Sand-verbena (*Tripterocalyx micranthus*), 3 with Western Spiderwort (*Tradescantia occidentalis*), 4 with Hairy Prairie-clover (*Dalea villosa*), and 8 with Buffalograss (*Buchloë dactyloides*). Monitoring was conducted on 14 sites (of a possible 39) in 2009. Other species on RPR sites include Slender Mouse-ear-cress (*Halimolobos virgata*), Small Lupine (*Lupinus pusillus*), Prairie Dunewort (*Botrychium campestre*), Beaked Annual Skeletonweed (*Shinnersoseris rostrata*), Smooth Goosefoot (*Chenopodium salinum*) and Bur Ragweed (*Ambrosia acanthicarpa*). Since it began in 2002, RPR has gained 59 participating landowners that are conserving over 27,000 acres of rare plant habitat.

The Saskatchewan Prairie Conservation Action Plan: Embracing a New Approach for 2009-2013

Michelle Yaskowich
Prairie Conservation Action Plan

Abstract – Since 1998, the Saskatchewan Prairie Conservation Action Plan (SK PCAP) has brought together diverse organizations representing producers, industry, provincial and federal governments, environmental non-government organizations, and research and educational institutions, all working toward a common vision of conservation of native prairie and species at risk in Saskatchewan. The PCAP Partnership, which has grown from 16 to 27 partners, has proven to be an important forum for guiding conservation and management efforts within Saskatchewan's Prairie Ecozone. It reduces duplication, increases communication and coordination amongst partners, addresses gaps in native prairie research, activities and programming, guides the development of programs and policies that reward sustainable use and promote ecological health and integrity including species at risk recovery, and improves public understanding of native prairie and species at risk.

After ten years of collaborative prairie conservation experience through the implementation of two five-year action plans (1998-2003 and 2003-2008), the Partnership decided to embrace a new approach over its next five years. Rather than a five-year action plan, the Partnership developed a five-year Framework for Action upon which annual work plans are built. The Framework sets out a renewed Vision, Mission and Guiding Principles for the Partnership including three goals and five priority focus areas.

Focus groups, including other stakeholders, are formed each year around these focus areas and are responsible for developing, reporting on, and revising the annual work plans. The deliverables outlined in the annual work plans are realistic and can be achieved within each given year, allowing PCAP to take small attainable steps towards its overall goal.

Over the next five years, the PCAP Partnership will deliver innovative and critical prairie conservation activities that grow out of the unique capacity provided by a partnership such as this. These activities will benefit the social, cultural, economic and ecological fabric of Saskatchewan.

CHANGING RELATIONSHIPS

Changing Ethics: Developing Ecological Conscience through Faith-based Conservation

Larry Danielson
A Rocha Prairie Canada

Abstract – Aldo Leopold, in his famous essay "The Land Ethic" (*A Sand County Almanac*), called for "a change in ethics accompanied by an internal change in intellectual emphasis, loyalties, affections, and convictions" Now, some 60 years later, faith-based organizations are helping to realize Leopold's vision of extending social conscience from people to the land. A Rocha Prairie Canada is part of a Christian conservation network helping to develop what Leopold called an "ecological conscience." Based in 19 countries around the world, A Rocha provides environmental education and outreach to schools, youth groups, churches and communities and engages in a variety of conservation work; e.g., mapping and studying ecosystems, surveying and monitoring species, managing and protecting habitats, and restoring wetlands and forests. A Rocha carries the message of land stewardship to a significant audience and taps a new pool of committed volunteers for conservation projects.

The Changing Value of Citizen Science: A Manitoba Example

J. Paul Goossen
A Rocha Prairie Canada

Abstract – The role of citizen scientists in conservation is of increasing importance as government and non-government agencies struggle to keep pace with the growth of environmental stressors. Baseline data collected over broad geographical areas are often gathered by citizen scientists who make valuable contributions to scientific and conservation research. Key areas where citizen scientists are making a contribution are through fauna, flora or environmental monitoring programs or projects such as NatureWatch, Breeding Bird Surveys and Christmas Bird Counts.

An example of citizen science is A Rocha Prairie Canada's raptor migration monitoring project in the Pembina Valley of Manitoba. Opportunistic counts over 20 years by interested birdwatchers at this valley, located 125 km southwest of Winnipeg, resulted in the recognition of this major Manitoba raptor migration site. These historical counts, along with the more recent standardized counts initiated by A Rocha, a non-profit conservation organization, confirm the Pembina Valley as Manitoba's premiere spring raptor migration corridor. Count data are collected by A Rocha project personnel who are aided by interested birdwatchers and the general public. In 2009, the annual spring raptor count of 14 species peaked at over 10,000. Information gathered by citizen scientists and the interested public can play an increasing role in monitoring the status of various species and documenting areas in need of conservation. Raptor migration information gathered locally in Manitoba not only serves regional interests but also contributes to continental monitoring efforts which endeavour to assess the status of species and population trends.

Manitoba Provincial Prairie Grass Campaign

Marilena Kowalchuk, Cary Hamel and Julie Sveinson Pelc

Abstract – In 2009, a grassroots citizen-led campaign invited all Manitobans to select the native prairie grass species that best symbolizes Manitoba as a Canadian Prairie Province. By engaging the public in a vote for an official provincial grass emblem, the campaign raised awareness of the variety and value of Manitoba's prairie ecosystems. The candidates were Big Bluestem (*Andropogon gerardii*), Sideoats Grama (*Bouteloua curtipendula*), Blue Grama (*Bouteloua gracilis*) and Little Bluestem (*Schizachyrium scoparium*). Over 1500 votes were cast at www.manitobagrass.ca or at booths displayed at several rural and urban community events. Voting results were revealed officially at the 9th Prairie Conservation and Endangered Species Conference.

How it began

Inspired by their prairie neighbours to the west and driven by a passion for Manitoba's native prairie grasslands, a small group of enthusiasts initiated a campaign to have Manitoba declare an official Provincial Grass Emblem.

Objectives

The campaign objective was to celebrate and increase awareness of Manitoba's native grasslands by engaging Manitobans in the selection of a provincial prairie grass emblem. The formal goal was: "By 2010, in time for the 9th Prairie Conservation and Endangered Species Conference being held in Manitoba, Manitobans will declare a provincial grass for Manitoba".

Voting process

Manitobans were invited to cast their votes online at the campaign website www.manitobagrass.ca, or in person at booths displayed at various community events. The campaign website included information on the candidates, Manitoba's grasslands, threats to native prairie, where to see native prairie and how to engage in prairie conservation. Voting was open from April 15 to December 15, 2009.

Selection and criteria

Manitoba supports at least 117 native grass species. The campaign committee narrowed this list down to 9 prairie grassland species that were both recognizable and charismatic. Over 50 prairie experts and enthusiasts were asked to rank these 9 species based on several criteria, including representativeness, ease of identification, beauty and charisma. The top four species were presented to the public as candidates for the provincial prairie grass emblem. They were: Big Bluestem (*Andropogon gerardii*), Sideoats Grama (*Bouteloua curtipendula*), Blue Grama (*Bouteloua gracilis*) and Little Bluestem (*Schizachyrium scoparium*).

Public engagement

Voters were from all regions of the province and included seniors, children, new Canadians, and Aboriginals. Voter awareness ranged widely; many voters expressed surprise upon learning of Manitoba's variety of grass species and native grassland types. Numerous voters expressed the personal meaning that the prairies hold for them – childhood memories of playing in the pasture, family camping trips at local parks, or admiring the plants growing along the roadside on long drives.

Voting results

The total number of votes cast was 1602. The results are: 747 people voted for Big Bluestem; 427 people voted for Little Bluestem; 229 people voted for Blue Grama; and 199 people voted for Sideoats Grama.

Big Bluestem garnered nearly half of the votes (47%) and therefore was declared the winning candidate. Several voters expressed a similar view to Robert Parsons, a voter from Winnipeg, who stated "as this was the centre of abundance for Big Bluestem in Canada, it seems appropriate for it to be our provincial grass emblem."

Next steps

To be official, provincial emblems must be adopted as an amendment to *The Coat of Arms, Emblems and Manitoba Tartan Act*. The committee will ask a member of the provincial legislature to introduce this as a bill.

Acknowledgements

The campaign committee (Marilena Kowalchuk, Cary Hamel and Julie Sveinson Pelc) thank the people, programs and events that invited us to display in their communities, waived or covered display fees, provided meeting space, contributed photos, promoted the campaign and provided advice. We especially thank all the people who took time to vote for Manitoba's official prairie grass.

Do the Germination Temperature Characteristics of the Species at Risk Hairy Prairie Clover (*Dalea villosa*) Differ from the More Common Prairie Clovers (*D. purpurea* and *candida*) Found in the Canadian Prairies?

Michael P. Schellenberg
Agriculture and Agri-Food Canada

Darcy C. Henderson
Canadian Wildlife Service

Jacqueline Bolton and Richard St. Pierre
Agriculture and Agri-Food Canada

Abstract – On the Canadian Prairies, the northern portion of the Northern Great Plains, three species of *Dalea* can be found. Their ranges overlap, but their occurrence is commonly weighted to *D. purpurea* followed by *D. candida* and *D. villosa*, considered a species at risk (endangered). *D. purpurea* and *candida* have been found to be a valuable species to include in seeding mixtures as they improve forage nutritive value late in the season, when protein can be lacking, as well as nitrogen fixation and neutracine potential.

A germination study was done, consisting of seed lots of the three species at four temperatures (5, 10, 20 and 30°C). The experiment consisted of Petri dishes with two layers of Whatman's No. 2 ashless paper (two papers on bottom, one paper on the top), four replicates, and 100 seeds per species per Petri dish per temperature. All of the parameters reported here (total germinants, days to reach largest number of germinants, and days to first germination) were significantly different ($P<0.05$) for each species. They all had the most germinants at 20°C, with *D. purpurea* having the most. Both *D. purpurea* and *candida* had fewer germinants at 30°C while *D. villosa* had no decline. All species required more days to germinate at lower temperatures, but *D. candida* and *villosa* required fewer days. At 30°C *D. purpurea* and *candida* required one day to reach peak number of germinants and one day to first germinant, but reached only 65% and 34% of total germinants for 20°C. *D. purpurea* responds most rapidly to temperature change while *D. candida* will germinate at lower temperatures but with fewer germinants. *D. villosa* demonstrates a preference for warmer temperatures. These differences explain in part the relative numbers of the species occurrence, and also indicate the need for longer periods of vegetation control necessary for establishment of *D. candida* and *villosa* seedlings.

AUTHOR INDEX