A Conservation Plan for Greater Sage-Grouse in Saskatchewan

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1.0 Introduction

The purpose of this Conservation Plan is to outline activities for the conservation of Greater Sage-Grouse (*Centrocercus urophasianus*); hereinafter referred to as Sage-Grouse. This plan aims to include the most up-to-date knowledge and scientific information, and, when appropriate, provides actions for addressing information gaps so that better management practices can be developed for the future. It is intended to guide management of Sage-Grouse and Sage-Grouse habitat between 2012 and 2016, or until an action plan is developed through the South of the Divide Multi-species Action Plan initiative.

1.1 Background

The need to manage and conserve Sage-Grouse populations has been recognized in Saskatchewan since the early 1900's. It has long been acknowledged that Sage-Grouse are limited in abundance and range in Saskatchewan. Hunting Sage-Grouse has been prohibited since at least the 1930's (Kerwin 1971) and formal hunting seasons may have never been implemented (McAdam 2003). Some population monitoring occurred during the 1960's, 1970's and early 1980's, but only sporadically and not over the entire range. It was not until 1983 that Sage-Grouse were recognized as potentially threatened with extirpation in Saskatchewan (Saskatchewan Parks and Renewable Resources 1984). In 1987, the province of Saskatchewan listed Sage-Grouse as Threatened (Saskatchewan Parks and Renewable Resources 1987) and in the next few years there was increased survey effort to better assess the status of populations across their range in Saskatchewan. Continued decline in Sage-Grouse populations increased the need for management actions. In 1992 the "Recovery and Management Plan for Sage-Grouse in Saskatchewan" was developed to ensure that Sage-Grouse populations were maintained, and in 1999, Sage-Grouse were listed as endangered under Saskatchewan's *The Wildlife Act 1998*.

The Canadian population of Sage-Grouse was first assessed as *Threatened* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1997 (COSEWIC 2008). However, because of declining population numbers and decreased range it was reassessed as *Endangered* in 1998 and was confirmed as *Endangered* in 2000 (COSEWIC 2008). The formal recognition that Sage-Grouse were at risk of extirpation from Canada prompted the formation of the Canadian Sage-Grouse Recovery Team in 1997, which included representation from several government and non-government agencies in Saskatchewan and Alberta (Canadian Sage-Grouse Recovery Team 2001). The team prepared the "Canadian Sage-Grouse Recovery Strategy" to set objectives and strategies for recovering populations and it was completed by the team in 2001. In 2003, the federal *Species at Risk Act* (SARA) was introduced and in 2003, Sage-Grouse were listed as *Endangered* in Schedule 1 of the Act. As a requirement of the Act, a second Recovery Strategy was completed for Sage-Grouse in Canada in 2008, which set objectives and identified strategies to recover Sage-Grouse populations in Canada (Lungle and Pruss 2008). However, Sage-Grouse populations and range have continued to decline across Canada and within Saskatchewan and Sage-Grouse have since remained listed as endangered both federally and provincially. An Amended Recovery Strategy was posted for consultation in December 2013 and as of June 2014 is still in its final draft version.

A significant amount of research has been conducted on Sage-Grouse since the "Recovery and Management Plan for Sage-Grouse in Saskatchewan" was completed in 1992. New information on Sage-Grouse and its habitat is now available. Furthermore, some threats to Sage-Grouse have intensified and other new threats have emerged. New scientific data on threats and their impacts to Sage-Grouse has also been gathered. This document is meant to incorporate this new knowledge into an updated plan for Saskatchewan. Additional to a recovery strategy, the federal *Species at Risk Act 2003* also requires the preparation of an action plan. An action plan for Sage-Grouse is anticipated to be completed by 2015 as part of the South of Divide Multi-species Action Plan initiative for southwest Saskatchewan, and has already started the implementation phase. This document is intended as an interim plan until the multi-species action plan is complete.

2.0 Status of Sage-Grouse in Saskatchewan

2.1 Distribution

Sage-Grouse are dependent on sagebrush (*Artemisia* spp.) for food and cover and thus their distribution is closely associated with sagebrush habitats (Schroeder et al. 2006, Schroeder et al. 2004, Connelly et al. 2004, Aldridge and Brigham 2003). The range of Sage-Grouse includes 11 states in the northwest United States of America (U.S.A.), southeastern Alberta, and southwest Saskatchewan. The historical range also previously included small portions of Arizona, Nebraska, and British Columbia where they have since been extirpated (Fig. 1; Schroeder et al. 2004, Braun 1998, Connelly and Braun 1997). Sage-Grouse habitats in Saskatchewan include the sagebrush-steppe habitats within the semi-arid mixed grasslands of the southwest portion of the province (Canadian Sage Grouse Recovery Team 2001). The dominant sagebrush species in the core area of their range is Big Sagebrush (*Artemesia tridentata*) but Silver Sagebrush (*Artemesia cana*) is the dominant woody species of sagebrush available to Sage-Grouse at the northern fringe of their range in northern Montana, Alberta, and Saskatchewan. Big Sagebrush may provide higher quality habitat and support more Sage-Grouse than Silver Sagebrush (Aldridge and Brigham 2002, Kerwin 1971). Silver Sagebrush habitat occurs sparsely in upland grasslands, but grows in larger, denser patches in poorly drained areas along the banks of creeks and rivers in the extreme southwest region of Saskatchewan (Tack et al. 2011). Therefore, the distribution of Sage-Grouse in Saskatchewan is predominantly in sagebrush habitat along valley bottoms and creeks bordering the U.S.A. and to a lesser extent, in upland sagebrush flats.

Historically, Sage-Grouse may have ranged as far north as the South Saskatchewan River and as far east as the Big Muddy (Schroeder et al. 2004, Weichel and Hjertaas 1992, Canadian Sage Grouse Recovery Team 2001). The northernmost record in Saskatchewan occurred near the community of Anerley in 1965 (Roy 1996). However, only a few observations have been documented north of the Cypress Hills and Wood Mountain uplands and there is uncertainty as to whether populations persisted in these areas over time. It is difficult to estimate how abundant and wide-ranging Sage-Grouse were in Saskatchewan prior to European settlement but early descriptions of Sage-Grouse observations in Canada and the prominence of Sage-Grouse in Native American culture suggests that they were likely once more common and widespread in southwest Saskatchewan.

Since European settlement, large areas of prairie habitat have been tilled for production of agricultural crops and forage. The reduction of sagebrush steppe habitat in Saskatchewan has been estimated to be as high as 90% (Aldridge and Brigham 2003). Most land cultivation occurred prior to the 1980's (Lungle and Pruss 2008). Remaining sagebrush habitat is now fragmented, and many habitat patches may be too small to be utilized by Sage-Grouse. Consequently, the range of Sage-Grouse has been reduced significantly from pre-settlement times and has continued to decline.

Although dependent on sagebrush, Sage-Grouse also use other seasonal habitats that are important to their survival, which may further influence their distribution (Aldridge and Brigham 2003). For example, mesic sites abundant in forbs and insects are important for brood rearing during the summer (Wallestad 1971, Peterson 1970). Sage-Grouse are seldom found far from sagebrush (Johnsgard 2002) and the proximity and connectedness of these habitats is likely important so they continually have access to sagebrush for escape cover. Sage-Grouse are capable of long distance movements (>20 km) and often undertake movements between different seasonal habitats (Connelly et al. 2000, Connelly et al. 1988). Recently, Tack et.al (2011) reported long distance movements of up to 120 km for Sage-Grouse in Grasslands National Park when moving to wintering habitat in Montana. It may be essential to maintain suitable corridors between seasonal habitats.

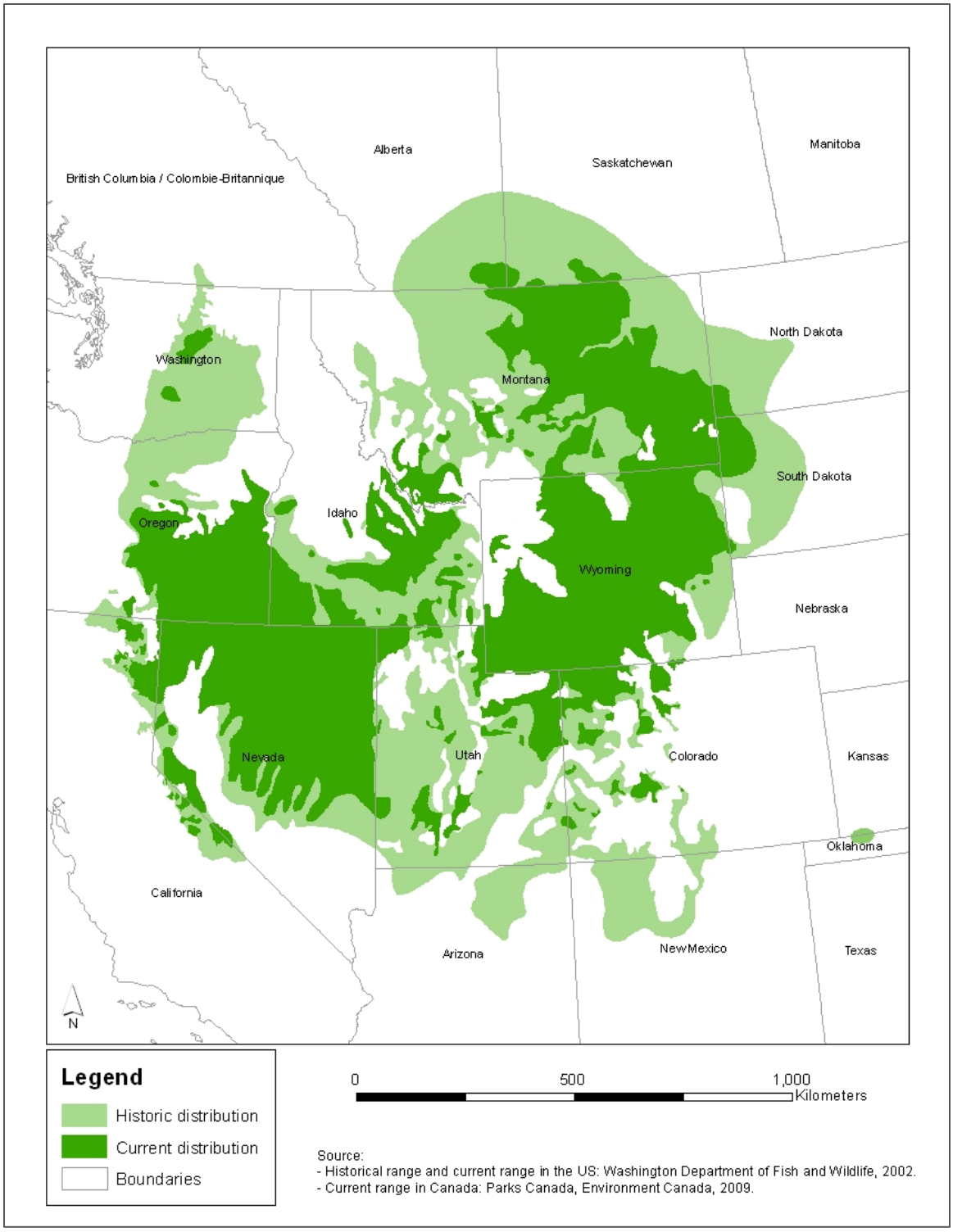

Figure 1 Historical and current distribution of Sage-Grouse in North America

2.2 Summary of Habitat Related Efforts to Date

Most habitat-related efforts in Saskatchewan have focused on habitat identification, habitat assessment, and studies on habitat use by Sage-Grouse. Early efforts focused on locating and documenting locations of lek sites used by breeding Sage-Grouse. Aerial surveys to search for new lek locations were conducted in 1983 (Saskatchewan Parks and Renewable Resources 1983), 1988 (Harris and Weidl 1988), 2004 (Beveridge 2008), and 2012 (Prieto 2012) and a database has since been maintained, which contains location records of all known current and historical lek sites in the province.

Few efforts have been made to identify and map Sage-Grouse habitat range-wide in Saskatchewan. One of the earliest habitat efforts in Saskatchewan occurred in the 1980's as part of the Terrestrial Wildlife Habitat Inventory (TWHI) project in which habitat identified as important to Sage-Grouse was mapped (Barber et al. 1976). Potentially suitable habitat was identified from expanses of sagebrush within suitable soils (Barber et al. 1976). Subsequent to the TWHI, mapping Silver Sagebrush habitat in more detail was identified as a priority in the Canadian Sage Grouse Recovery Strategy (Canadian Sage Grouse Recovery Team 2001). Consequently, an effort to map Silver Sagebrush based on aerial photography was initiated in 2001. Silver Sagebrush habitats were classified based on the type of habitat and the percent cover, distribution pattern, and height of Silver Sagebrush (Penniket 2003). This mapping was completed for a significant portion of the known current range of Sage-Grouse in Saskatchewan, but is not complete for the entire Saskatchewan range.

Various studies have been done to assess Sage-Grouse habitats in Saskatchewan. Recently, an analysis of known current and historically occupied sagebrush habitats in Saskatchewan was undertaken to rank quality and viability of each location, identify areas of high importance to Sage-Grouse, identify areas that could benefit from habitat enhancement, and to provide habitat management recommendations that could lead to recovery of Sage-Grouse (McNeil 2009). A key recommendation resulting from the analysis was that maintaining habitat connectivity is important for Sage-Grouse conservation in Saskatchewan.

Thorpe et.al. (2005) studied the differences in habitat and land use between active and abandoned lek sites and found that leks tended to persist in larger areas of sagebrush habitat. Furthermore, they created a model based on soil-vegetation relationships to predict areas that have potential to support Silver Sagebrush habitat. Another recent study focused on vegetation differences between grazed and un-grazed sagebrush habitats in and near Grasslands National Park and found that grazing increased the area of bare soil, reduced vertical cover, and increased the richness of forb species (Thorpe and Godwin 2003).

Several studies have focused on habitat use by Sage-Grouse and identifying habitats important for Sage-Grouse conservation. Since Sage-Grouse are generally characterized by relatively high adult survival and low annual recruitment (Connelly and Braun 1997, Schroeder 1997), studies have mostly focused on breeding, nesting, and brood-rearing habitat as potential limiting factors. Breeding typically but not necessarily occurs within close proximity to lek sites (Connelly et al. 2000) and the area surrounding leks often provides important nesting habitat (Aldridge and Boyce 2007, Holloran and Anderson 2005). These areas are known to be essential to reproduction. As a result, lek sites and the surrounding nearby habitat (approximately 1 km buffer) have been designated as Critical Habitat and are protected under the *Species at Risk Act 2002*.

With recognition that other habitats are also critical to Sage-Grouse survival and persistence, studies to identify nesting and brood-rearing habitat were done (Aldridge and Boyce 2007, Aldridge and Brigham 2002). Aldridge and Boyce (2007) also incorporated nest success and chick survival rates into a model for nesting and brood-rearing habitat to distinguish between population source habitats and habitats that are attractive to Sage-Grouse but likely to be population sinks (i.e., ecological traps). By incorporating data collected in Alberta during this study and using similar methodology, Parks Canada created a map of nesting and brood-rearing habitat for the Canadian range (Gummer 2011, pers. comm.). More recently, Environment Canada (2013) has fully identified Critical Habitat for Sage-Grouse, including lekking, nesting, brood-rearing and wintering habitat. The Critical Habitat attributes and locations have been identified using the best available information, including documented field observations from both Alberta and Saskatchewan, the output from habitat modeling, and other scientific information on seasonal habitat requirements for the species. This information is now available internally for the Government of Saskatchewan and has been distributed amongst provincial land and resource managers.

The importance of breeding, nesting, and brood-rearing habitat to maintaining Sage-Grouse populations is undeniable; however, the importance of wintering habitat may also be important to the long-term persistence of Sage-Grouse populations. Winter survival is generally high for Sage-Grouse populations (Connelly et al. 2000, Crawford et al. 2004) and seldom reported as a limiting factor. It can be easy to overlook the importance of winter habitat in maintaining Sage-Grouse populations, but there is some evidence that severe winters can cause significant mortality (Moynahan et al. 2005). Mortality may be more significant at the northern edge of their range where severe winters may occur more regularly. Furthermore, wintering habitat can occur within small areas (Swenson 1987, Beck 1977) causing them to be highly vulnerable if not protected. Winter habitat use by Sage-Grouse within Saskatchewan is largely unknown. A study on Sage-Grouse movements has revealed that at least some Sage-Grouse in Saskatchewan undertake long distance movements to winter habitat in the U.S.A. (Tack et.al. 2012), but observations of Sage-Grouse wintering near summer habitat within Saskatchewan have also been reported (Harris 1993, Harris 1991, Harris 1990, Houston 1988, Houston 1986, Renaud et al. 1988). More studies are needed to determine winter habitat use by Sage-Grouse across Saskatchewan.

2.3 Summary of Population Monitoring Efforts to Date

Sage-Grouse populations have been monitored range-wide in Saskatchewan since 1987. Lek counts are a standard index survey used by many jurisdictions responsible for monitoring Sage-Grouse across their range (Connelly et al. 2003), and have been the primary method for monitoring population trends in Saskatchewan. Lek counts were first conducted in Saskatchewan during the 1960's, but only sporadically and for a limited number of locations. It was not until 1987 when Sage-Grouse were identified as Threatened in Saskatchewan (Saskatchewan Parks and Renewable Resources 1987) that efforts were made to survey Sage-Grouse across their range.

Extensive survey effort was undertaken during the spring of 1987 and 1988 to locate leks and conduct counts across Saskatchewan, which would serve as baseline data for subsequent population monitoring. The survey involved both aerial and ground searches. A total of 515 males were counted on 30 different leks, and the province-wide population was estimated at 1600 - 2500 individuals (Harris and Weidl 1988). Lek counts were conducted in 1989 and have occurred annually since 1994, but not consistently at the same lek sites and not with consistent survey effort. Survey efforts were greatest during the late-1990s, but documentation on survey protocols used is lacking and it is difficult to assess how comparable surveys are from year-to-year. The most consistent data set in Saskatchewan is for Grasslands National Park, which includes annual lek counts since at least 1994.

Analysis of lek counts in Saskatchewan suggests that populations have fluctuated, but have also declined over the long-term (Table 1). There may have previously been as many as 50 active leks during the 1960's (Saskatchewan Parks and Renewable Resources 1987), but by 1993 there were only 14 active leks recorded; in 2000, only 10 active leks were observed; and by 2014, only 3 active leks were observed. The number of males counted per active lek has also declined from 17.1 in 1987 to 3.3 in 2014. In Saskatchewan, the lack of consistency in survey effort and protocol make it especially difficult to analyze population trends. Furthermore, there is some evidence that Sage-Grouse populations may be cyclic (Fedy and Aldridge 2011), which makes it difficult to distinguish natural population fluctuations from population declines. However, counts have been done over a long period of time and continue to indicate declines.

The validity of lek counts as a method to monitor population trends for Sage-Grouse has been criticized because lek attendance can vary significantly between days and within a single day, and because males sometimes attend multiple leks (Beck and Braun 1980). Lek counts may also be inaccurate because males can move between leks (Connelly et al. 2011), although Kerwin (1971) did not observe inter-lek movements by males during his study within the Frenchman River valley and suggested that it may have been because leks are more widely spaced in Saskatchewan compared to areas where inter-lek movements occur. Connelly et al. (2003) suggested a survey methodology that includes repeated counts to account for day-to-day and within-day variation of male lek attendance, and is now widely accepted as standard protocol for conducting lek counts.

Genetic studies have been done to clarify population delineation, gain understanding about gene flow and inter-relatedness between populations, and to determine if there is any evidence of inbreeding depression (Bush et al. 2011, Bush et al. 2010, Oyler-McCance et al. 2005). These studies are important to the conservation of a rare species, particularly when habitat is highly fragmented, because inbreeding depression can accelerate population declines and reduce the viability of the population (Primack 2010). Thus, genetic population structure needs to be considered for long-term management.

Across their range, Sage-Grouse can be divided into populations and sub-populations because genetic studies have shown isolation-by-distance (Oyler-McCance et al. 2005). Both Oyler-McCance et al. (2005) and Bush et al. (2011) consider Sage-Grouse in Saskatchewan as part of the Northern Montana Population (NMP) which includes Saskatchewan, Alberta, and northern Montana as a single population. Within the NMP, Connelly et al. (2004) suggested there may be three subpopulations including one south of the Milk River and two northern subpopulations separated by cultivated land in southwestern Saskatchewan, but, based on a recent genetic study, Bush et al. (2011) suggested that despite evidence that large areas of cultivated land can act as barriers to gene flow, only one subpopulation exists north of the Milk River. Bush et al. (2011) also found no indications of inbreeding depression within the NMP, with genetic variability comparable to areas within the species' core range and no significant decreased variability for Sage-Grouse at the edge of their range.

Table 1 Saskatchewan Sage-Grouse Monitoring Data

Year	# Leks Checked	# Active Leks	Total # Males	# Males/Lek	Spring Popn. Low Estimate*	Spring Popn. High Estimate**
[1]1970	5	5	133	26.6		
[1]1971	8	7	199	28.4		
[2]1983	13	12	144	12.0		
1987	45	29	497	17.1		
1988	[3]170	61	934	15.3	2802	4151
1989	15	7	94	13.4		
1994	71	15	93	6.2	279	413
1995	56	16	105	6.6	315	467
1996	47	19	123	6.5	369	547
1997	26	10	61	6.1	183	271
1998	18	11	122	11.1	366	542
1999	27	8	101	12.6	303	449
2000	37	10	126	12.6	378	560
2001	19	10	106	10.6	318	471
2002	21	10	84	8.4	252	373
2003	17	10	81	8.1	243	360
2004	18	8	60	7.5	180	267
2005	11	8	62	7.8	186	276
2006	12	6	60	10.0	180	267
2007	13	6	56	9.3	168	249
2008	12	5	51	10.2	153	227
2009	12	5	45	9.0	135	200
[4]2010	5	2	42	21.0	126	187
[4]2011	4	3	35	11.7	105	156
2012	33	3	18	6	54	80
[4]2013	2	2	4	2	12	18
2014	13	3	8	2.6	24	36

[1] Data collected by Kerwin (1971)
[2] Data from Frenchman River Valley area only
[3] "Lek" was not clearly defined and this number may Include potential and historical lek sites
[4] Weather conditions and access to lek sites was not optimal and affected survey results
*Low population estimate assumes a 2:1 ratio of females to males
**High population estimate assumes a 2:1 ratio of females to males, 90% of leks are censused, and 75% of males associated with the lek are included in the maximum count

2.4 Information Gaps

Recent monitoring efforts have indicated that Sage-Grouse have declined in numbers and range in Saskatchewan. Sage-Grouse have not been detected in the west portion of the Saskatchewan range since 2009. In 2013, song meters were set in high potential historical lek sites, and two locations on the west side of the range were found positive for the presence of Sage-Grouse. However, further field work during 2014 provided no evidence of the presence of the birds. Further efforts are being made by this Ministry to develop better audio models to automate the analysis of recordings.
Recent surveys indicate that populations are declining but continue to persist in and near Grasslands National Park.

Assessing the status of Sage-Grouse populations is difficult and requires intensive survey effort because Sage-Grouse are easily disturbed and they often occupy secluded areas that are difficult to access. Periodic aerial searches are needed for long-term monitoring of Sage-Grouse populations because lek locations can shift (Connelly et al. 2011). These aerial searches can result in the discovery of previously unknown leks (Smith et al. 2004), which may include leks that previously existed but were not known, newly formed leks, and leks that have shifted location. Aerial searches are needed so that the status of Sage-Grouse in Saskatchewan can be assessed and to guide future monitoring efforts. The last range-wide aerial search conducted in Saskatchewan occurred in 2012, and although some birds were observed, no lek locations were identified.

An abundance of studies have been conducted to investigate seasonal habitat use and movements of Sage-Grouse, but few studies have been focused within the Silver Sagebrush ecosystems of Canada and even fewer been done within Saskatchewan. Saskatchewan's Sage-Grouse populations occur entirely within Silver Sagebrush and are at the northern fringe of their distribution. All suitable seasonal habitats need to be identified within Sage-Grouse range in Saskatchewan. Completing the mapping of Silver Sagebrush habitats that was done in 2003 (Penniket) for the rest of the Sage-Grouse range would help to achieve this.

Sage-Grouse are known to be capable of undertaking long distance movements during other times of the year, particularly when moving to overwintering habitat (Tack et al. 2011, Carpenter et al. 2010, Connelly et al. 2000, Connelly et al. 1988, Berry and Eng 1985) and estimated range may not include overwintering habitat. Research has shown that Sage-Grouse at the eastern extent of the Saskatchewan range migrate south to overwintering habitat in Montana (Tack et al. 2011) but little is known about movements of Sage-Grouse in far southwest Saskatchewan. Although Big Sagebrush habitat in Montana provides more suitable overwintering habitat, Sage-Grouse have been observed overwintering in Saskatchewan (Harris 1993, Harris 1991, Harris 1990, Houston 1988, Houston 1986, Renaud et al. 1988) and in Alberta (Carpenter et al. 2010). Research is needed to determine overwintering areas used by Sage-Grouse in Saskatchewan.

The Saskatchewan population of Sage-Grouse exists in two distinct areas of south-west Saskatchewan separated by an expanse of cultivated land. Although expanses of cultivated land are thought to act as barriers to Sage-Grouse movements, genetic evidence indicates that Sage-Grouse movements occur between eastern and western habitats (Bush et al. 2011). Important dispersal corridors may connect the east and west habitats. Identification and protection of such corridors may be crucial to maintaining genetic variability in Sage-Grouse in Saskatchewan.

3.0 Threats to Sage-Grouse Populations

Sage-Grouse in Saskatchewan are vulnerable because the population size is small, occurs at the periphery of their range, has a relatively low density (Kerwin 1971), and because habitat is fragmented. Populations are more likely to become extirpated when near the periphery of their range, particularly when Sagebrush cover is limited and habitat is fragmented (Wisdom et al. 2011, Aldridge et al. 2008). The current Saskatchewan population may also be below the minimum size needed to withstand natural fluctuations and may be vulnerable to density-dependent factors such as predation (Niemuth and Boyce 1995)

Sage-Grouse are dependent on Sagebrush; tend to exhibit high site fidelity (Holloran and Anderson 2005, Fischer et al. 1993, Berry and Eng 1985, Wallestad and Pyrah 1974), and; require both landscape-scale and site-specific habitat features (Doherty et al. 2010) and therefore likely do not adapt well to habitat changes. In addition to naturally-occurring limiting factors, humans have significantly altered Silver Sagebrush habitats and introduced several additional threats to Sage-Grouse populations. A detailed summary of threats to Sage-Grouse in Canada is provided by Lungle and Pruss (2008).

3.1 Habitat Loss or Degradation

Habitat loss, degradation, and fragmentation are a primary contributor to Sage-Grouse population declines (Connelly and Braun 1997, Braun 1995, Saskatchewan Parks and Renewable Resources 1987). Direct permanent loss of habitat leads to population decline because the carrying capacity is reduced, but degradation and fragmentation of habitat can also impact populations because degraded and fragmented habitat may be avoided by Sage-Grouse, effectively reducing the amount of available habitat, and may also result in lower survival and reproductive success (Aldridge and Boyce 2007). Sage-Grouse habitats are influenced by periodic natural disturbances (i.e., fire, drought) (Connelly et al. 2004) but additional disturbances caused by humans has led to permanent habitat loss and an accumulation of degradation and fragmentation. In Saskatchewan, agriculture and industrial development are the two most common uses of Sage-Grouse habitats that can lead to habitat loss, degradation, and fragmentation.

Livestock grazing is an important activity that occurs throughout a large area of Saskatchewan's remaining Sagebrush habitat. Grazing can impact Sage-Grouse habitats by influencing the density, composition, and structure of vegetation (Call and Maser 1985) which can change the quality of the habitat for Sage-Grouse. Depending on grazing management practices, grazing can have beneficial effects or can cause negative impacts to Sage-Grouse habitats (Beck and Mitchell 2000). Overgrazing, in particular, can lead to habitat degradation by removing important nesting cover for Sage-Grouse, leaving nests more susceptible to predation. Infrastructure associated with agriculture may also influence Sagebrush habitats such as water impoundments created for watering livestock or for irrigation purposes, which can disrupt hydrology and degrade sagebrush communities over time by preventing overflow events (McNeil and Sawyer 2001).

An increasing threat to Sage-Grouse habitat is energy development. The demand for oil and gas development has been intensified in southwest Saskatchewan. Habitat degradation and fragmentation can result from the installation of oil and gas infrastructure (i.e., pump jacks, wells, compressors, roads, etc.) and it may take several years before infrastructure is decommissioned and habitat is reclaimed.

Other developments and human activities also contribute to habitat loss and degradation for Sage-Grouse. Construction of roads, trails, power lines, generation facilities, and gravel pits can directly remove, degrade and fragment habitat. Recreational activities such as off-road use of all-terrain vehicles can also degrade habitat by destroying important vegetation. Human disturbances also facilitate the spread of alien invasive species that degrade Sage-Grouse habitats (Knick et al. 2011).

3.2 Direct Mortality and Disturbance

Sage-Grouse are sensitive to human disturbances including noise (e.g., traffic, oil and gas equipment, power generation facilities, etc.) (Hollaran 2005), vertical structures (e.g., fences, power distribution and transmission lines, buildings, oil and gas infrastructure, etc.) (Holloran 2005), and anthropogenic edges (e.g., roads, trails, agricultural cropland, etc) (Aldridge and Boyce 2007, Carpenter et al. 2010). Human land uses, including energy development, livestock operations, and recreational activity, have created new vertical and linear features and sources of noise on the landscape, which Sage-Grouse were not exposed to previous to settlement. These disturbances can impact Sage-Grouse populations by causing direct mortality (i.e., vehicle collisions, collisions with power lines and fences) (Call and Maser 1985); by altering ecological dynamics such as increased predation (Bui et al. 2010, Manzer and Hannon 2005, Vander Hagen et al. 2002), or; by causing Sage-Grouse to avoid suitable habitat (Aldridge and Boyce 2007, Carpenter et al. 2010, Holloran 2005).

3.3 Changes in Ecological Processes

Natural processes such as climate, disease, predator-prey dynamics, and fire regimes influence Sage-Grouse population and habitat dynamics (Connelly et al. 2004). Many of these processes are disrupted or influenced by humans, and may lead to population impacts if Sage-Grouse are unable to adapt.

Climate change may lead to more frequent and unpredictable severe weather events (McNeil et al. 2007), and has the potential to negatively impact Sage-Grouse populations (Cornelis Van Kooten 2007). For example, increased drought could impact Sage-Grouse (Aldridge et al. 2008, Connelly and Braun 1997, Connelly et al. 2004) by reducing nest and chick survival (Connelly et al. 2000), and could reduce the range and density of Silver Sagebrush if flooding events become less frequent (McNeil and Sawyer 2001). Sage-Grouse in Saskatchewan are at the northern edge of the species range where winters are often severe and winter mortality could potentially be a more significant factor for populations in Saskatchewan than in other areas of their range. More frequent severe winters may increase the risk of extirpation because the population would have a shorter period of time to recover between severe winters.

Although predation under natural conditions is generally not considered to be a limiting factor for Sage-Grouse, human modification of Sage-Grouse habitat may alter predator-prey dynamics within Sagebrush ecosystems (Bui et al. 2010, Manzer and Hannon 2005, Vander Hagen et al. 2002). Predation is frequently reported as a significant source of mortality for Sage-Grouse nests and chicks (Bui et al. 2010, Gregg et al. 2007, Kerwin 1971), and can lead to low recruitment and population declines.

Habitat fragmentation, urbanization, and agriculture may be beneficial to many potential Sage-Grouse predators, such as Common Ravens (*Corvus corax*), Black-billed Magpies (*Pica husonia*), domestic dogs (*Canis familiaris*) and cats (*Felis cattus*), Red Foxes (*Vulpes vulpes*), Racoons (*Procyon lotor*) and Skunks (*Mephitis mephitis*). Vertical structures, created by humans, also provide additional perches for predators such as Golden Eagles (*Aquila chrysaetos*), Ferruginous Hawks (*Buteo regalis*), Red-tailed Hawks (*Buteo jamaicensis*), Swainson's Hawks (*Buteo swainsonii*), Rough-legged Hawks (*Buteo lagopus*), Great Horned Owls (*Bubo virginianus*) and Common Ravens, and may lead to increased predation on Sage-Grouse (Bui et al. 2010, Coates et al. 2008, Coates and Delehanty 2010, Vander Hagen et al. 2002).

Furthermore, Sage-Grouse may be more vulnerable to predation when nests are concentrated within small areas because they are easier for predators to detect (Holloran and Anderson 2005, Niumeth and Boyce 1995, Vander Hagen et al. 2002), and predation rates by other predators such as American Badger (*Taxidea taxus*) and Swift Fox (*Vulpes velox*) may increase.

Fire and grazing regimes in Saskatchewan have been altered by human land management. The effect of fire suppression on Sage-Grouse habitat in Saskatchewan is largely unknown, but is likely dependent on the spatial and temporal scale considered. Several studies done in habitats dominated by other species of sagebrush (mainly Big Sagebrush) suggest that burned areas are not suitable for Sage-Grouse (Rhodes et al. 2010, Connelly et al. 2000b, Nelle et al. 2000, Fischer et al. 1996) and sagebrush can take long periods of time to recover (Nelle et al. 2000), but the effects of fire on Sage-Grouse in Silver Sagebrush habitats is poorly understood. Fires may also lead to a more patchy distribution of habitat over the landscape, which may benefit Sage-Grouse (Aldridge and Boyce 2007, Aldridge and Brigham 2002). Likewise, historical grazing by bison likely resulted in a mosaic of habitats, and current grazing management by livestock may not closely resemble past grazing by bison. The impact of grazing on Sage-Grouse may also depend on economics and climate (Knick et al. 2011).

The West Nile Virus (WNV) is a relatively new disease in North America, and has emerged as a threat to Sage-Grouse (Kilpatrick et al. 2007, Naugle et al. 2004, Walker and Naugle 2011). The first confirmed Sage-Grouse mortality caused by WNV occurred in Wyoming in 2002 (Kilpatrick et al. 2007). The impact of WNV on Sage-Grouse in Saskatchewan is poorly understood, but the virus is known to occur in Saskatchewan (Kilpatrick et al. 2007) and has caused significant Sage-Grouse mortality in both southeastern Alberta and northeastern Montana (Naugle et al. 2005, Naugle et al. 2004, Walker et al. 2004). Survival rates in sites where WNV-related mortality has been confirmed have been shown to be as much as 25% lower than at sites where WNV-related mortality has not been confirmed (Naugle et al. 2005). Walker et al. (2004) also found that lek attendance of males declined in areas where WNV-related mortality was confirmed the previous summer whereas lek attendance did not decline in areas where WNV-related mortality was not detected.

3.4 Information Gaps

Abundant information is available on factors that can affect Sage-Grouse populations, but little is known about the specific causes for the decline of the Sage-Grouse population in Saskatchewan. There is little doubt that habitat loss, degradation and fragmentation have contributed to the population decline, and it has been suggested that low recruitment rates have led to population declines (Aldridge and Boyce 2007). However, the exact sources of juvenile mortality leading to lower recruitment and the influence of habitat quality are not well understood. Possible sources of mortality include increased predation caused by increased predator abundance or efficiency, insufficient forage, extreme weather (e.g., suboptimal temperature and precipitation conditions during nesting) and disease. Understanding the underlying causes of mortality and factors influencing habitat quality will help to focus conservation actions to be more cost effective.

4.0 Management Options

4.1 Species Protection

Sage-Grouse are listed and protected as an endangered species in both provincial and federal legislation. In Saskatchewan, Sage-Grouse are protected by *The Wildlife Act, 1998* and *The Wildlife Regulations, 1981*, which prohibits any person from legally being able to "kill, injure, possess, disturb, take capture, harvest, genetically manipulate or interfere with or attempt do any of those things". The federal *Species at Risk Act 2003* states that no person shall "kill, harm, harass, capture or take an individual" or "possess, collect, buy, sell or trade" any listed endangered species. Indirect mortality or disturbance of Sage-Grouse may still inadvertently occur through human activities (i.e., development, agriculture) and infrastructures (i.e., power lines, fences) since it is not clearly defined in provincial legislature as to what is harmful to Sage-Grouse. Developments known to impact Sage-Grouse need to be regulated by government in other ways, such as restricting development on critical Sage-Grouse habitats and requiring developers to follow activity restriction guidelines and mitigation measures as a condition for approval of developments to occur.

Activity restriction guidelines are used within Saskatchewan to assist proponents during the planning of proposed projects and are considered during the approval process to ensure impacts to Sage-Grouse are minimized. In Saskatchewan, guidelines were last updated in 2013 to include: setback distances of 3,200 m for leks, all year-round, and; 1,000 m for habitat (lekking, brood-rearing and wintering), all year-round.

Beneficial management practices (BMPs) are needed to ensure that disturbance to Sage-Grouse populations from ongoing land-use activities is minimized and is especially important if development and conservation are to co-exist. Grazing and energy development are the two most significant and widespread land-uses for Sage-Grouse habitats in Saskatchewan in which land managers (i.e., livestock producers) and developers need to be engaged. Government regulation and incentive programs are two possible ways to implement beneficial management practices.

Preventative measures can also be taken to minimize sources of direct mortality, such as WNV and predation. Because mosquitoes are the main vector of WNV and require water for laying eggs, managing water sources for mosquito control can help reduce WNV transmission rates (Walker et al. 2007). Outbreaks of WNV-related mortality of Sage-Grouse have been associated with drought years (Naugle et al. 2004) and therefore special attention to WNV should be taken during drought years. Predator control programs have also been implemented in some jurisdictions to reduce predation rates. Targeted predator control may be useful under exceptional circumstances at a local scale but indirectly managing predators by managing habitat is more likely to be more effective for long-term Sage-Grouse conservation.

4.2 Habitat Protection and Enhancement

Saskatchewan's Sage-Grouse habitats are limited and fragmented, thus, protection of the remaining habitat is essential if Sage-Grouse are to persist over the long-term. The viability of Sage-Grouse in Saskatchewan is already in question (Aldridge and Brigham 2003, Aldridge 2001) and populations likely cannot withstand further habitat loss and degradation. Land use planning needs to consider the spatial and temporal scales relevant to Sage-Grouse ecology. Sage-Grouse require large areas of undisturbed diverse habitats (Braun et al. 2005, Connelly et al. 2000) and although some disturbances may seem insignificant at a local scale, an accumulation of disturbances can have serious population-level impacts.

Sage-Grouse habitat in Saskatchewan occurs across both provincial and federal administered lands and is protected by multiple pieces of legislation with varying levels of protection. Based on province-wide lek counts, the majority of Saskatchewan's active leks and breeding Sage-Grouse population occurs within Grasslands National Park where habitat is secure and protected under the National Parks Act, or; are within the proposed park boundary where there is little risk of significant habitat destruction.

Grazing land administered by the Agri-Environment Services Branch of Agriculture and Agri-Food Canada (AESB) also contains a significant portion of Sage-Grouse habitat. This land is not legally secure but pasture management policies reflect a value for conservation of biodiversity and there is likely little risk of this land being tilled. A recent decision with implications for the conservation of species at risk is the Government of Canada's plan to transfer management of its community pastures back to provincial governments, transfer that started with Lone Tree in 2013. The rest of the pastures within Sage-Grouse habitat are scheduled for transfer by 2017. Additional Sage-Grouse habitat occurs on provincial land protected under *The Wildlife Habitat Protection Act* (WHPA), which protects this land from being tilled and from being sold. The new Southern Conservation Land Management Strategy, released by Landscape Stewardship Branch in 2014, provides agricultural lessees with opportunities to purchase certain lands under WHPA with the option of using Crown conservation easement to protect ecological value.

Protection on AESB and WHPA lands may be inadequate for protecting Sage-Grouse populations. Several activities destructive to Sage-Grouse habitat can be permitted on these lands, such as energy development, road construction and other industrial activities. Moreover, the new changes in regulations and ownership of the land add uncertainty to the impacts for Sage-Grouse conservation. Sage-Grouse habitat on private land has little protection. Conservation easements may provide a method for protecting Sage-Grouse habitats on private lands.

The Emergency Protection Order (EPO) issued by the federal government on December 4, 2013, also has implications for the conservation of Sage-Grouse. The EPO took effect on February 18, 2014. Private lands and grazing activities on federal and provincial Crown land are exempted from this Order. This is the first time since the inception of the Species at Risk Act (SARA) in 2002 that this section has been invoked. The EPO detailed requirements for special protection on listed quarter sections of critical habitat that represent spring breeding and brood rearing habitat for Sage grouse. The area of provincial lands affected is localized into four areas totaling 689 km^2 (267 mi^2). The EPO invoked prohibitions on destroying native prairie, construction of new structures and chronic noise during the Sage-Grouse breeding season. Prohibition of new activities can range from development of oil and gas wells to construction of roads and fences on the designated land parcels.

Further efforts are needed to identify, prioritize, and secure remaining habitat important to Sage-Grouse. Protecting all potential Sage-Grouse habitat is likely not practical and prioritizing habitat for protection is of significant importance, especially considering increasing development activity in southwest Saskatchewan. Maintaining large intact habitat patches, especially those which contain the largest and most consistently active leks is of high priority, whereas small isolated habitat patches are likely of lower conservation value. Maintaining habitat connectivity and travel corridors between seasonal habitats is also highly important for preventing bottlenecks to genetic flow and therefore sustaining genetic diversity.

Identifying seasonal Sage-Grouse habitats could be highly beneficial for mitigating disturbance to Sage-Grouse. Depending on the quality and distribution of required habitats, some Sage-Grouse populations use separate distinct habitats during different times of the year (Connelly et al. 2000). When this is the case, it may be possible for impacts of some activities to be mitigated by regulating the time of year or time of day for human activities to avoid times Sage-Grouse are most sensitive. For example, Sage-Grouse use leks during the breeding season and are highly sensitive to disturbance during this time; however, brood-rearing hens may shift to other habitats during the summer (Connelly et al. 2000, Kerwin 1971, Peterson 1970). Some activities may be acceptable at breeding/nesting areas during times when Sage-Grouse have moved to brood-rearing and wintering sites, which would otherwise be harmful during the breeding and nesting season. By restricting activities only during times of the year that they cause impact, some economic and recreational opportunities may be taken advantage of without impacting Sage-Grouse populations. However, there is not yet a clear understanding of seasonal habitat use by Sage-Grouse in Saskatchewan, and more research is needed to determine the level of impact that various activities may have on seasonal habitats during different times of the year.

Opportunities may also exist for enhancing habitat to increase available suitable habitat for Sage-Grouse. An evaluation of Saskatchewan Sage-Grouse habitat was conducted by Landwise Inc. (2009) and strategies were recommended for maintaining and enhancing Sage-Grouse habitat. Thorpe et.al. (2005) also identified land that would most likely support Silver Sagebrush based on soil types. It may be possible to enhance these areas to increase Silver Sagebrush habitat. Although protection of existing Sage-Grouse habitat is of higher priority, it may be valuable to protect habitat with high potential for supporting Silver Sagebrush where opportunities exist.

4.3 Population Monitoring

Monitoring Sage-Grouse populations is essential for guiding, evaluating, and tracking the progress of management actions. Understanding the population distribution, size, and trend is the first step towards effectively developing and implementing appropriate management actions. Monitoring can also assist with identifying causal factors for Sage-Grouse since changes in population trend can be more easily detected and is more reliable than anecdotal evidence, and may correspond with changes in land management and use, climatic conditions (i.e., drought), disease outbreaks, or predator abundance. For example, analysis of monitoring data can track and quantify the impact of a West Nile Virus outbreak (Naugle et al. 2004, Naugle et al. 2005, Walker et al. 2007). Monitoring data can also form the basis for various research analyses and core populations can be identified and prioritized for protection measures. Once the status of a population is known, an appropriate management response can take place.

4.4 Collaboration and Public Awareness

Cooperative partnerships will be fundamental to Sage-Grouse management in Saskatchewan because habitats occur on provincial, federal, and private lands with a variation of land-use interests. Populations and habitats also cross provincial and international borders. Thus, collaboration and coordination with partners in Alberta and Montana is needed to manage Sage-Grouse in Saskatchewan as part of a larger population. Initiatives such as the Northern Sage-Steppe Initiative and Crossing the Medicine Line Initiative will help to ensure a consistent and coordinated effort across jurisdictions. However, it is ultimately the ground-level land managers and users that need to be engaged for implementation of conservation actions.

Human activity and disturbance can potentially have detrimental impacts to Sage-Grouse, but mitigation measures can often be taken to prevent or minimize the impacts. In many cases, appropriate mitigation measures may not be undertaken because of a lack of awareness for the species, or because there is a lack of understanding for the harmful impacts of the activity. Increased awareness for Sage-Grouse biology, ecology, and habitat requirements is needed, along with effective strategies for information dissemination. Various media may be useful, such as website material, written communications (e.g., pamphlets), etc.

Ideally, land users and stakeholders should be engaged from the beginning stages of developing a conservation strategy. Involving land users (i.e., developers, recreational users, etc.) and stakeholders during the development of beneficial management practices, helps to ensure that their needs and concerns are addressed and it is more likely that beneficial management practices will be followed. If economic loss is expected from implementing beneficial management practices, it may also be useful to consider cost sharing between partners or developing incentive or compensation programs.

4.5 Research

Addressing information gaps could significantly improve the management and conservation of Sage-Grouse. The decline in population size and occupied range over the last 30 years indicates that current management practices in Saskatchewan are not adequate for conserving Sage-Grouse. A greater understanding of the root causes for the declining trend in Saskatchewan is needed as well as effective management strategies to counteract them. Collaboration with partners to engage in research initiatives, such as with the Northern Sage-Steppe Initiative, is a vital step towards improving management and conservation of the Sage-Grouse population and its habitats in Saskatchewan.

5.0 Goals, Objectives and Recommended approaches

This Conservation Plan is meant for the interim until a more complete action plan is developed through the South of Divide Multi-species Action Plan initiative. As such, goals, objectives and actions are identified for the period 2012 – after 2015. Long-term objectives and activities that cannot be reasonably initiated in the next 3 to 5 years are not included in this document, but some of the listed activities will require ongoing implementation beyond that timeline. For a list of activities, threats addressed, partners and timelines refer to Table 2.

5.1 Goals

- Ensure that a Greater Sage-Grouse population persists in Saskatchewan.
- Manage Greater Sage-Grouse habitat to benefit both the species and the sagebrush-steppe ecosystem, and to ensure not only that other species at risk are not negatively impacted, but also potentially benefit from conservation actions.

5.2 Objectives

- Identify the factors contributing to the decline of Greater Sage-Grouse abundance and occupied range in Saskatchewan and mitigate threats to the extent possible.
- Monitor populations province-wide.
- Protect Sagebrush habitat within Greater Sage-Grouse range in Saskatchewan.
- Increase awareness and collaboration.

5.3 Recommended approaches

5.3.1 Population assessment and monitoring.

Assess the current status of the Greater Sage-Grouse population in Saskatchewan and monitor to evaluate progress towards population recovery and effectiveness of recovery actions

a. Conduct a comprehensive range-wide survey to assess the status of the population.

b. Develop and implement a systematic monitoring program for Sage-Grouse in Saskatchewan.

c. Contribute to and help maintain a common database through the NSSI, so Alberta, Montana and Saskatchewan can share information.

5.3.2 Habitat identification and assessment

Identify and assess Sage-Grouse habitat to guide management actions

a. Identify and map core habitat for Sage-Grouse, assessing both the quality of the habitat and the suitability for Sage-Grouse.

b. Identify and prioritize areas within Sage-Grouse habitat where management actions are needed (e.g., development activities anticipated to occur, exploration permits, undeveloped leases).

5.3.3 Threat Mitigation

Mitigate threats to Sage-Grouse populations and habitats

a. Identify oil and gas infrastructures on Crown land that can be reclaimed/enhanced.

b. Review internal processes within the government of Saskatchewan (e.g., Ministry of Agriculture, Ministry of Energy and Resources) for approving and/or restricting development activities, identify gaps on information sharing and improve the information flow both ways.

c. Identify human-related vertical structures including fences, buildings, wind turbines, power transmission and distribution lines, etc., within Sage-Grouse habitat.

d. Review current scientific information on Sage-Grouse tolerances and thresholds for developments and associated activities (e.g., energy development, roads) and update Activity Restriction Guidelines accordingly.

e. Review and adopt existing BMPs and mitigation measures for activities that impact Sage-Grouse populations and its habitats (e.g., grazing, energy development).

f. Review and develop appropriate reclamation protocols for abandoned infrastructures that impact Sage-Grouse populations and its habitats (e.g., oil wells, water impoundments).

g. Ensure BMPs, mitigation measures, reclamation protocols and Activity Restriction Guidelines are implemented within Sage-Grouse habitat.

5.3.4 Partnership Collaboration

Collaborate with partners and develop broad sector support for Sage-Grouse conservation efforts

a. Collaborate with and engage landowners and lessees in BMPs, stewardship and conservation easements.

b. Ensure information regarding Sage-Grouse is shared between the government of Saskatchewan and its partners (e.g., data sharing, CDC website).

c. Collaborate with partners in research initiatives on Sage-Grouse ecology and management.

d. Develop and distribute information products (e.g., pamphlets, website) to develop support for Sage-Grouse conservation.

Table 2 Sage-Grouse conservation activities planning, to be led by the Saskatchewan Ministry of Environment.

1.	Assess the current status of the Greater Sage-Grouse population in Saskatchewan and monitor progress towards population recovery and efficiency of recovery actions.					
	Activities	**Threats or concerns addressed ***	**Partners**	**Timeline and progress**		
				2012-13	**2014**	**2015+**
	a. Conduct a comprehensive range-wide survey to assess the status of the population.	All	EC, NS, PC	✓		
	b. Develop and implement a systematic monitoring program for Sage-Grouse in Saskatchewan.	All	EC, PC	✓	✓	✓
	c. Contribute to and help maintain a common database through the NSSI, so Alberta, Montana and Saskatchewan can share information.	All	GOA, GOM	✓	✓	✓
2.	Identify and assess Sage-Grouse habitats to guide management actions					
	Activities	**Threats or concerns addressed ***	**Partners**	**Timeline and progress**		
				2012-13	**2014**	**2015+**
	a. Identify and map core habitat for Sage-Grouse, assessing both the quality of the habitat and the suitability for Sage-Grouse.	Habitat loss, degradation, and fragmentation.	EC, PC	✓	✓	
	b. Identify and prioritize areas within Sage-Grouse habitat where management actions are needed (e.g., development activities anticipated to occur, exploration permits, undeveloped leases).	Habitat loss, degradation, and fragmentation.	EC, Industries, MER		✓	
3.	Mitigate threats to Sage-Grouse populations and habitats					
	Activities	**Threats or concerns addressed ***	**Partners**	**Timeline and progress**		
				2012-13	**2014**	**2015+**
	a. Identify oil and gas infrastructures on Crown land that can be reclaimed/enhanced.	Habitat degradation and fragmentation.	EC, GOA, GOM, Industries, MER		✓	

	b. Review internal processes within the government of Saskatchewan for approving and/or restricting development activities, identify gaps on information sharing and improve the information flow both ways.	Habitat loss, degradation and fragmentation.	MER, MOA	✓	✓	✓
	c. Identify human-related vertical structures including fences, buildings, power transmission and distribution lines, etc., within Sage-Grouse habitat.	Habitat degradation and fragmentation, predation, direct mortality.	EC, GOA, GOM, Industries, MER			✓
	d. Review current scientific information on Sage-Grouse tolerances and thresholds for developments and associated activities (e.g., energy development, roads) and update Activity Restriction Guidelines accordingly.	Habitat degradation and fragmentation.	EC, MOA, MER	✓		
	e. Review and develop beneficial management practices and mitigation measures for activities that impact Sage-Grouse populations and its habitats (e.g., grazing, energy development).	Habitat loss, degradation, and fragmentation, predation.	EC, GOA, GOM, Landowners, Metis and First Nations, MOA, MER, SWA			✓
	f. Review and develop appropriate reclamation protocols for abandoned infrastructures that impact Sage-Grouse populations and its habitats (e.g., oil wells, water impoundments).	Habitat loss, degradation, and fragmentation, predation.	EC, Landowners, Metis and First Nations, MOA, MER, SWA			✓
	g. Ensure BMPs, mitigation measures, reclamation protocols and Activity Restriction Guidelines are implemented within Sage-Grouse habitat.	Habitat degradation and fragmentation, predation, direct mortality.	EC, Industries, MOA, MER		✓	✓
4.	Collaborate with partners and develop broad sector support for Sage-Grouse conservation efforts					
	Activities	**Threats or concerns addressed ***	**Partners**	**Timeline and progress**		
				2012-13	**2014**	**2015+**
	a. Collaborate with and engage landowners and lessees in stewardship and conservation easements.	Habitat loss, degradation, and fragmentation.	DU, Landowners/lessees, NCC, NS.		✓	✓

	b. Ensure information regarding Sage-Grouse is shared between the Government of Saskatchewan and its partners.	Habitat loss, degradation, fragmentation, direct mortality, predation, altered hydrology.	Academia, Conservation groups, Industries, Landowners/lessees, Metis and First Nations, GOM, GOA, Other government agencies	✓	✓	✓
	c. Collaborate with partners in research initiatives on Sage-Grouse ecology and management.	Habitat loss, degradation, fragmentation, direct mortality, predation, altered hydrology.	Academia, Conservation groups, GOM, GOA, Industries, Landowners/lessees, Metis and First Nations, Other government agencies	✓	✓	✓
	d. Develop and distribute information products (e.g., pamphlets, website) to develop support for Sage-Grouse conservation.	Habitat loss, degradation, and fragmentation.	EC, CDC, GOA, GOM, NS			✓

* Threats or concerns as outlined in the "Recovery Strategy for the Greater Sage Grouse in Canada" (2008).

List of Partners:
CDC: Saskatchewan Conservation Data Centre
DU: Ducks Unlimited Canada
EC: Environment Canada
GOA: relevant Government of Alberta agencies
GOM: relevant Government of Montana agencies
MOA: Saskatchewan Ministry of Agriculture
MER: Saskatchewan Ministry of Energy and Resources
NCC: Nature Conservancy of Canada
NS: Nature Saskatchewan
PC: Parks Canada
SWA: Saskatchewan Watershed Authority

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