Towards a New Game Management Plan for Saskatchewan

A White Paper Presented to the Government of Saskatchewan

by the

Saskatchewan Wildlife Federation

August 2015

Table of Contents

Preface

Saskatchewan boasts a vast and prodigious diversity of wildlife and wildlife habitat. Species such as pronghorn antelope, moose, deer and upland game birds as well as species at risk inhabit this diverse prairie-scape. The province, its people and its policy makers, however, stand at the cusp of a dramatically changing paradigm as it pertains to both the environment and its economy.

The compelling question is: How do we balance a growing economy with its demands for space and resources with the need to conserve wildlife and wildlife habitat? Provincially, human population growth is dynamic and increasing, the demands for resources including land continue to escalate, economies of scale in the agricultural and resource sectors are amplified, and potential climate change effects from flooding to drought all converge to challenge policy makers, who have to make decisions that will have far reaching effects on our environment, the human ecology and landscape, and on our valued way of life.

Our resource, its fish, upland game birds, waterfowl and big game species and the habitat they occupy have and continue to occupy an intrinsic part of our heritage and future. So that we never have to have a discussion on the need to 're-wild' our landscape, the Government and its people are acting together to maintain this wild heritage.

In the face of this changing paradigm, with so much at stake for our wildlife and wildlife habitat, the Government of Saskatchewan, which holds our public trust*, and the Saskatchewan Wildlife Federation (SWF), the largest per-capita conservation group of its kind in the world, have partnered in the development and implementation of a new provincial game management plan. This plan has, as its goal, the balanced conservation and management of the resources in the years to come.

The Saskatchewan Wildlife Federation is proud to have produced this 'White Paper' that advises and informs this process. A White Paper is an authoritative report or guide issued either by a government or an organization, informing in a concise manner about a complex issue and presenting the issuing body's philosophy on the matter. It is meant to help readers understand the issue, solve a problem, or make a decision. In essence, it is a tool for persuading customers and partners and for promoting a viewpoint or product (Wikipedia 2015). The intent of this White Paper is to do just that with respect to the new game management plan currently under development by the Ministry of Environment.

** A Public Trust Doctrine provides that public trust lands, waters and living resources are held by government in trust for the benefit of all people and establishes the right of the public to fully enjoy public trust lands, waters and living resources for a wide variety of recognized public uses.*

The SWF would especially like to acknowledge the support of the Minister of Environment for this project. In a recent speech given at the 2015 SWF Convention, the Minister stated:

"There has been significant work undertaken to develop a long-range plan for the management of big game and game birds that will mirror the current provincial Fisheries Management Plan. Once the plan is further developed, we will look for input from other stakeholders. The intent is to create a solid science-based decision-making document that will ensure the sustainability of game populations into the future."

SWF would also like to thank Ministry of Environment staff and others for their support of this White Paper through their thoughtful discussions and review of earlier drafts. We look forward to working closely with them as work proceeds towards the release of the new game management plan near the end of 2015.

The SWF will also be monitoring the implementation of the plan during the years to come. In closing, the SWF would like to acknowledge the efforts of Dr. Paul James in the production of this report.

- David Pezderic, President, SWF

Vision and Scope

In 1931, the first game office for Saskatchewan (then part of the Northwest Territories) was opened in Calgary. In the intervening decades, there have been many changes to the province's landscape and its wildlife resources. For the most part, the management of game species in the province through these changes has been largely successful. Despite this, there has never been a strategic vision provided that sets the direction and future of wildlife management in Saskatchewan. This document is intended to address this need and is timely in that the province is now experiencing greater changes than ever before with its strongly growing economy and human population. The vision for the strategy includes consideration for three main components: Conservation, Status, and Allocation.

- Conservation - To maintain or restore ecosystem health in Saskatchewan including the health of wildlife resources and their habitats.
- Status - To monitor and manage the health of ecosystems in Saskatchewan including the condition of wildlife resources and their habitats.
- Allocation - To provide resource use opportunities that are ecologically, economically and socially sustainable.

Choosing a suitable timeline for any plan or strategy is a challenge. Too short a period of time may not allow particular management actions to take effect and/or be assessed; too long a period could act to dilute the relevance of such actions. For the purposes of this strategy, a 10-year forward-looking timeline is proposed.

While this document covers the entire province, it emphasizes the wildlife management challenges south of the northern forest. This is because the majority of wildlife management interactions take place in the south where most of the human population lives. For this reason, the strategy should be considered as a 'farmland ecosystem' strategy. The reasons for this will become more apparent later in the document. However, much of what the document outlines also applies in the north.

The wildlife species groups considered in this document include those most hunted in the province : ungulates (white-tailed and mule deer, antelope, moose, elk, etc.), upland game birds (grouse, pheasants, Hungarian partridge, etc.) and waterfowl (ducks, geese, etc.). Waterfowl also are managed through cooperative, international agreements with the Federal Government and the United States. For the most recent update on the status and management of all game species in Saskatchewan, see the Ministry of Environment (2013) report referenced at the end of this document.

Overarching Principles

Wildlife conservation in Canada and the United States began to develop a unique form in the mid-19th century. In more recent years, the recognition of wildlife conservation here as distinct from other forms worldwide has led to the adoption and endorsement of the term 'North American Model of Wildlife Conservation' (The Wildlife Society 2007, Organ et al. 2012). The following seven principles have been cited as forming the foundation of the Model:

- **Wildlife resources are a public trust** - A public trust doctrine provides that public trust lands, waters and living resources are held by government in trust for the benefit of all people and establishes the right of the public to fully enjoy public trust lands, waters and living resources for a wide variety of recognized public uses.
- **Elimination of markets for game** – Many wildlife populations suffered as a result of unsustainable market hunting at the turn of the century. While regulated hunting has largely addressed this issue, the global commercial trade in wildlife remains a growing concern. In addition, there is pressure to create a market for access to wildlife through private permitting.
- **Allocation of wildlife by law** – While this is generally in place, there remains challenges with respect to inconsistent approaches between various levels of government.
- **Wildlife should be killed only for a legitimate purpose** – This is a generally

accepted fact by most hunters today and is taught to beginners enrolled in hunter education programs.

- **Wildlife should be considered an international resource** – Many species of wildlife cross the borders between Canada, Mexico, and the United States. Interagency coordination is therefore important when managing these species.
- **Science should be the proper tool to discharge wildlife policy** – While socioeconomic considerations are important, wildlife management can easily become politicized. It is important that decisions are made using the best possible available science.
- **Democracy of hunting** – While regulated harvests ensure equitable allocation, reduction in and access to land compromises this equity in hunting opportunity. Restrictive and ineffective firearms legislation is another barrier that hinders participation.

One key precursor to the development of a wildlife conservation movement included the Industrial Revolution, which led to the unsustainable hunting of game for markets in order to feed the growing urban industrial workforce. It also resulted in an urban class with more money and leisure time during the mid-19th century, many of whom hunted under self-imposed conditions that promoted fair play, self-restraint, pioneer skills, and health. Conflict between sport hunters and market hunters led to advocacy by the former for the elimination of markets for game, allocation of wildlife by law rather than by privilege, and restraint on the killing of wildlife for anything other than legitimate purposes, conditions that eventually prevailed to this day.

While the basis for publicly owned versus privately owned wildlife was founded on British common law, the U.S. 1842 Supreme Court ruling (Martin v. Waddell) laid the groundwork for the principle that wildlife resources are owned by no one, and are held in trust by government for the benefit of present and future generations (TWS 2007). Coupled with the advocacy of sport hunters and other conservationists concerned with the dramatic declines in wildlife, this 'Public Trust Doctrine' became the legal foundation for state and federal governments in the U.S. to establish regulatory authority over wildlife and its use. Advocates for wildlife conservation included many Canadians, and while Canada had not experienced human population pressures on its natural resources to the same extent as in the U.S. during the 19th century, alarm over the declines south of the border led to governmental protection of wildlife at the provincial and federal levels here. The subsequent collaboration of U.S. and Canadian wildlife conservationists led to treaties establishing certain species of marine mammals and migratory birds as international resources.

One further historical footnote requires highlighting in order to place this plan firmly within the context of Saskatchewan. The Natural Resources Acts were a series of Acts and amendments to the Constitution passed by the Parliament of Canada and the provinces of Alberta, British Columbia, Manitoba and Saskatchewan in 1930 to transfer control over crown lands and natural resources (including most wildlife) within these provinces from the federal government to the provincial governments. This was because Alberta, Manitoba and Saskatchewan had not been given control over their natural resources when they entered Confederation, unlike other Canadian provinces. Following negotiations, the federal government and the four provinces reached a series of agreements for the transfer of the administration of the natural resources to the provincial governments, called the Natural Resources Transfer Agreements. Parliament amended The Constitution Act, 1867 (then The British North America Act, 1867) and the four provincial legislatures then passed acts to

Photo by: Jim Kroshus

Overarching Principles

implement these agreements (Wikipedia 2013b). Canada maintained jurisdiction over migrating species such as songbirds and waterfowl. Notable exceptions to this rule were raptors and pelicans, which were transferred to the Provinces.

Despite recent intrusions by the federal government into this authority, for example, The Species at Risk Act (2002) and the recent Sage Grouse Emergency Order (2014), the most efficient and effective conservation of wildlife and wildlife habitat will always come from within Saskatchewan itself, particularly from its growing conservation and hunting community.

Unlike most other wildlife conservation models applied elsewhere in the world, hunting in Canada and the U.S. has largely remained open to all citizens regardless of class, and democratic hunting has become central to the ongoing success of the Model's application. Saskatchewan game management plans should therefore be grounded on the public trust model.

The Importance of Habitat

While the North American Model of Wildlife Conservation provides important key principles for the sustainable management of wildlife populations, another crucial element is the conservation of natural wildlife habitats. At the time when the Model was being conceived, the biggest threat to wildlife was direct overexploitation. As the decades have passed, this has been eclipsed by the destruction of natural habitats as the most pervasive threat to wildlife populations (Primack 2006). This is simply due to the rapid growth of human populations on the continent. Since the period of the Industrial Revolution, Canada's population has increased ten-fold while that of the United States has increased 100-fold (Wikipedia 2013a). This has translated into a concomitant growing human footprint with respect to urban growth, transportation, food production, and resource utilization.

Conservation agencies and organizations have recognized this challenge and many habitat conservation initiatives have been implemented over the years. However, unlike wildlife itself, the key point to habitat conservation in southern Saskatchewan is that most of it is under private tenure, something that has created a tension between the advocates of wildlife and the landowners on whose land the wildlife resides. Many wildlife conservation programs have recognized the critical role that landowners play but more needs to be done. To this end, an additional principle relevant to wildlife habitat should be included:

- Wildlife management should be integrated with habitat conservation on both private and Crown lands.

Note that it is important to realize that wildlife habitat is not always 'natural'. This is particularly the case in southern Saskatchewan where most of the original natural habitats have been converted to agriculture.

As a result, the role of the private landowner in wildlife conservation and management is critical.

Pastures, crops, and crop residues provide an important source of food for many species of wildlife including ungulates, upland birds, and waterfowl. Crops also provide important cover and protection against weather and predators. Many biologists have been slow to recognize or accept this ecological reality. It is worth noting that despite the widespread conversion of natural habitats to agriculture, only a handful of Saskatchewan species have become extinct (Saskatchewan Ministry of Environment 2011). In contrast, many new wildlife species, including the white-tailed deer, have moved into the province as a result of these changes.

Principles Specific to Saskatchewan

While general principles are important, it is appropriate to distill these further down to reflect the unique make-up and character of Saskatchewan:

- Use precautionary, adaptive management approaches to wildlife management that are based on science, local and aboriginal traditional knowledge and social values.
- Focus on the long term and consider broader implications of all management decisions to ensure a sustainable supply of wildlife in perpetuity.
- Provide opportunity for open and meaningful involvement of stakeholders and landowners to promote shared stewardship.
- Provide optimal, sustainable benefits for all Saskatchewan residents.
- Maintain the public access to wildlife and land.
- Provide clear, understandable and effective wildlife management.
- Promote regulatory compliance through education, verification and enforcement.
- Consider the implications of all wildlife management decisions at the ecosystem level, recognizing that air, water, land and living things are interconnected parts of an ecosystem and that effects of proposed actions should be considered at varying spatial and temporal scales.
- Respect and accommodate the First Nations, Metis and aboriginal right to hunt.
- Encourage the participation of First Nations, Metis, and aboriginal people in wildlife management.

First Nations, Metis and Aboriginal Rights

The special role that aboriginal people play in wildlife management deserves further highlighting. The use of wildlife in Saskatchewan by indigenous people predates the arrival of Europeans by several thousand years. For this reason, First Nations today enjoy special rights with respect to the harvesting of wildlife. For example, they are not required to purchase a hunting license or to adhere to any season restrictions such as the time of year or bag limit. As such, they are allocated the first quota of any wildlife harvest, provided that the species can sustain such a harvest.

Photo courtesy of the Saskatchewan Archives Board

Socioeconomic Importance of Hunting in Saskatchewan

Hunting is an important economic and social activity in Saskatchewan. Government studies in 2006 showed that it annually generated almost $108 million in gross expenditures, $63 million of which was the marginal impact to the economy resulting in a GDP of more than $36 million and more than 1,000 FTEs (Saskatchewan Environment 2006a, 2006b, Table 1). These numbers would be much higher in today's dollars. In addition, the more than approximately 70,000 resident hunters cycled millions of these dollars from urban centres to the rural economies in which they hunt. There have also been other economic spins offs more recently; for example, Cabela's Canada and Wholesale Sports now operate large retail stores in both Regina and Saskatoon.

	Gross ($)	Marginal($)	GDP ($)	FTEs Outfitted
Outfitted	39.2	39.2	27.6	743
Non-Outfitted	68.3	24.1	8.9	269
Totals	107.5	63.3	36.5	1,012

Table 1. Contribution of Hunting to the Saskatchewan Economy in Millions of Dollars (2006)

Through their connection to the land, hunters give value to habitat and other aspects of environmental stewardship. They have a vested interest in the environment that coincides with several environmental objectives such as wildlife population control and habitat conservation. Animal population control and monitoring is a positive benefit provided by hunters in the province and hunting is one of the most humane mechanisms available to wildlife managers in terms of wildlife population control. Groups such as the Saskatchewan Wildlife Federation (SWF) and others are examples of hunting organizations that are very active in conservation and maintaining natural habitats in the province. The SWF is the largest per capita non-profit conservation organization of its kind in the world and together with other groups annually brings millions of external dollars into the provincial economy (Saskatchewan Environment 2006a).

Hunters highly value being outdoors - relaxation, recreation, and camaraderie are given as reasons for hunting. The preference for wild meats and trophy opportunities are less important reasons. Hunters also feel, to a large extent, that hunting is an important part of culture, lifestyle, and social tradition that provides opportunities to spend quality time with friends and family (Saskatchewan Environment 2006a). It also contributes to mental and physical wellbeing.

Hunting organizations such as the SWF contribute significantly to the environmental education of children in the province. The SWF, for example, has 20,000 students in 200 schools currently participating in the National Archery in the Schools Program (NASP), the Bigfoot snowshoe loan program has reached 7,500 children, the annual conservation camp has been attended by more than 1,000 youth, branch summer camps involve more than 250 children a year, and over 100,000 wildlife posters have been mailed out to Saskatchewan schools and others throughout the world. Several SWF education programs have received national awards.

Photo by: Jim Kroshus

Ten Challenges Facing Future Wildlife Management

In general, Saskatchewan's wildlife resources are secure. However, it is important to remain vigilant and to recognize the challenges that lie ahead. The following list is not meant to be exhaustive but intended to capture the more important issues potentially facing wildlife management over the next decade and beyond.

1. Loss of natural habitat to sustain populations

Since European settlement, about 80% of the original natural upland habitat in southern Saskatchewan has been modified to meet the needs of food production (PCAP 2010). This has, of course, forced our native wildlife to exist on much smaller pieces of natural habitat, and/or to adapt to the farmland ecosystem that now surrounds it. Fortunately, it appears to have done this with only a handful of native vertebrate species becoming extirpated over the last 100 years. Of these, only one, the Passenger Pigeon, is extinct. Despite this, some of our wildlife species have declined or are at risk (FPTGC 2010), including game species such as the Sage Grouse, Woodland Caribou, and Pronghorn Antelope. Others, such as moose and elk, are newly thriving in the southern half of the province.

2. Habitat changes and environmental conditions

The natural world is always changing. Natural disturbances such as wind, insects, and fire change habitats and in doing so change the wildlife species that occupy them. The same is true when these agents of change are absent or removed. Wildlife itself also causes changes in habitat, such as seen through the effects of grazing and browsing by deer and other ungulates. People are another important agent of ecological change and our influence on the natural world has grown steadily over time.

Of Saskatchewan's eight species of ungulates, several have experienced dramatic population changes in recent and historic times, in part due to changes in habitat. The wholesale decline of the plains bison following European settlement is probably the best-known example. In contrast, another species, like the white-tailed deer, rarely existed in the province prior to European settlement. It expanded its range westward as once common prairie fires were reduced and trees and shrubs became more widespread and abundant, providing important cover for them during the harsh winter months. The conversion of native grasslands into cereal crops provided a source of food, and also likely encouraged their spread and eventual establishment in the province. Today, the white-tailed deer has become our most important game animal (Saskatchewan Ministry of Environment 2013).

Two other ungulates, the moose and elk, have experienced dramatic changes in their distribution in more recent years. The moose, typically a species of our northern forests, has expanded its range into the south where it has become a not unusual sight on Saskatchewan's farmland. The same is true of the elk, which was once a common prairie animal prior to European settlement. While the reasons for these increases are not well understood, it may be useful to again consider recent changes in agricultural practices on the southern landscape. Following changes in government agricultural policies, a greater diversity of crops is now being grown in the province than ever before (Saskatchewan Ministry of Agriculture 2013a). There has also been a steady decline in the number of people living in rural Saskatchewan over the last 70 years. Since reaching a peak of 138,713 in 1941, the number of farms in Saskatchewan has declined to 36,952 in 2011, a decrease of 73% (Hay 2006, Saskatchewan Ministry of Agriculture 2012).

Photo by: Jim Kroshus

Our wildlife has also benefitted from crop diversification. One of the notable recent crop success stories has been the rapid spread of canola production. Provincial canola crop yields were first reported in 1967 (Saskatchewan Ministry of Agriculture 2013b), when 36% of the RMs grew it. By 2012, the proportion of RMs reporting canola yields had increased to 99%. Harvested acreage of canola in Saskatchewan has grown from 2.5 million acres in 1986 to 11.4 million acres in 2012 (Canola Council of Canada 2013). Seeding of canola in the early years occurred mostly along the northern and eastern forest fringe, immediately adjacent to existing populations of moose and elk (Figure 1), and then spread south and west. Early seeding also occurred adjacent to major wildlife travel corridors like the North Saskatchewan and Qu'Appelle and around island forests such as Moose Mountain and Fort a la Corne.

Little quantitative information exists on the diets of farmland moose and elk, although anecdotal observations by farmers and others have noted the attraction of canola to both species (e.g. Alberta Outdoorsmen Forum 2011a, 2011b, 2012, Cast Boolits 2013, Fins and Fur Forums 2010, University of Saskatchewan News 2013, Saskatchewan Hunts 2009). None of this proves that canola is the cause of moose and elk expansion into the south; however, it does suggest that more attention should be paid to the role that the agricultural landscape plays in the conservation of our wildlife.

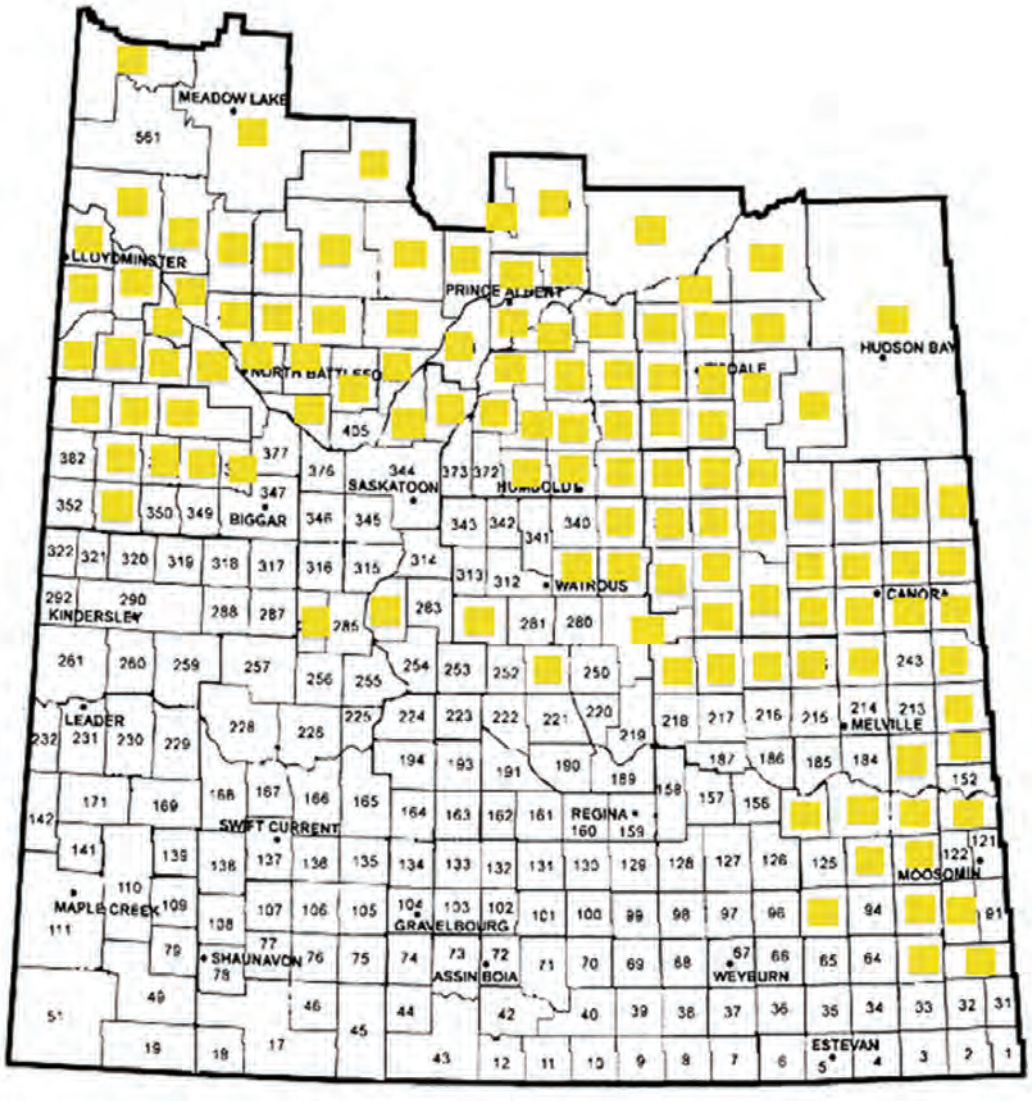


Figure 1. Initial Distribution of RMs First Seeding Canola in 1967. The Crop is now grown in all RMs.

Irrespective of the reasons why moose and elk have become more prevalent in the south, their newfound environment is quite different than their more traditional northern habitats:

- They exist in a predator free environment.
- Their food resources are generally of a higher quality.
- Unlike white-tailed deer, they are much less affected by harsh winters.

These characteristics would lead one to predict that moose and elk survival and fecundity are higher in the south thus the potential for their populations to increase more rapidly than further north. This might well translate into more hunting opportunities for these two species in the south.

3. Allocation of resources and managing harvest

Governments have limited human and financial resources with which to carry out their respective mandates. Provincial wildlife management is no different in this regard so it is important to direct what finite resources exist to the issues of greatest importance. Science and technology have an important role to play here. For example, the commercial use of drones for wildlife conservation and management is in its infancy, but has the potential to conduct wildlife surveys at much reduced cost without exposing pilots and professional staff to death and injury from aircraft accidents. To date, the development and application of 'Unmanned Aerial Vehicles' (UAVs) or 'drones' has mainly centered on their military purposes. The civilian application of these systems, by comparison, is at a relatively early stage of development, yet has been investigated in a number of disciplines including farm and crop management, weather monitoring, coastal surveillance, wildfire management, search and rescue, pollution monitoring, and traffic monitoring. Recent developments in the technical capacity and civilian use of UAVs have also led to some investigations into their potential use for aerial surveys of marine mammals, seabirds and terrestrial species such as Sandhill Cranes, Sage Grouse, African Elephants, and primates. UAVs operating with/without autopilot and mounted with GPS and imaging systems have the potential to replace and/or augment traditional manned aerial surveys and provide an innovative method for monitoring elements of conservation concern, such as wildlife populations and their habitats through:

- Reduced costs: With redesigned surveys, the potential exists for significant cost reductions.
- Reduced human risk: The need for humans to fly is reduced or eliminated.
- Increased accuracy of detection, location, and identification of wildlife and their associated habitats.
- Precise flight repeatability over any time period.
- Provision of permanent digital records of surveys.

Given these substantive advantages, the Ministry of Environment, in conjunction with other partners, has begun the evaluation of UAVs for wildlife surveys and other environmental monitoring.

Photo by: Jim Kroshus

4. Wildlife diseases

Most diseases and parasites in wildlife are a naturally occurring phenomenon and the vast majority of Saskatchewan's wildlife are considered to be healthy. However, in recent years, concerns have been raised regarding a number of new wildlife diseases that have surfaced in the province, including Chronic Wasting Disease (CWD) in ungulates, which can be traced back to imported sick animals (Bollinger et al. 2004, IOC 2005). This and other diseases have affected Canada substantially over the past two decades (NWDS 2004). For example, attempted eradication of CWD from Canadian farms has already cost $100 million to governments and industry, while its emergence in wild deer in Canada since 2001 poses uncertain risks to wild deer populations and important socioeconomic activities such as hunting. Bovine tuberculosis in wild elk and deer in Manitoba has the potential to spread east and west across Canada and south into the United States (Wobeser 2009, Brook et al. 2012). West Nile virus moved across Canada from 2001 to 2003, causing both human illness and wildlife deaths, as has Lyme disease more recently (Leighton et al. 2012, Saskatchewan Ministry of Health 2013). Both of these demonstrate the potential of introduced infectious organisms to disperse quickly and extensively once introduced into new environments.

Chronic Wasting Disease is a fatal disease that affects the nervous system of deer, elk and moose. CWD is similar to BSE (mad cow disease) in cattle and scrapie in sheep. It was introduced into Saskatchewan farmed elk from infected elk imported from the United States in the late 1980s. CWD was first detected in a wild mule deer in the fall of 2000. It has since spread to wild white-tailed deer, mule deer and elk populations in several locations within Saskatchewan (Saskatchewan Ministry of Environment 2014a, Figure 2). The extent and effects of CWD in wild deer are still being studied and debated. Research projects are underway to measure the impact of CWD on wild deer populations, determine the factors promoting transmission and explore options to limit transmission. Predicted effects on deer populations, based on past research are increased fawn mortality, reduced reproduction rates and a decline in the average age of deer. Although CWD has existed in North America for at least 40 years, we still do not know how the disease will ultimately impact wild deer and elk populations. Early mathematical modeling suggested that CWD would eliminate entire populations. More recent models suggest that CWD will decrease the population, but over time it might recover, albeit at levels lower than those prior to the disease's arrival.

Despite extraordinary attempts by some provincial and state wildlife management agencies to eradicate CWD, these efforts have not stopped the spread of the disease anywhere. Today, there are many commonly accepted management practices (i.e. targeted/individual animal removal, annual surveillance, carcass transportation regulations) adopted by most jurisdictions to try and slow the spread of CWD. Few wildlife professionals today believe that CWD can be eradicated once it becomes established. Should it become very prevalent in our deer populations, we might experience a decline in hunter interest, similar to that sometimes seen when fish are affected by disease or pollution.

On domestic game farms, Saskatchewan's Cervid Chronic Wasting Disease Surveillance Program provides CWD surveillance for the province of Saskatchewan for the purpose of detecting CWD on domestic game farms (Saskatchewan Ministry of Agriculture 2011). Saskatchewan Agriculture administers and regulates the program under The Domestic Game Farm Animal Regulations. All operators of domestic game farms that keep cervids in Saskatchewan are required by provincial regulations to participate. The voluntary program began in January 2001 and was made mandatory in December 2001. CWD surveillance was originally intended to provide data to measure the effectiveness of the Canadian Food Inspection Agency's (CFIA) CWD eradication program. However, CFIA has recently recommended CWD to be enzootic in Saskatchewan, meaning that eradication is no longer thought to be feasible. In addition CFIA has recommended removing CWD as a reportable disease, further removing the obligation for federal CFIA involvement for management.

A new CWD Working Group has also recently been created to review and guide the province's ongoing approach to the disease. Given the newly emerging research on the long-term stability and movement of prions in the agricultural environment, including its uptake in plants (Johnson 2013), the potential for CWD and other game farm diseases to seriously affect Canadian agricultural foreign markets is a rapidly growing concern.

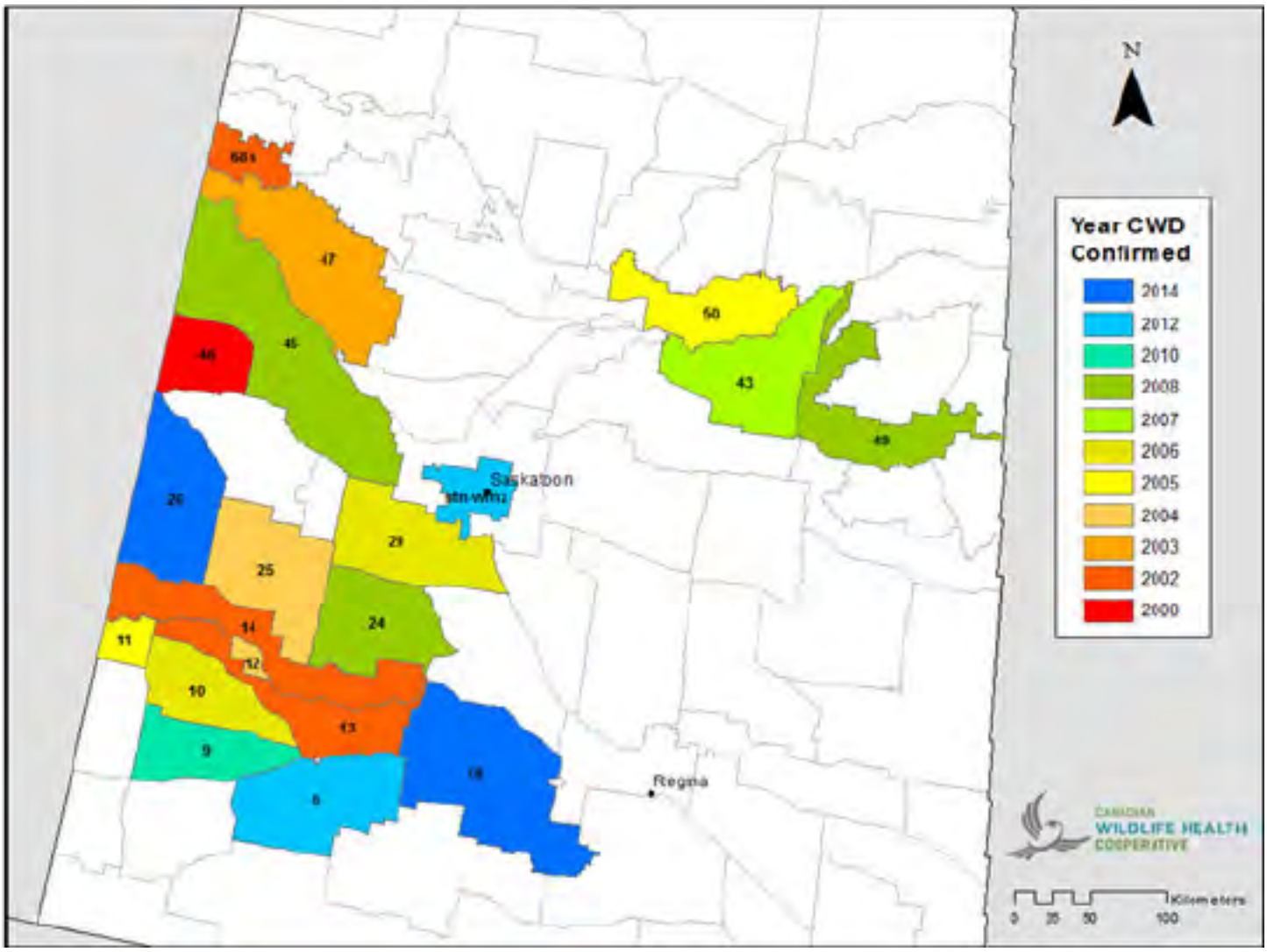


Figure 2. Distribution of CWD by WMZ in Saskatchewan 2000 to 2014 (Source: CWHC 2015).

5. Invasive non-native species

The introduction and spread of non-native species in Saskatchewan is a large and growing problem. Non-native species not only impact our native wildlife and its habitats, but also can be economically very damaging. Examples include mammals like wild boar and plants like leafy spurge. However, it is important to differentiate between these non-native species that are 'invasive', and those that are not (Wikipedia 2014). An introduced, alien, exotic, non-indigenous, or non-native species is a species living outside its native distributional range, which has arrived there by human activity, either deliberate or accidental. Non-native species can have a variety of effects on the local ecosystem. Non-native species that have a negative effect on the ecosystem are known as invasive species. Not all non-native species are considered invasive. Most have no negative effects and can, in fact, be beneficial as an alternative to pesticides in agriculture (e.g. leafy spurge beetle), or as a valued game species (e.g. Ring-necked Pheasant).

This distinction between invasive and non-invasive can be illustrated by the non-native species of vertebrate wildlife currently existing in Saskatchewan (Table 2). Invasive birds like the European Starling and House Sparrow have negative effects on native birds by competing for nesting holes, whereas the introduced pheasant and partridge do not. The latter both seem to occupy ecological niches that are not filled by native birds. The Wild Turkey is very similar, although it is native to North America, whereas the pheasant and partridge are not.

Invasive	Non-Invasive
Birds	**Birds**
Rock Dove	Ring-necked Pheasant
European Starling	Hungarian Partridge
House Sparrow	Wild Turkey
Mammals	**Fish**
Wild Boar (Feral Pig)	Brook Trout
Gray Squirrel	Brown Trout
House Mouse	Splake
Norway Rat	Tiger Trout
Black Rat	Rainbow Trout
	Smallmouth Bass
Fish	Largemouth Bass
Common Carp	

Table 2. Invasive and Non-Invasive Non-Native Fish and Wildlife Species Present in Saskatchewan.

Domestic wild boars were introduced across western Canada to diversify agriculture in the 1980s and 1990s and they were first introduced to Saskatchewan during the 1990s as part of a broad initiative to diversify agricultural production (Wilkins and Dobbs 2013). Specific dates within Canada are not recorded and the timing and frequency of releases and escapes from captivity remains unknown. Although there has never been any formal monitoring of feral wild boars on the Canadian prairies, it became apparent from reports in the 2000s that there were significant numbers of feral wild boar in parts of the three prairie provinces (Brook and Van Beest 2014).

The feral wild boar population is predicted to become a serious environmental and agricultural problem in Saskatchewan, as they already exist in 70% of the 296 RMs surveyed in the province (Brook and van Beest 2014). Damage to agricultural crops elsewhere exceeds millions of U.S. dollars annually in many areas, and the wild boar is an important host for a wide variety of diseases. Their potential effect on natural habitats is also of great concern.

There have been some small-scale efforts to remove feral wild boar in parts of Saskatchewan through local efforts, individual hunters, and a program administered by the Saskatchewan Association of Rural Municipalities (SARM). One concerned citizen has posted a useful website on which people can plot their wild boar sightings in order to assist control efforts (Wild Boars in Canada 2014). However, based on experiences elsewhere, these efforts will prove insufficient to contain or reduce the population (Brook and van Beest 2014). Boars have a high reproductive rate and dispersal capability so hunting them alone will not have the desired effect.

Another example of an environmentally and economically damaging invasive species that is well established and expanding its range in Saskatchewan is leafy spurge. First recorded in Saskatchewan in the 1930s, by 2005 the Saskatchewan Ministry of Agriculture estimated more than 20,000 acres were infested. Today, that number is much higher. The plant is completely able to overtake prairie and field vegetation by shading and absorbing available water and nutrients and by releasing toxins that prevent other nearby plant growth. This species can easily overtake large areas of open land. Not only does this invasive alien plant rapidly expand to overtake nearby areas, the milky liquid from its stems and flowers is an irritant to most livestock and may cause severe skin rashes or irritation in humans. Leafy spurge is categorized as a noxious weed under The Weed Control Act 1990, which directs all landowners to contain and control noxious weeds on their land and to prevent the spread of noxious weeds to other lands. One recent study in Manitoba estimated that the total economic impact of leafy spurge there has grown to more than $40 million annually (Rural Development Institute 2010).

6. Pesticides

The minimization of competition from undesirable plants and insects in agriculture is a cornerstone of modern food production and is likely to continue into the future. Sometimes, however, human-made chemicals have adversely affected some species of wildlife. For example, the populations of some birds of prey were once reduced to critically low levels by the use of organochlorines in farming and PCBs in industry (Newton 1979). The elimination of these chemicals was followed by the full recovery of the species affected. In general though, Saskatchewan's wildlife has been able to largely co-exist with intensive farming to date, although issues can occur from time to time. For example, concerns have been recently raised with respect to the widespread use of neonicotinoids as a seed dressing (Hopwood et al. 2012, Mineau and Palmer 2013, Hallman et al. 2014). Studies have shown that this class of pesticides is toxic to birds and important insect pollinators, such as bees. Declines in the Hungarian partridge population of Europe have also been linked to their use. Most of Saskatchewan's canola crop is currently treated with this chemical, although any effects on wildlife remain unknown.

7. Conflicts between humans and wildlife

An expanding human population and provincial economy may create new future challenges when it comes to wildlife management. One of these is the potential for the collision of wildlife with motor vehicles (Denham et al. 2011, Figure 3).

Figure 3. Total Vehicle Collisions (Green) and Wildlife-Vehicle Collisions (Red) in Saskatchewan (Source: SGI).

Wildlife collisions accounted for approximately 17% of all collisions on provincial roads between 2008 and 2013. Overall, total wildlife collisions have remained fairly constant over the past few years of reporting, although their proportion of the total number of collisions has declined.

Note that 'wildlife' insurance claims include birds (c. 12% of total claims, 2008-2013) deer (70%), domestic animals (3%), and 'other wildlife' which includes moose (15%). Moose have only been separated out in the claims data for the last few years. In 2013, they accounted for 4% of the total claims. Wildlife collisions are also not evenly distributed across the province. Research by SGI has shown that 'hot spots' exist where concentrated numbers of collisions occur (Figure 4), which are presumably related to the non-random distribution of wildlife and wildlife habitat across the landscape.

One notable feature of Figure 3 is that the number of wildlife collisions does not directly reflect the size of provincial wildlife populations, and deer in particular. White-tailed deer are especially vulnerable to harsh winters and their population can fluctuate by up to 50% from year to year. However, this fact is clearly not reflected by the collision rate, which is relatively stable from year to year. From this, one could infer that higher numbers of deer do not necessarily mean more highway collisions.

Contributing factors are those circumstances or factors that directly contribute to the collision or its severity. SGI recognizes that a collision often results from many causal factors and accepts up to four for each vehicle involved in a collision. In 2013, alcohol involvement, distracted driving, and excessive speed accounted for 36% of fatal collisions, while wildlife ranked 15th in the list of factors and accounted for only 1.5% of fatalities (SGI 2013).

Saskatchewan has lower wildlife collision rates compared to the two adjacent provinces. In Manitoba on average, there are about 6,800 vehicle-deer collisions each year, resulting in about 300 injuries (Manitoba Public Insurance 2012). In Alberta, the most recent statistics indicate that vehicle wildlife collisions are on the rise; 5,997 collisions were recorded in 1991 and 16,322 in 2008, an increase of almost 170% for that time period (Carter 2010).

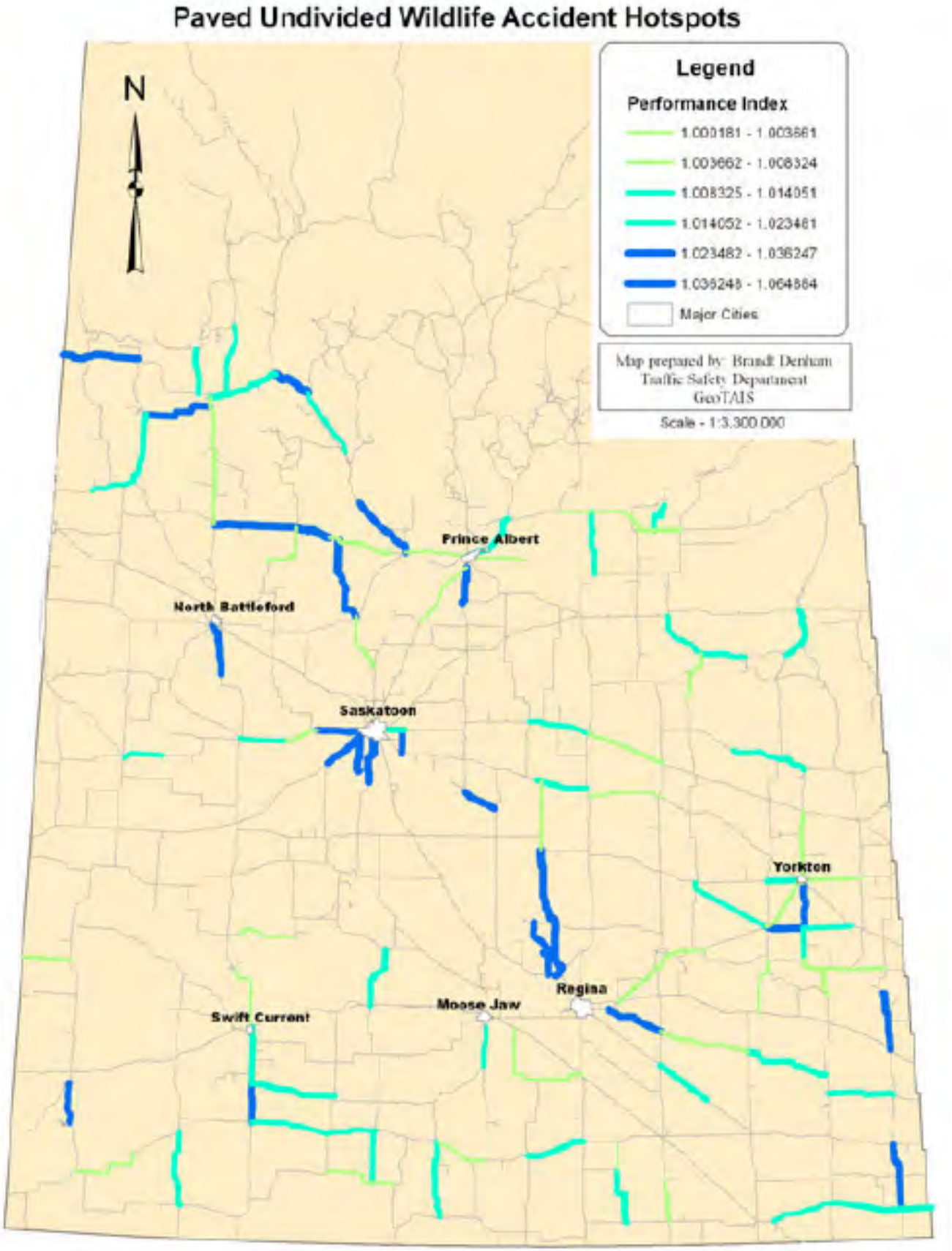


Figure 4. Wildlife Collision Hotspots in Southern Saskatchewan (Denham et al. 2011).

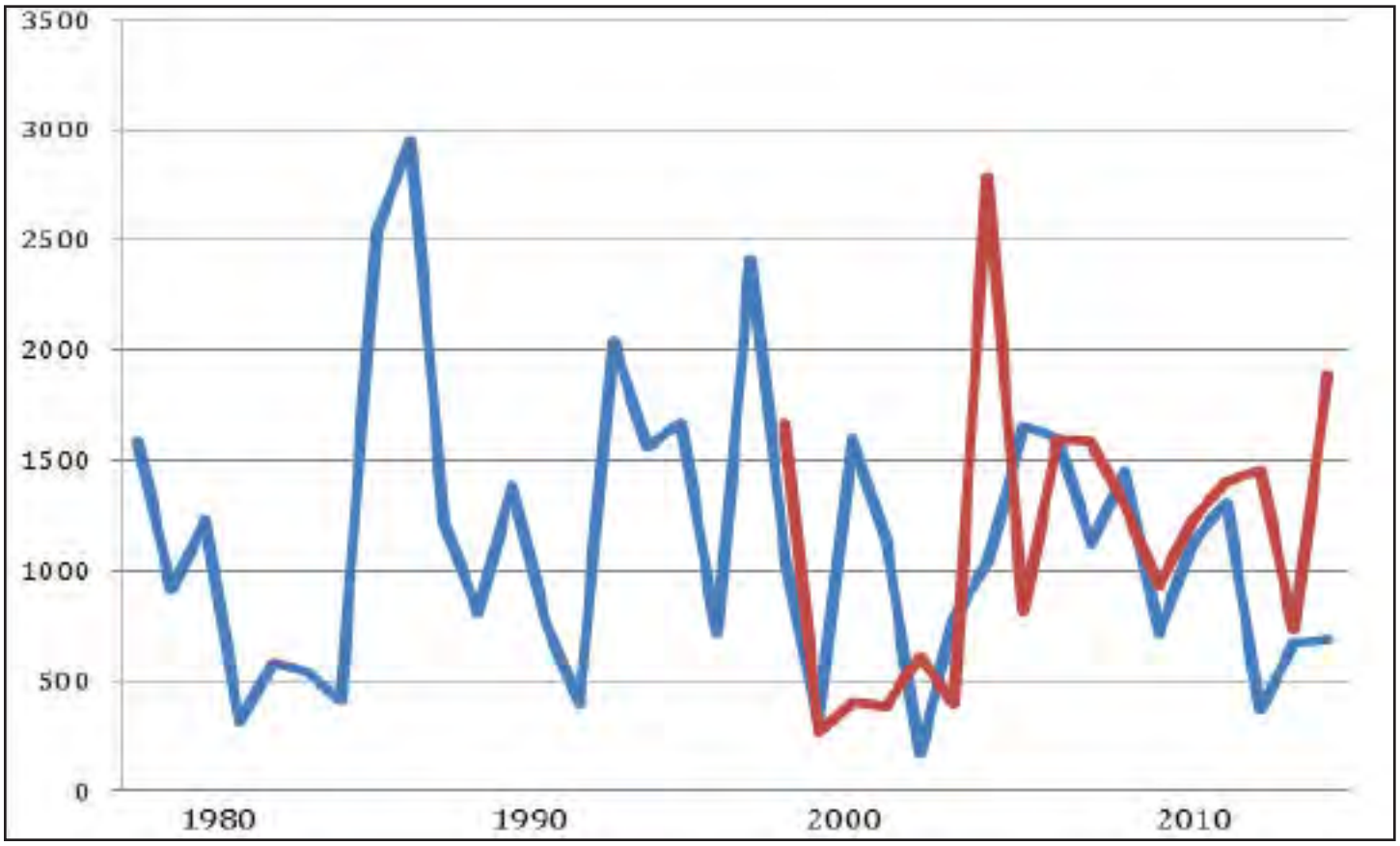
Another important ongoing wildlife management challenge will be crop damage (Saskatchewan Crop Insurance Corporation 2013). Currently, the provincial Wildlife Damage Program is comprised of:

- Compensation for wildlife damage to agricultural crops (including alternative feeding systems).
- Compensation for predation of livestock and poultry.
- Wildlife damage prevention for crops and livestock (fences, for example).

The Program is available for all Saskatchewan producers who suffer crop or livestock losses due to wildlife. The Saskatchewan Crop Insurance Corporation (SCIC) administers this program, but affected producers do not have to be customers to receive compensation through the Wildlife Damage Compensation Program. Producers can receive 100% compensation without any cost or premium to participate. The first 80% of program funding is cost-shared by federal and provincial governments; the provincial government contributes the remaining amount.

The number of claims paid for crop damage by wildlife varies enormously year to year, yet has remained relatively consistent over the last 40 years, averaging about 1,100 claims per year for both waterfowl and big game (Figure 5). Over the last several years, wildlife claims made up between 4% and 14% of the total crop damage claims registered (SCIC 2014). Much of the year-to-year variation in wildlife damage is weather dependent. For example, in years with late harvests, damage by migrating waterfowl is heaviest. Likewise, winters with severe weather that reduce the deer population tend to be followed by growing seasons with a reduced number of big game claims. The changes in crop diversity in recent years also play a role. For example, migrating waterfowl are strongly attracted to harvested pea fields. However, because this crop is taken very early, the residue helps to keep birds off other crops such as wheat and barley until after they are harvested.

Figure 5. Total Annual Number of Crop Damage Claims for Waterfowl (Blue) and Big Game (Red) 1978-2014 (Source: SCIC).



8. Public participation and perception

The shooting sports, which include hunting, are undergoing some interesting changes in Saskatchewan. The Saskatchewan Association for Firearm Education (SAFE) reports that since the 1960s, approximately 230,000 people have graduated from the Saskatchewan hunter education program (SAFE, pers. comm.). Up until two years ago, SAFE was putting 3-4,000 people a year through the program. However, beginning in 2013, this number jumped to 5,400 and increased again in 2013 to 6,400. Of these people, more than a third are aged between 20-30 years and more than a third are women. Hunting appears to be undergoing a renaissance in the province, and this is reflected in the resident demand for hunting opportunities. For example, the annual big game draw for resident hunters has recorded a dramatic increase in both applicants and applications. In 2005, there were 24,937 applications for the big game draw; in 2014, this number increased to 54,929 or by 220%. Over the same period, the number of applicants on these applications increased from 45,691 to 81,803, a 179% increase. The same upward trend is occurring for other hunting licenses.

Despite these encouraging numbers, there is also a small but growing, vocal anti-hunting lobby in Canada, which includes people opposed to meat consumption and the gun control lobby. These anti-hunting elements tend to be urban-based, where many people have lost the close contact with nature that comes with rural living. One recent study of livestock production in the U.S. showed that beef production required 28, 11, 5, and 6 times more land, irrigation water, greenhouse gases, and reactive nitrogen than did the average production of dairy, poultry, pork, and eggs (Eshel et al. 2014). The authors argue that eating less beef would provide multiple environmental benefits. However, their conclusions ignore the important environmental benefits that sustainable ranching creates including the maintenance of North American grassland biodiversity and wildlife, watershed filtration, ground water recharge, carbon sequestration, and recreation (GLCI 2010). Furthermore, grazing lands greatly increase the land area that can be used to produce plants for food purposes. Most grazing lands will not support cultivated crop production due to soil characteristics, topography, and climatic constraints. They do support vegetation that can be grazed by livestock to transform this renewable resource into food and fiber products. Well-managed grazing lands support desirable vegetative cover, which is highly resistant to the erosive forces of water and wind; and is a renewable, natural, and sustainable form of agriculture. Converting these remaining grasslands in Saskatchewan to annual crop production would be an ecological disaster for our wildlife resources.

Firearms ownership by law-abiding individuals is also under attack via the small but vocal gun control lobby, despite several comprehensive studies in North America that show no causative link between legal gun ownership and violent crime rates (Mauser 2013).

Photo by: Jim Kroshus

9. Privatization and commercialization of wildlife

There have always been pressures to privatize and commercialize wildlife and wildlife lands around the world, resulting in a variety of wildlife management approaches in various countries. In most, the state owns the wildlife and is responsible for conserving it for the public. However, the recovery of the North American bison from the edge of extinction was largely due to the efforts of private individuals (Econet 2014). Today, most of the bison in North America are privately owned and producers are involved in returning this species to the wild. At the present time, Saskatchewan has a diverse mixture of commercial and non-commercial human activities that occur using both privately and publicly owned wildlife or wildlife lands (Table 3). The degree of commercialization occurs along a wide spectrum, and ranges from low as seen in wildlife viewing, to high as seen in the privately owned wildlife on game farms.

	Activities	
Ownership Type	**Commercial**	**Non-Commercial**
Public Wildlife and Lands	Outfitting Commercial fishing Fishing derbies Trapping Grazing Game farming Hunting (shoot farms) Wildlife viewing Timber harvesting Mining Oil and gas	Hunting Angling Wildlife viewing
Private Wildlife and Lands	Outfitting Trapping Grazing Game farming Hunting (shoot farms) Wildlife viewing Timber harvesting Mining Oil and gas Exotic pets	Hunting Wildlife viewing

Table 3. Some Commercial and Non-Commercial Activities that use Private or Public Lands or Wildlife in Saskatchewan.

Opponents of wildlife privatization and commercialization point to unrestrained markets as being an important cause of wildlife declines historically. This was certainly the case in North America and other places like Africa. Privately owned, domesticated wildlife can also introduce diseases into free-roaming animals, such as CWD discussed previously, or create a substantial problem when they escape captivity, as with wild boars.

Hunting in Saskatchewan occurs on both public Crown lands and private lands. The Crown owns the wildlife on all lands. Both Saskatchewan and non-resident hunters have access to these lands in order to hunt, although private landowners and others generally expect hunters to seek permission to do so. Landowners have the legal right to post their land against any trespassers, hunters or otherwise, thus they effectively control access. However, it is currently illegal for a private landowner to charge a hunter a fee to hunt on his or her land. How many actually do this is difficult to determine, although the number is likely small.

One example of moderate commercialization is wildlife outfitting. Over the past few decades, Saskatchewan has experienced an increase in outfitting. This has benefited both outfitters and their clients who are almost exclusively non-resident hunters (Saskatchewan Environment 2006b). The outfitters benefit because there are more people using their services and the non-resident users benefit as a result of having a greater choice. Over time the industry has significantly reduced the availability of 'unused' natural resources for new outfitter applicants. Outfitting opportunities for big game and birds are therefore fully allocated (Saskatchewan Ministry of Environment 2014b). New people who are interested in getting involved in outfitting now have to look for an existing business that is for sale by contacting existing outfitting businesses, the Saskatchewan Outfitters Association (SOA) or by checking local advertisements.

Ten Challenges

The SOA is the voice of professional outfitters in the province. The purpose of the Association is to encourage and promote a standard of services within the membership, to establish liaisons with various sectors affecting the industry, to assist and inform its membership in areas of marketing and promotion and to inform its members of services that assist in their operation within the industry. It has also established a code of ethics to promote standards of behavior for its members. However, of the 622 outfitters licensed in the province only 117 (19%) are currently members of SOA (SOA 2014). Of the 622, 323 (52%) are endorsed for guided black bear, 243 (39%) are endorsed for upland and migratory birds, 197 (32%) are endorsed for guided white-tailed deer, and 75 (12%) are endorsed for guided moose.

In 2012-13, outfitter license sales totaled 2,671 for white-tailed deer, 1,563 for black bears, and 107 for moose. These comprise only a small percentage of the total provincial license sales for these three species. Wildlife outfitting is economically important to the province and as discussed previously brings in millions of dollars each year.

Despite the relatively low numbers of licenses sold through outfitters, some resident hunters have argued that the rise of paid hunting in Saskatchewan is excluding resident hunters from some areas of the province, especially along the forest fringe. The issue for them is reduced access to wildlife lands for hunting. In addition to outfitting, there has also been increased pressure for more private landowners to exclude resident hunters in favour of non-resident hunters.

Overall, it seems that neither wholly public nor wholly private models of wildlife conservation are sufficient by themselves in Saskatchewan because much of the public wildlife lives on privately owned land. In the end, we are all responsible for conserving our natural resources. The key question to address is how do we recognize the efforts of private landowners in providing society with publicly owned wildlife?

Photo by: Jim Kroshus

10. Cumulative impacts on habitat and wildlife

Taken individually, the various human pressures on wildlife and wildlife habitat may not be significant in themselves, yet when considered in total, the outcome can sometimes be quite different. This phenomenon is known as cumulative impacts and a good example of it has occurred in the Great Sand Hills of Saskatchewan, an important wildlife area in the province (Figure 6). In 1979, there were already 2,497 km of roads and trails in the area, mostly servicing the numerous gas wells built there. By 1991, this had increased by 17% to 2,932 km, and by 2005 the total had reached 3,175 km, an overall increase of 27% over the 26 years. The effects of these roads and trails on wildlife are mixed. For example, studies in the Great Sand Hills have shown that certain bird species decline in the presence of roads, whereas others increase or remain unaffected (GSH Scientific Advisory Committee 2007). Of greater concern perhaps are the opportunities that roads provide to invasive weed species that affect the health of the surrounding native rangeland.

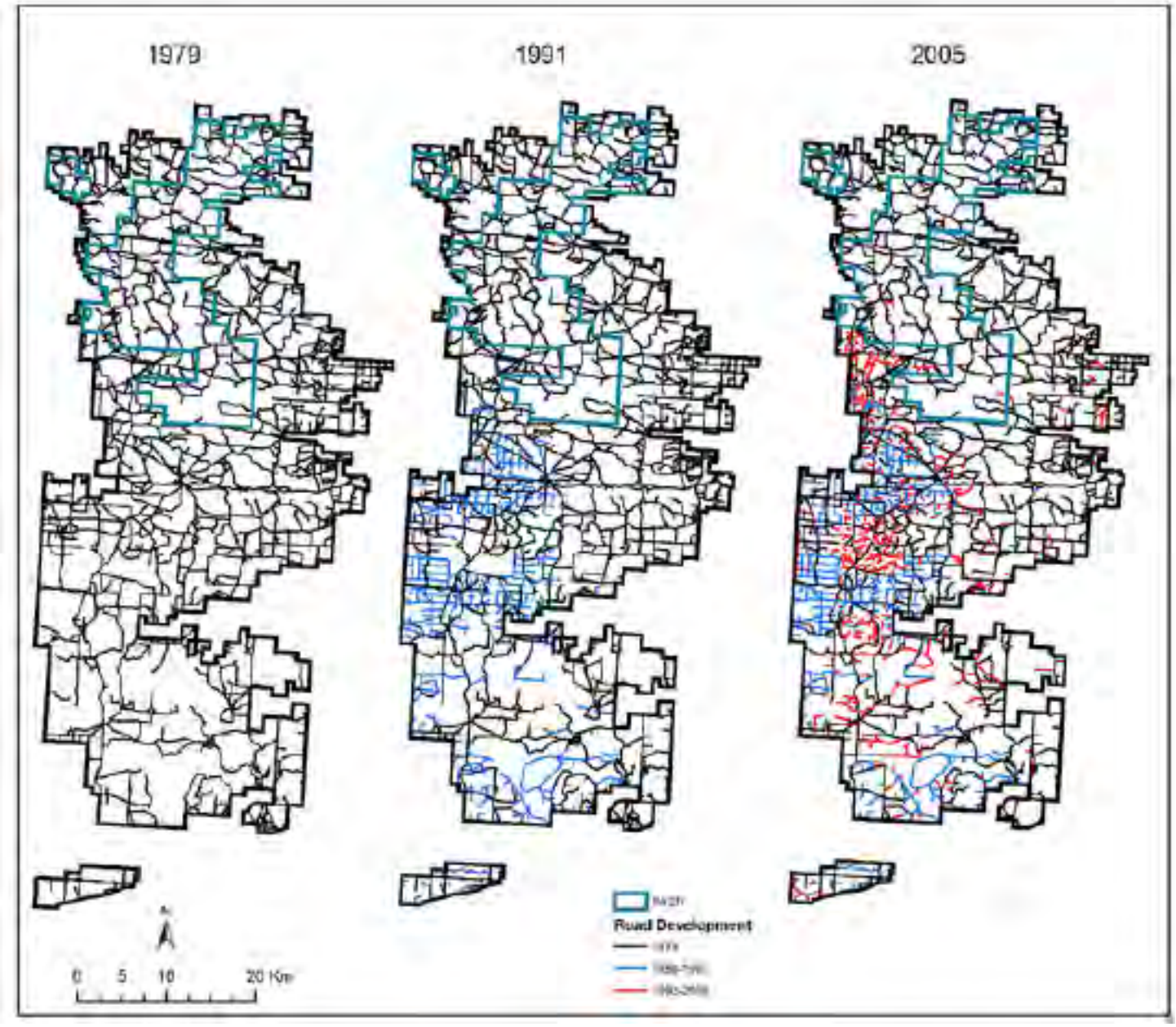


Figure 6. Time Sequence of Road and Trail Development in the Great Sand Hills from 1979 to 2005 (Source: GSH Scientific Advisory Committee 2007).

Long Term Objectives

Given the key challenges outlined in this review, game management in the future should achieve three broad, desirable outcomes - the sustainable management of wildlife, the equitable allocation of wildlife resources to optimize social and economic benefits, and shared responsibility and public engagement with respect to wildlife management.

- **The sustainable management of wildlife** - Sustainable management means conserving our wildlife resources for future generations while enjoying their social and economic benefits today. A key component of this is a science-based approach that minimizes arbitrary decision-making based on uninformed emotions and conjecture.

- **Equitable allocation of wildlife resources to optimize social and economic benefits** - The allocation of wildlife for human use is a cornerstone of management; however, it is important that this allocation be equitable in nature, in other words, fair and unbiased. Conservation of wildlife should be the first priority before any allocations are made. Aboriginal people who are legally entitled to subsistence opportunities have priority access to any wildlife resource surplus. After conservation and subsistence needs, the public should have priority access to wildlife, beginning with Saskatchewan residents first.

- **Shared responsibility and public engagement with respect to wildlife management** - Traditionally, governments were solely responsible for wildlife management. Today, however, a greater emphasis is being placed upon stakeholders and the general public to share this important task. In particular, the role of private landowners is often ignored or taken for granted. Greater efforts need to be made to recognize and engage these critical stakeholders.

Photo by: Jim Kroshus

Conclusions and Recommendations

Some broad conclusions can be drawn from the preceding review. Firstly, despite more than a century of widespread change regarding pre-European natural habitats, Saskatchewan's game species are generally secure. There are a few exceptions including the Sage Grouse, Woodland Caribou, and Pronghorn Antelope. However, the first two are habitat specialists so their provincial populations were probably never large to begin with. The current status of the antelope is more of a concern as it was once a commonly hunted species in the south. For this reason, it is receiving attention from the Ministry of Environment in cooperation with adjacent jurisdictions.

Despite this overall positive situation, some important challenges lay ahead that need to be understood within the context of Saskatchewan's most critical regulator of game populations – winter severity. The current state of affairs serves as a good illustration (Crabbe 2014). Recent successively severe winters have reduced the White-tailed Deer population to less than 200,000 animals. Population surveys report an overall decline of 49% compared to the long-term average, and a fawn to doe ratio of 62:100, the lowest recorded since 1983. Some WMZs are documented to be more than 65% below the long-term average. Mule Deer populations have also not recovered from recent harsh winters with the fawn to doe ratio the lowest since 1984 and the population at 22% below its long-term average. The effects of recent severe winters have reduced the provincial pronghorn population by 51% due primarily to low fawn production. Extensive evidence indicates that prairie upland game populations remain low following two severe winters and springs, particularly Sharp-tailed Grouse and Hungarian Partridge. Yet, despite all of these population declines, the demand for hunting opportunities is increasing dramatically in the province. Of course, these populations should recover with milder winters but it does serve to illustrate the challenges of managing and allocating wildlife in northern climates. In addition, as mentioned before, winter severity also plays an important role in determining the extent and degree of crop damage each year.

Given this background, the following thoughts are advanced for inclusion in the new wildlife management plan:

Habitat – Efforts to maintain existing natural habitat should continue. However, there needs to be greater recognition of the fact that wildlife habitat includes altered farmland ecosystems and not just natural habitat. It therefore follows that rural landowners should be better recognized for their role in conserving Saskatchewan's wildlife.

One of several successful examples of how this might be achieved is the Block Management Program in Montana (Montana Fish Wildlife and Parks 2014). This is a cooperative program between private landowners and FWP that helps landowners manage hunting activities, compensates them for maintaining wildlife habitat, and provides the public with hunting access to private land. There is no charge to hunt on block management lands (referred to as Block Management Areas or BMAs). Program funding comes from the sale of various hunting licenses, both resident and non-resident. Landowner participation in block management is voluntary.

Allocation – Allocation of wildlife resources should never be arbitrary. The proper scientific allocation of wildlife depends on the collection of good quality information about their population status and trends. Traditional surveys with manned aircraft are expensive and dangerous to the personnel involved, which have resulted in fewer surveys in recent years. More attention should therefore be directed to alternative methods of data collection including the use of small civilian drones and the use of the new HAL (Hunting, Angling and Trapping Licence) system to gain new and improved insights into hunter demographics, attitudes, harvest, and the assessment of wildlife numbers and trends. This approach should be extended to include a sufficient sample of private landowners who are very much in touch with the habitat and wildlife on their lands.

Disease – Despite the initial alarm created by the introduction of CWD into our wildlife populations, we have yet to see substantive population declines due to the disease. However, while we may have dodged a bullet this time we may not be so lucky next time around. Dealing with CWD has cost taxpayers millions of dollars so it makes sense to make every attempt to prevent another disease outbreak occurring again. This is not only about wildlife, but also about markets for our livestock industry, and will require

Conclusions and Recommendations

improved planning and coordination between the Ministries of Agriculture and Environment, as well as better communication among the various agricultural and conservation organizations.

Invasive Species – Currently, the biggest concern is the expanding wild boar population in the province. Total eradication is now likely not possible, but every effort should be made to hold the population to an acceptable level. Again, better information on boar distribution, numbers and trends is required. The lessons learned in other North American jurisdictions should be also studied and incorporated into a coordinated management approach. As a result of the ongoing economic and environmental impacts of unwanted introduced species and their diseases, the SWF is opposed to any further expansion of the game farming sector. As a formative step, the SWF encourages the government to phase out the farming of wild boar in the province.

Highway Collisions – While this review shows that this is not a serious problem in Saskatchewan, there are certain higher collision areas that could be targeted for both human and wildlife management actions. This will require improved planning and coordination among the Ministries of Environment and Highways, as well as with SGI. It should be noted that the SWF is opposed to the arbitrary and widespread use of the hunting community to severely reduce game populations under any but the most extreme circumstances.

Literature Cited

Alberta Outdoorsmen Forum. 2011a. What do I feed moose? http://www.outdoorsmenforum.ca/showthread.php?t=99983

Alberta Outdoorsmen Forum. 2011b. Do Elk like barley? http://www.outdoorsmenforum.ca/showthread.php?t=107124

Alberta Outdoorsmen Forum. 2012. Elk + Bearded Wheat. http://www.outdoorsmenforum.ca/showthread.php?t=147462

Bollinger, T. et al. 2004. Chronic Wasting Disease in Canadian wildlife: An expert opinion on the epidemiology and risks to wild deer. Canadian Cooperative Wildlife Health Centre, University of Saskatchewan.

Brook, R. K., E. Vander Wal, F. M. van Beest, and S. M. McLachlan. 2012. Use of cattle winter feeding areas by elk and white-tailed deer: implications for managing bovine tuberculosis transmission risk from the ground up. Preventive Veterinary Medicine 108: 137-147

Brook, R. K. and F. M. van Beest. 2014. Feral wild boar distribution and perceptions of risk on the central Canadian prairies Wildlife Soc. Bull. doi: 10.1002/wsb.424.

Canadian Wildlife Health Cooperative (CWHC). 2015. http://www.cwhc-rcsf.ca/data_products_cwd.php

Canola Council of Canada. 2013. Canadian Canola Harvested Acreage. http://www.canolacouncil.org/markets-stats/statistics/harvest-acreage/

Carter, A. 2010. Vehicle and Wildlife Collisions. http://www.huntingfortomorrow.com/HFTF_Home/What's%20New_files/Wildlife%20and%20Vehicle%20Collisions.pdf

Cast Boolits. 2013. 30-30 moose hunting. http://castboolits.gunloads.com/showthread.php?190866-30-30-moose-hunting/page4

Crabbe, D. 2014. SWF Executive Director's Report. Outdoor Edge 24: 37-38.

Denham, B. et al. 2011. GeoTAIS: An Application of Spatial Analysis for Traffic Safety Improvements on Provincial Highways in Saskatchewan. 2011 Annual Conference of the Transportation Association of Canada. Edmonton, Alberta.

Econet. 2014. Bison Conservation Champions. http://econet.ca/sk_enviro_champions/bison.html

Eshel, G. et al. 2014. Land, irrigation water, greenhouse gas, and reactive nitrogen burdens of meat, eggs, and dairy production in the United States. Proceedings National Academy Sciences. http://www.pnas.org/content/early/2014/07/17/1402183111.full.pdf+html?with-ds=yes

Federal, Provincial and Territorial Governments of Canada (FPTGC). 2010. Canadian Biodiversity: Ecosystem Status and Trends 2010. Canadian Councils of Resource Ministers. Ottawa, ON.

Fins and Fur Forums. 2010. Canola. http://forum.finsandfur.net/index.php?topic=13166.0

Grazing Lands Conservation Initiative (GLCI). 2010. Sustainable grazing lands providing a healthy environment. USDA.

Great Sand Hills (GSH) Scientific Advisory Committee. 2007. The Great Sand Hills Regional Environmental Study. University of Regina, Regina, SK.

Hallman, C. A. et al. 2014. Declines in insectivorous birds are associated with high neonicotinoid concentrations. Nature doi:10.1038/nature13531.

Hay, D. 2006. Rural population. In: The Encyclopedia of Saskatchewan. University of Regina, Regina. http://esask.uregina.ca/entry/rural_population.html

Hopwood, J. et al. 2012. Are neonicotinoids killing bees? Xerces Society for Invertebrate Conservation, Portland, OR.

Interagency Oversight Committee (IOC). 2005. Canada's National Chronic Wasting Disease Control Strategy. Saskatchewan Environment.

Literature Cited

Johnson, C. 2013. Uptake of prions into plants. http://www.abstractsonline.com/Plan/ViewAbstract.aspx?sKey=cf0f185d-6f87-40f8-af8c-19d631e62561&cKey=219cd4d8-9980-4835-82cb-7649156010fa&mKey={40C89FC9-A586-491D-A3C7-B0F26504839B}

Leighton, P. A. et al. 2012. Predicting the speed of tick invasion: An empirical model of range expansion for the Lyme disease vector Ixodes scapularis in Canada. Journal of Applied Ecology 49: 457–64.

Manitoba Public Insurance. 2012. Wildlife hot zone maps on MPI website. http://www.mpi.mb.ca/en/Newsroom/Manitoba-Driver/Pages/MBDec2012.aspx

Mauser, G. 2013. http://www.sfu.ca/~mauser/

Mineau, P. and C. Palmer. 2013. The impact of the nation's most widely used insecticides on birds. American Bird Conservancy.

Montana Fish Wildlife and Parks (MFWP). 2011. Hunting Access Enhancement Program Report. http://fwp.mt.gov/hunting/hunterAccess/blockman/reports.html

Montana Fish Wildlife and Parks (MFWP). 2014. Block Management. http://fwp.mt.gov/hunting/hunterAccess/blockman/

National Wildlife Disease Strategy (NWDS). 2004. Canadian Cooperative Wildlife Health Centre.

Newton, I. 1979. Population ecology of raptors. T. & A.D. Poyser, UK.

Organ, J.F., V. Geist, S.P. Mahoney, S. Williams, P.R. Krausman, G.R. Batcheller, T.A. Decker, R. Carmichael, P. Nanjappa, R. Regan, R.A. Medellin, R. Cantu, R.E. McCabe, S. Craven, G.M. Vecellio, and D.J. Decker. 2012. The North American Model of Wildlife Conservation. The Wildlife Society Technical Review 12-04. The Wildlife Society, Bethesda, Maryland, USA.

PCAP. 2010. Saskatchewan Prairie Conservation Action Plan – Framework 2009-2013. Regina, SK: Prairie Conservation Action Plan.

Primack, R. B. 2006. Essentials of Conservation Biology. 4th Ed. Habitat Destruction, pages 177-188. Sinauer Associates, Sunderland, MA.

Saskatchewan Crop Insurance Corporation (SCIC). 2013. Wildlife Damage. http://www.saskcropinsurance.com/wildlife

Saskatchewan Crop Insurance Corporation (SCIC). 2014. Annual Report 2013-14.

Rural Development Institute. 2010. Economic impact assessment of leafy spurge in southern Manitoba. Brandon University, Brandon, MB.

Saskatchewan Crop Insurance Corporation (SCIC). 2014. Wildlife damage. http://www.saskcropinsurance.com/wildlife

Saskatchewan Environment. 2006a. Economic Evaluation of Hunting in Saskatchewan. D. Murray Consulting Associates, Regina.

Saskatchewan Environment. 2006b. Economic Evaluation of Saskatchewan's Outfitted Hunting and Fishing Industry. D. Murray Consulting Associates, Regina.

Saskatchewan Government Insurance (SGI). 2013. 2011 Saskatchewan Traffic Accident Facts. SGI, Regina.
Saskatchewan Government Insurance (SGI). 2014. Wildlife Claims 2008-2013.

Saskatchewan Hunts. 2009. Where did all the moose/elk come from? http://saskatchewanhunts.ca/forum/showthread.php?t=1597

Saskatchewan Ministry of Agriculture. 2011. Cervid Chronic Wasting Disease Surveillance Program. http://www.agriculture.gov.sk.ca/Default.aspx?DN=4aa45d0a-145a-44ad-b970-0e749381af14

Saskatchewan Ministry of Agriculture. 2012. Size of Farms. Census Fact Sheet. http://www.agriculture.gov.sk.ca/Default.aspx?DN=508d1598-3b66-428a-93ce-7ea9fa3abaee

Literature Cited

Saskatchewan Ministry of Agriculture. 2013a. September Estimate of 2013 Crop Production. http://www.agriculture.gov.sk.ca/Default.aspx?DN=18885f12-03d4-4a1e-8985-2da545f75e97

Saskatchewan Ministry of Agriculture. 2013b. Crop Yields by Rural Municipality. http://www.agriculture.gov.sk.ca/rmyields

Saskatchewan Ministry of Environment. 2011. Saskatchewan's 2011 State of the Environment Report.

Saskatchewan Ministry of Environment. 2013. Saskatchewan Wildlife Management Report 2006-2011. Fish and Wildlife Branch, Regina.

Saskatchewan Ministry of Environment. 2014a. Chronic Wasting Disease (CWD). http://www.environment.gov.sk.ca/Default.aspx?DN=0e02165a-9ef2-440f-81f7-d6a0fd1e1ee7

Saskatchewan Ministry of Environment. 2014b. Guiding and Outfitting in Saskatchewan. http://www.environment.gov.sk.ca/Default.aspx?DN=42ead2be-af0a-4cdd-b458-ecff0c9c96ae

Saskatchewan Ministry of Health. 2013. Protect Yourself, West Nile Virus. http://www.health.gov.sk.ca/west-nile-brochure

The Wildlife Society. 2007. Final Position Statement: The North American Model of Wildlife Conservation.

University of Saskatchewan News. 2013. On the trail of prairie mammals. http://words.usask.ca/news/2013/03/01/on-the-trail-of-prairie-mammals/

Wikipedia. 2013a. Population of Canada; Demographics of the United States. http://en.wikipedia.org/wiki/List_of_population_of_Canada_by_years http://en.wikipedia.org/wiki/Demographics_of_the_United_States

Wikipedia. 2013b. Natural Resources Acts. http://en.wikipedia.org/wiki/Natural_Resources_Transfer_Acts

Wikipedia. 2014. Introduced species. http://en.wikipedia.org/wiki/Introduced_species

Wikipedia. 2015. White Paper. http://en.wikipedia.org/wiki/White_paper

Wild Boars in Canada. 2014. http://wildboarcanada.ca/index.php#sthash.rNZkNTs5.dpbs

Wilkins, W. and S. Dobbs. 2013. Have you seen feral wild boar? http://www.agriculture.gov.sk.ca/agv1212-pg11

Wobeser, G. 2009. Bovine tuberculosis in Canadian wildlife: An updated history. Can. Vet. Journal 50: 1169-1176.

Photo by: Jim Kroshus