Alberta Greater Sage-grouse Recovery Plan 2013-2018

Alberta Species at Risk Recovery Plan No. 30

Alberta Greater Sage-grouse Recovery Plan 2013–2018

Prepared by:

Alberta Environment and Sustainable Resource Development

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PREFACE

Albertans are fortunate to share their province with an impressive diversity of wild species. Populations of most species of plants and animals are healthy and secure. However, a small number of species are either naturally rare or are now imperiled because of human activities. Recovery plans establish a basis for cooperation among government, industry, conservation groups, landowners, and other stakeholders to ensure these species and populations are restored or maintained for future generations.

Alberta's commitment to the *Accord for the Protection of Species at Risk* and to the *National Framework for the Conservation of Species at Risk*, combined with requirements established under Alberta's *Wildlife Act* and the federal *Species at Risk Act*, has resulted in the development of a provincial recovery program. The overall goal of the recovery program is to restore species identified as *Threatened* or *Endangered* to viable, naturally self-sustaining populations within Alberta. The policy document *Alberta's Strategy for the Management of Species at Risk 2009–2014* (or future updates of this document) provides broader program context for recovery activities.

Alberta species at risk recovery plans are prepared under the supervision of the Species at Risk Program, Alberta Environment and Sustainable Resource Development. This often includes involvement of a recovery team composed of a variety of stakeholders including conservation organizations, industry, landowners, resource users, universities, government agencies and others. Membership is by invitation from the Director of Wildlife Management and may include representation from the diversity of interests unique to each species and circumstance. Conservation and management of these species continues during preparation of recovery plans.

The Executive Director of the Fish and Wildlife Policy Branch provides these plans as advice to the Minister responsible for fish and wildlife management. Alberta's Endangered Species Conservation Committee also reviews draft recovery plans and provides recommendations to the Minister. Additional opportunities for review by the public may also be provided. Plans accepted and approved for implementation by the Minister are published as a government recovery plan. Approved plans are a summary of the Ministry's commitment to work with involved stakeholders to coordinate and implement conservation actions necessary to restore or maintain these species.

Recovery plans include three main sections: background information that highlights the species' biology, population trends, and threats; a recovery section that outlines goals, objectives, and strategies to address the threats; and an action plan that profiles priority actions required to maintain or restore the *Threatened* or *Endangered* species. Each approved recovery plan undergoes regular review, and progress of implementation is evaluated. Implementation of each recovery plan is subject to the availability of resources from within and from outside government.

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This recovery plan was prepared by Dale Eslinger (Alberta Environment and Sustainable Resource Development, ESRD), Joel Nicholson (ESRD), and Kelley Kissner (consultant); Jennifer Chandler (ESRD) was instrumental in drafting the 2005 version of the Plan. We thank Cameron Aldridge, Cormack Gates, David Gummer, Kevin Redden, and Al Violette for providing background information during the development of this Plan. This recovery plan was reviewed by the current Alberta Greater Sage-grouse Recovery Team composed of the following members:

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Funding from the Species at Risk Program of ESRD supported the preparation of this recovery plan. Many individuals, agencies, and organizations supported the implementation of recovery actions specified in the inaugural recovery plan. Future support from these and other individuals, agencies and organizations will be needed to successfully implement the recovery actions described in this recovery plan and, ultimately, to recover the species.

EXECUTIVE SUMMARY

Greater sage-grouse (*Centrocercus urophasianus urophasianus*), the largest grouse in North America, is a year-round resident of the sagebrush range of the semi-arid mixed-grass prairie regions of south-eastern Alberta. Currently, sage-grouse are located in the southeastern corner of the province, centered south and east of the town of Manyberries. This 4 000 km^2 area contains extensive native prairie and sagebrush flats, which form unique habitat for sage-grouse. Canadian sage-grouse are entirely dependent on silver sagebrush as a source of food and shelter. Sage-grouse have experienced decline in all parts of their range, and in Canada have been designated as *Endangered* since 1998. The Minister of Environment and Sustainable Resource Development approved sage-grouse for listing as *Endangered* under the *Wildlife Act* in Alberta in 2000.

The source of the species decline is poorly understood. However, many potential threats have been identified. Continued cropland conversion south of the Alberta border may increase isolation of the Alberta population. Water impediments may affect the health of the silver sagebrush communities required for sage-grouse survival. Increasing industrial activity is known to cause disturbance to the birds and contributes to loss and fragmentation of habitat. Light to moderate grazing regimes generally favour sage-grouse, but recurring drought and climate change may have an impact on grazing practices needed to sustain healthy range and suitable habitat for sage-grouse. Disease, particularly West Nile virus, has the potential to have population-level impacts on sage-grouse. Predation and human disturbance from recreational viewing may also be impacting the population.

In late 2002, the Minister of Environment and Sustainable Resource Development formally delegated the responsibility of drafting a provincial recovery plan to the greater sage-grouse recovery team. In 2005, the greater sage-grouse recovery team produced the *Alberta Greater Sage-Grouse Recovery Plan 2005–2010* that recommended strategies and actions to recover the species in a manner that respected the livelihoods and land uses within sage-grouse range. This plan had two main goals:

1. Enhance and maintain habitat for sage-grouse to satisfy life-cycle requirements in support of a viable population within its remaining historical range.

2. Achieve recovery of the sage-grouse population to a level that provides for sustainable recreational viewing and hunting.

Despite implementation of many of the recovery actions outlined in the inaugural recovery plan, the Alberta population has continued to decline with the lowest count of 13 males recorded in the spring of both 2011 and 2012. As such, the goals specified in the inaugural plan are now considered long-term goals. Short-term goals to prevent extirpation of the species and facilitate meeting of long-term goals are as follows:

1. Restore, and prevent further loss of, identified critical habitat in the Alberta range through immediate implementation of updated land use standards, identified Conservation and Development Zones and enhanced land stewardship.

2. Increase suitable habitat available for sage-grouse through accelerated reclamation of industrial developments and restoration of marginal annual cropland.

3. Reverse population decline in the Alberta range through population augmentation, predator management, and habitat remediation. By 2018, the Alberta population will show a positive trend in the number of strutting males at leks and the number of active leks.

A translocation program was initiated in 2011 to increase the breeding population while recovery continues. As of spring 2012, 38 female and three male sage-grouse had been translocated to Alberta from genetically similar populations from Montana.

This recovery plan provides a series of actions required to meet each goal with timelines and lead agencies identified. The Plan focuses on habitat conservation and population increase, such that a positive trend in sage-grouse abundance is observed in the near term, eventually leading to a self-sustaining population. A major part of the recovery effort is to coordinate energy development with conservation of sage-grouse critical habitat. Reclamation of roads and well sites no longer in production should serve to reduce the industrial footprint and create potential habitat for sage-grouse. Promoting good range health in an effort to maintain existing habitat on rangelands will also help enhance habitat for sage-grouse and promote long-term sustainable grazing. In 2018, the Plan will be reviewed and updated, as necessary.

The cost of implementing the recovery plan is estimated at $2 980 000 over five years, including cash and in-kind support, but not including costs for captive breeding. A variety of agencies will be invited to participate in the funding and implementation of recovery actions. In considering recovery actions, an attempt was made to draw on existing programs to reduce costs and effort associated with implementation.

1.0 INTRODUCTION

1.1 Provincial and Federal Status

In June 2000, the Minister of Alberta Environment and Sustainable Resource Development approved the listing of greater sage-grouse (*Centrocercus urophasianus urophasianus*) as *Endangered* in Alberta. This status designation was based on the species' small distribution and its small and declining population in Alberta. The Minister's *Initial Conservation Action Statement* specified that the species be removed from the list of game bird species (although there has been no hunting season for sage-grouse in Alberta since 1995), that a recovery plan be developed, and that management activities necessary to ensure the protection of breeding grounds (lek sites) and adjacent nesting areas be implemented. In addition, the action statement specified that new resources should be secured to support these activities and to support research necessary to inform conservation and recovery efforts for this species.

Nationally, the species was listed in 1997 as *Threatened* by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) because of very small and declining populations in Saskatchewan and Alberta. The species status was upgraded to *Endangered* in 1998, reconfirmed in 2000 (COSEWIC 2004), and greater sage-grouse is now listed under Schedule 1 of the *Species at Risk Act*. The Canadian Sage Grouse Recovery Team was formed in 1997 by representatives from the provinces of Alberta and Saskatchewan to recommend strategies to address the population decline of this species in Canada. In 2001, the *Canadian Sage Grouse Recovery Strategy* was completed, which outlined broad areas where action could be taken for recovery of the species in Canada (Canadian Sage Grouse Recovery Team 2001). In 2008 the *Recovery Strategy for the Greater Sage-Grouse (Centrocercus urophasianus urophasianus) in Canada* was developed as an update to the inaugural federal plan to guide ongoing national recovery efforts (Lungle and Pruss 2008).

In 2005, the *Alberta Greater Sage-Grouse Recovery Plan 2005–2010* was developed (Alberta Sage Grouse Recovery Action Group 2005) that outlined strategies and actions required to facilitate sage-grouse recovery in a manner that respects both livelihoods and current land uses within the species' range in Alberta. Implementation of many of the recovery actions specified in the inaugural Alberta plan has allowed for continued monitoring of population size and trends, has minimized sagebrush habitat lost to various anthropogenic land uses, and has helped to mitigate effects of development. Furthermore, recent research studies have enhanced knowledge of the species' habitat requirements during various stages of its life cycle, of habitat use in relation to various land use developments, and of the degree to which genetic connectivity exists between the Alberta population and neighbouring populations in Saskatchewan and the United States. Despite these activities, the Alberta sage-grouse population has continued to decline and, as such, translocation of birds from the neighbouring jurisdiction of Montana was initiated in 2011 to help augment the Alberta population while recovery efforts continue. The *Alberta Greater Sage-grouse Recovery Plan 2013–2018* (herein, the Plan) outlines recovery actions necessary to prevent further declines in the population, conserve its habitat, and, ultimately to recover the population in the province.

1.2 Recovery Team

The greater sage-grouse recovery team (herein, the recovery team) was initiated by the Minister of Environment and Sustainable Resource Development in late 2002 and receives operational guidance from the Director of Wildlife on behalf of the Minister. The recovery team includes representatives who may be affected by the management of sage-grouse and its habitat, including Alberta Energy, Alberta Environment and Sustainable Resource Development (ESRD), Alberta Fish and Game Association, the oil and gas industry, the local ranching community, and the Society of Grassland Naturalists.

The recovery team's primary responsibility is to advise the Minister on management of this species by outlining recovery strategies and actions in the Plan. ESRD oversees implementation of the Plan by facilitating and encouraging involvement of appropriate and interested parties, including members of the team. The team Chair is responsible for evaluating and reporting on the progress of recovery actions, and updating the Plan at the end of its lifespan; the recovery team may be reconvened to assist with the update as necessary.

1.3 Technical Advisory Group

During development of the inaugural Alberta sage-grouse recovery plan, a technical advisory group, reporting to the recovery team, provided scientific information regarding sage-grouse ecology, silver sagebrush ecology, water impediments, and the effects of grazing on sagebrush habitat. While not directly involved in the decision-making process, this group provided valuable advice on request from the recovery team and contributed a great deal to discussions of appropriate goals, objectives, indicators, and actions. This group consisted of wildlife managers, researchers, range management specialists, and geographic information science (GIS) experts. The technical advisory group's expertise, combined with local knowledge of the recovery team, was used to develop a set of actions that would facilitate sage-grouse recovery. The technical advisory group was not involved in the development of this updated recovery plan, but technical experts have been consulted, as needed, during the development of this plan.

2.0 SAGE-GROUSE BIOLOGY

2.1 Life History

Greater sage-grouse is the largest species of grouse in North America (Beck and Braun 1978). As its name implies, the species depends on sagebrush (*Artemesia* spp.), which it uses for food and protective cover throughout the year (Patterson 1952, Schroeder *et al.* 1999). In Canada, the species occurs in silver sagebrush (*Artemesia cana*) habitat, whereas in other parts of its range it is associated mainly with big sagebrush (*A. tridentata* ssp.) (Lungle and Pruss 2008).

Sage-grouse have rounded wings, long pointed tails, brownish-black upper parts finely marked with white or grey, and black patches on their abdomens (Schroeder *et al.* 1999, Connelly *et al*.

2004; Lungle and Pruss 2008). Males can be distinguished from females by their larger size, longer tail feathers, larger abdominal patches, black throats, white breast feathers, long feathers on the backs of their necks, and arched yellow combs above their eyes (Connelly *et al.* 2004). In addition, males possess two yellow-coloured air sacs on their breasts, which they inflate and deflate during courtship displays (Patterson 1952; Schroeder *et al.* 1999).

Each spring, male sage-grouse gather on strutting or dancing grounds, called leks, and perform a strutting display to attract and mate with females (Connelly *et al.* 2004). Males display at dawn and dusk, with peak activity at sunrise (Patterson 1952; Gill 1965; Kerwin 1971; Johnsgard 1983). In Alberta, males typically arrive on leks in mid-March after leks are clear of snow cover (Aldridge 2000a; see Figure 2). Older, dominant males generally are the first to arrive at leks, while yearling males arrive in late April to early May (Aldridge 1998a, 2000a). The number of males on leks typically peaks in late April, and courtship displays continue until the end of May (Aldridge 2000a). Yearling males rarely breed, while older males have a greater chance of mating (Eng 1963; Gibson *et al.* 1991). Adult males typically return to leks if females continue to attend these leks each year (Dunn and Braun 1986; Schroeder and Robb 2004).

Females begin to arrive at leks shortly after males, and individual females are usually only present at a lek for two to three days (Gibson and Bradbury 1986). Hens usually copulate only once (usually with a dominant male) unless the first nesting attempt fails during incubation (Gibson and Bradbury 1986; Gibson 1996). In Alberta, peak female attendance at leks occurs in early April, with most of the breeding activity occurring over a two-week week period (Aldridge 2000a). Hens will return to the same lek each year if nesting habitat around the lek remains stable (Hartzler and Jenni 1988; Bradbury *et al.* 1989; Fischer *et al.*1993).

In Alberta, females begin laying eggs by mid-April (Aldridge 2000a) in shallow depressions on the ground lined with vegetation and feathers (Schroeder *et al.* 1999). Studies in Alberta found that most females attempt to nest (Aldridge 2000a, 2000b; Aldridge and Brigham 2001) and 36% of females whose first nest fails will re-nest (Aldridge and Brigham 2001). Eggs are incubated for an average of 27 days (Aldridge 2000a; Aldridge and Brigham 2001). In Alberta, peak hatching for first nests occurs in late May or early June, and second nests (re-nests) typically hatch the last week of June (Aldridge 2000a). Nest success in two Alberta studies was 46.2% and 35.3%, with lower success in one study possibly due to drier weather conditions (Aldridge 2000a, 2005). The primary cause of nest failure is egg predation, often by American crows (*Corvus brachyrhynchus*) and black-billed magpies (*Pica pica*) (Aldridge 2000a; Watters *et al.* 2002).

Grouse chicks are precocial (i.e., born with down feathers, eyes open, and able to move about). Chicks begin to fly by about 10 days of age (Schroeder *et al.* 1999). Shortly after hatching, hens and their broods (all chicks) move to areas with succulent herbaceous plants, abundant insects, and good cover (Connelly *et al.* 2004). The brood-rearing period lasts from the time of hatch until chicks are about 12 weeks of age (Drut *et al.* 1994a, 1994b).

The diet of sage-grouse consists primarily of sagebrush leaves, supplemented with forbs and insects during various life stages and seasons (Connelly *et al.* 2004). In the winter, sagebrush

accounts for nearly 100% of the diet (Connelly *et al.* 2004). Broods consume mostly insects and forbs and begin foraging on sagebrush at about 12 weeks of age (Crawford *et al.* 2004).

Sage-grouse begin gathering in flocks in late summer and fall. Males and females typically flock separately, but young males may flock with hens (Eng and Schadweiler 1972; Beck 1977; Connelly *et al.* 1988). In Alberta, Carpenter *et al.* (2010) observed mixed-sex flocks of between 13 to 14 birds, on average, with one observation of a flock of 100 birds. Alberta sage-grouse are year-round residents (non-migratory), although seasonal movements vary across the species' range (Connelly *et al.* 2004; Tack *et al.* 2012). Sage-grouse that nest and brood in silver sagebrush habitat in Saskatchewan make winter migrations of between 61 km to 122 km to big sagebrush habitat in Montana (Tack *et al.* 2012). In Alberta, Carpenter *et al.* (2010) documented several long-distance movements by radio-tracked sage-grouse of between 40 km to 50 km during the winter, although birds did not migrate outside of the province. The annual Alberta sage-grouse life cycle timeline is shown in Figure 1.

Annual survival of adults is typically high across the species' range (males 38–60%, females 55–75%, Schroeder *et al.* 1999). In Alberta, one study reported annual survival rate of males at 31% and of females at <56.5% (Aldridge 2000a). Chick survival (13.6–22.7%, Aldridge 2000a; 7-10.6%, Aldridge 2005) and recruitment are low (35% across two years) and may be primary factors limiting the Alberta population (Aldridge 2000a, 2005; Aldridge and Brigham 2001, 2003).

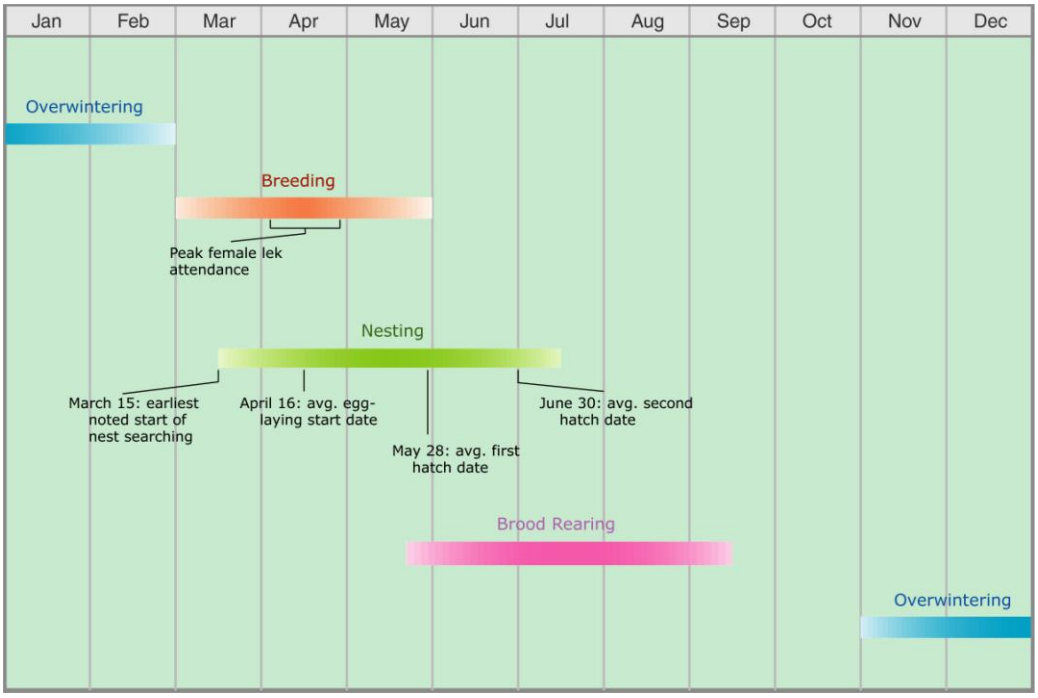

Figure 1. Alberta sage-grouse annual life cycle.

2.2 Habitat

Sage-grouse depend on sagebrush for survival during all seasons of the year and require a variety of sagebrush habitats during different stages of their life cycle (Braun *et al.* 1976; Hagen 1999; Connelly *et al.* 2000; Crawford *et al.* 2004). In Alberta, sage-grouse habitat is limited to the distribution of silver sagebrush which is primarily restricted to the extreme southeast corner of the province in the Dry Mixedgrass ecoregion (Aldridge 2000a).

Research in Alberta and elsewhere has demonstrated that sage-grouse select habitat based on characteristics at the local scale, such as the immediate area surrounding nest or brood locations, as well as characteristics of the larger landscape (Aldridge and Boyce 2007; Doherty *et al.* 2008; Carpenter *et al.* 2010; Doherty *et al.* 2010). This work suggests a hierarchy of selection by birds from landscape to local scale, and requires that suitable sagebrush habitat be available to meet the species' habitat needs at both levels of selection (Doherty *et al.* 2010). The local- and landscape-level habitat requirements for sage-grouse at each stage of their life cycle are summarised below.

2.2.1 Breeding

Leks are open, relatively flat areas with short sagebrush and sparse vegetation where displaying males are readily visible to females and to each other (Petersen 1980). Leks typically range in size from 0.04 ha to 4 ha (Dalke *et al.* 1963). Common areas for leks include floodplains, valley bottoms, and dried mudflats (Patterson 1952; Aldridge 1998a, 2000a; Thorpe *et al.* 2005). In Alberta, leks frequently occur near standing water or small creeks (Aldridge 1998a, 2000a). Leks are often surrounded by areas of taller (Petersen 1980) and denser sagebrush cover used for feeding, roosting, and nesting (Patterson 1952; Clark and Dube 1984; Aldridge 2000a; Connelly *et al.* 2004).

2.2.2 Nesting

After mating, females move to sagebrush habitat generally located around leks (Connelly *et al.* 2004). Average nest-to-lek distances across the species' range vary from 1.1 km to 7.8 km (Martin 1970; Wallestad and Pyrah 1974; Autenrieth 1981; Wakkinen *et al.* 1992; Schroeder *et al.* 1999; Aldridge 2000a; Connelly *et al.* 2004; Holloran 2005; Moynahan *et al.* 2006; Lungle and Pruss 2008). In Alberta, average lek-to-nest distance was 4.7 km, but individual nests were located between 0.42 km to 15.5 km from the nearest lek (Aldridge 2000a). Variation in nest-to-lek distances may reflect differences in the availability of suitable nesting habitat surrounding leks (Autenrieth 1981; Aldridge 2000a).

In Alberta, sage-grouse typically nest in relatively large patches of moderate sagebrush cover that is patchily distributed and that avoid anthropogenic edges (Aldridge 2005; Aldridge and Boyce 2007). Within these areas, hens appear to select nest locations in patches of relatively tall and dense sagebrush cover, and tall but less dense grass cover (Aldridge 2000a; Aldridge and Brigham 2002). These habitat preferences (vegetative cover) are similar to those found in other parts of the species' range (reviewed by Hagen *et al.* 2007) and presumably reflect the importance of both vertical and horizontal cover for concealing nests from ground and aerial predators (Patterson 1952; Klebenow 1969; Wallestad and Pyrah 1974; Weichel and Hjertaas 1992; Madsen 1995; Watters *et al.* 2002). Most hens in Alberta nest under sagebrush plants

rather than other shrub species (90%, Aldridge 2000a; 75%, Aldridge 2005), which may contribute to increased nest success (Connelly *et al.* 1991). Female sage-grouse generally exhibit high fidelity to nesting areas (Connelly *et al.* 2004), often nesting within hundreds of meters of their previous nest (Kaiser 2006). Yearling females have also been observed to nest in the same vicinity as their mothers (Lyon 2000; Kaiser 2006; Holloran *et al.* 2010).

2.2.3 Brood Rearing and Summer Habitat

Similar to nesting habitat, brood-rearing habitat for sage-grouse in Alberta consists of large patches of moderate sagebrush cover that is patchily distributed (Aldridge 2005; Aldridge and Boyce 2007). There is also evidence of selection for mesic (wet) habitats and avoidance of otherwise suitable sagebrush habitat if it contains high proportions of anthropogenic disturbance. Sagebrush habitat used by broods may sometimes occur in riskier habitats, such as in areas with higher densities of vehicle trails. Use of these sites may be associated with increased risk of predation or mortality from collisions (Aldridge and Boyce 2007, see Threats, Energy Development).

Within the large habitat patches identified above, brood-use locations in Alberta have relatively tall and dense sagebrush cover and taller grass and forb cover (Aldridge 2000a; Aldridge and Brigham 2002). Aldridge and Brigham (2002) did not find evidence that broods selected increased forb cover, despite the importance of forbs in the diet of chicks (Johnson and Boyce 1990; Drut *et al.* 1994a) and numerous studies indicating selection of increased forb cover by broods elsewhere in the species' range (Klebenow and Gray 1968; Peterson 1970; Schoenberg 1982; Drut *et al.* 1994a; Sveum *et al.* 1998a). However, forb cover is extremely low across the Alberta range of sage-grouse (11.2% cover) and there appears to be little variation in forb cover across the range. Broods may simply be using as much forb cover as is available in this portion of the species' range (Aldridge and Brigham 2002). Aldridge and Brigham (2002) also did not observe a shift in habitat use by Alberta broods during the summer as has been observed in other locations. In these other areas, as forbs in upland sagebrush habitat dry out, hens with broods move to wet meadow habitat with increased forb cover and insect abundance (Patterson 1952; Klebenow 1969; Wallestad 1971). Again, this absence of a habitat shift suggests there may be relatively little variation in forb cover across the Alberta range of sage-grouse and that mesic sites that would provide enhanced forb cover are limited (Aldridge and Brigham 2002). This lack of moist areas for foraging by broods may contribute to low chick survival and poor recruitment in Alberta (Aldridge 2000a), particularly if broods use riskier habitats (as above) to fulfill their dietary requirements (Aldridge and Boyce 2007).

During the summer, habitat use of males and females without broods tends to be similar to that of brooding females (Patterson 1952), and they may move to mesic areas early in the summer (Patterson 1952; Dalke *et al.* 1963; Gregg *et al.* 1993).

2.2.4 Overwintering

During winter, sage-grouse feed almost exclusively on sagebrush plants (leaves) that remain above the snow cover (Patterson 1952) and use the plants for thermal and protective cover (Connelly *et al.* 2004). Wintering habitat for sage-grouse in Alberta typically overlaps or is adjacent to sagebrush habitats used during the summer (Carpenter *et al.* 2010). Alberta sage-grouse select large patches of dense sagebrush cover and less rugged areas, but avoid these areas

to varying degrees (up to 1 900 m) if they occur near anthropogenic features (wellsites, edge habitat created by anthropogenic developments, and trails) (Carpenter *et al.* 2010). Use of dense sagebrush cover and less-rugged or gently sloping landscapes during winter has been observed in other parts of the species' range (Doherty *et al.* 2008). Similar to Alberta, grouse in Montana and Wyoming avoided energy developments during winter and were 1.3 times more likely to occupy sagebrush habitats where coal bed natural gas wells were absent (within a 4 km^2 area), compared to similarly-sized areas with the maximum allowable well density (Doherty *et al.* 2008). Within the larger habitat areas used by sage-grouse in the winter, factors such as topography, snow depth, and exposure of sagebrush above the snow may affect their distribution (Hupp and Braun 1989; Lungle and Pruss 2008). When snow cover (depth) limits accessibility to sagebrush, birds may use taller stands or stands on windswept slopes where sagebrush is exposed above the snow (Ihli *et al.* 1973; Hupp and Braun 1989; Connelly *et al.* 2000; Woodward *et al.* 2011). The quality of snow (e.g., snow pack) may also determine distribution because birds may burrow in snow for thermal protection (Beck 1977; Back *et al.* 1987).

2.3 Population Size and Trends

The distribution of sage-grouse is closely associated with the distribution of sagebrush (Adams *et al.* 2004; Connelly *et al.* 2004). Historically, the Alberta distribution of sage-grouse extended northeast as far as Elkwater and Walsh Flats, north to Empress, west to just north of Brooks, south to Champion, and possibly included Lethbridge (Canadian Sage Grouse Recovery Team 2001; Figure 2). This historical range encompassed an area of approximately 49 000 km^2 (Aldridge 1998a). The current distribution of sage-grouse covers less than 10% of its historical range and is restricted to a 4 000 km^2 area of sagebrush-grassland in the southeastern corner of the province, centered south and east of Manyberries (Aldridge 1998a; Figure 2).

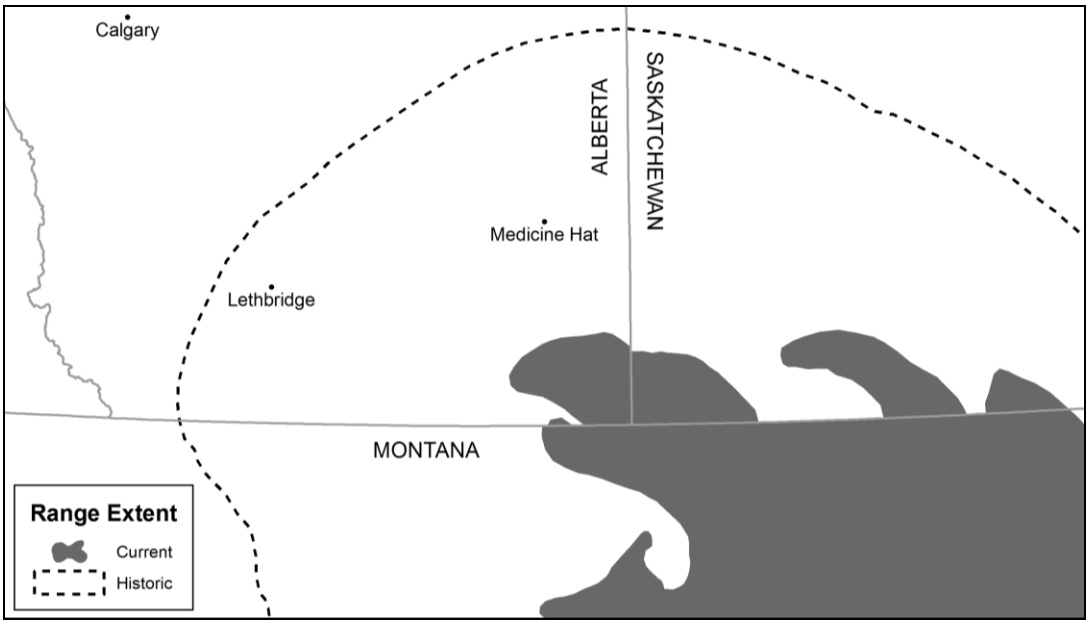

Figure 2. Historical and current range of sage-grouse in Alberta and Saskatchewan.

Population estimates for sage-grouse are based on observations from lek counts that enumerate all male sage-grouse displaying on a lek during the mating season (Beck and Braun 1980). The maximum number of males observed on each lek is used to estimate local population size and assess population trends (Jenni and Hartzler 1978; Beck and Braun 1980; Emmons and Braun 1984; Fedy and Aldridge 2011). In Alberta, lek counts were conducted every two years, on average, between 1968 and 1991 (Aldridge 2000a; Figure 3). However, not all leks were surveyed each year. Beginning in 1994, lek counts have been made annually at all (or most) active and inactive leks (Figure 3). Lek counts between the late-1960s to mid-1900s indicate considerable fluctuation in numbers, from a high of 613 male in 1968 to a low of 70 males in 1994. Since 1994, numbers of males have remained low and have continued to decline, with the lowest counts of 13 males observed in the spring of both 2011 and 2012. This represents a 98% decline since 1968. The number of active leks and average number of males per lek have similarly declined between 1968 and 2012, from 21 to 5 active leks and from 29.2 males per lek to 2.6 males per lek. In 2011, the average number of males per lek was even lower (1.6), given that the 13 males observed were distributed across 8 leks rather than 5 leks. Based on the 2011 and 2012 lek count of males, the size of the Alberta sage-grouse population is well under 100 birds with only 13 males being observed (see population estimate calculations in Aldridge and Brigham 2003). Using population data collected in 1998 and 1999, Aldridge (2000a) estimated that the Alberta population could reach fewer than 100 birds by 2018. Thus, the decline has occurred earlier than predicted.

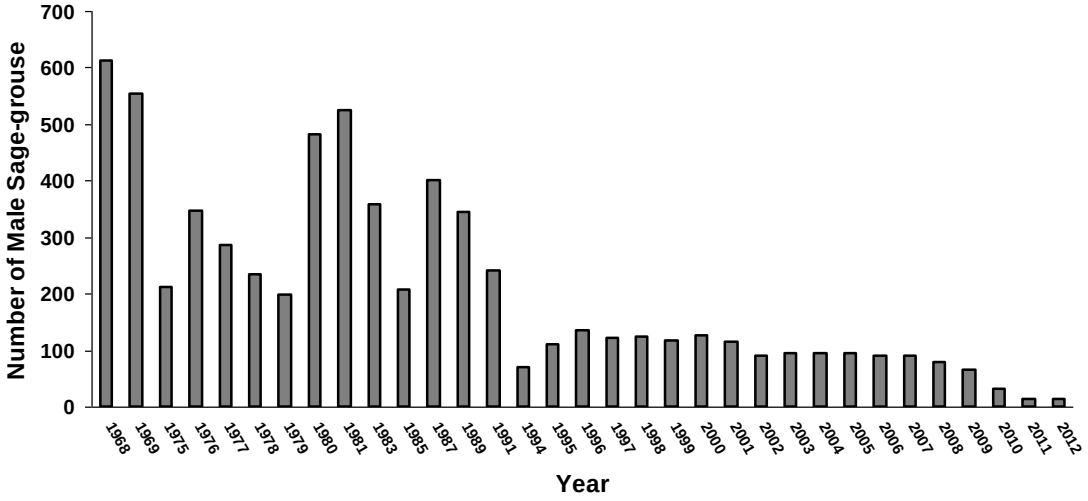

Figure 3. Annual sage-grouse lek surveys 1968–2012.

Recent genetic work has established that Alberta sage-grouse are part of a larger population that includes sage-grouse in Saskatchewan and northern Montana (Bush 2009, Bush *et al.* 2011). Currently there is no evidence for reduced genetic diversity in Alberta sage-grouse despite habitat loss and fragmentation. It is unknown how the current low size of the Alberta population may impact population structure and genetic diversity in the future.

3.0 THREATS AND LIMITING FACTORS

The decline of greater sage-grouse in Alberta likely results from a combination of factors (Connelly *et al.* 2004). The species requires large contiguous blocks of healthy sagebrush habitat to fulfill all of its life history requirements (Braun *et al.* 1977, Connelly *et al.* 2004). Activities that reduce survival or reproduction, or reduce the size, quality, or connectedness of sagebrush habitats are expected to be detrimental to sage-grouse populations (Aldridge and Brigham 2003, Lungle and Pruss 2008). Biological limiting factors as well as several factors that may threaten sage-grouse and its habitat in Alberta are discussed below.

3.1 Biological Limiting Factors

Greater sage-grouse have an obligate relationship with sagebrush, depending on it for food and protective cover during all life-stages and seasons. Sage-grouse require a variety of sagebrush habitats to breed, nest, brood, and overwinter, and there is limited existing habitat within Alberta to fulfill these needs (see Aldridge and Boyce 2007, Carpenter *et al.* 2010). The species is a year-round resident of Alberta, requiring that all seasonal components of its habitat remain available and interconnected within the province.

3.2 Cropland Conversion

Removal of sagebrush-grasslands for agricultural crop production has resulted in widespread habitat loss and fragmentation across sage-grouse range and is a major contributor to the historical decline of this species (Connelly *et al.* 2004). In a 202 km^2 area in Montana, Swenson *et al.* (1987) documented a 73% decline in the number of male sage-grouse between 1954 and 1984. During the same period, 16% of the area (30% of winter habitat) was ploughed. Cultivation of sagebrush-grassland has led to the abandonment of leks in Alberta and Saskatchewan (Dube 1993; Aldridge 1998b; McAdam 2003). McAdam (2003) found that rates of cultivation within 3.2 km of leks in Saskatchewan were much higher at abandoned leks compared to active leks. Sage-grouse may forage in alfalfa or hay fields and occasionally nest in cultivated fields (Patterson 1952), but doing so puts them at risk of being killed or injured by farm implements (Patterson 1952; Aldridge 2000a). In Alberta, hens with broods avoid suitable brood-rearing habitat if it occurs in close proximity to cropland. Further cultivation of the remaining sagebrush-grassland within the current (4 000 km^2) Alberta range is unlikely given that over 75% of the range is public land. However, population isolation could occur through increased cultivation of sagebrush-grassland south of the Alberta–Montana border or in Saskatchewan, although the rate of conversion in Saskatchewan has been low since the 1980s (McAdam 2003; Thorpe *et al.* 2005). At present there is no evidence that Alberta birds are genetically isolated from the birds in Saskatchewan or northern Montana (Bush *et al.* 2011). However, cultivation along the Milk River in Montana may have contributed to the formation of two subpopulations on either side of the river (Bush *et al.* 2011), indicating that cultivation may reduce gene flow.

3.3 Grazing Regime

Most of the current Alberta range of sage-grouse falls within public land allocated for grazing livestock. Grazing animals have the potential to alter the vegetation structure and composition of sagebrush grassland (Adams *et al.* 2004) in ways that could either enhance or degrade its suitability for sage-grouse (Beck and Mitchell 2000; Connelly *et al.* 2004). Livestock (excluding sheep) are not known to consume large quantities of sagebrush (Thorpe and Godwin 1997; Connelly *et al.* 2004), so their effect on vegetation composition and structure relates primarily to the modification of understory grasses and forbs (Connelly *et al.* 2004). Light to moderate livestock grazing regimes can enhance the quantity and quality of summer forage (forbs) for sage-grouse; however, residual cover must be maintained in the spring for nesting sage-grouse (Klebenow 1982; Beck and Mitchell 2000; Adams *et al.* 2004). Sage-grouse require adequate cover of tall grasses and forbs, particularly during nesting and brood-rearing (Wakkinen 1990; Gregg 1991; Gregg *et al.* 1994; Delong *et al.* 1995; Sveum *et al.* 1998a, 1998b; Beck and Mitchell 2000; Watters *et al.* 2002; Hagen *et al.* 2007). This herbaceous vegetation is important for protection of nests from predators and extremes in weather (Aldridge 1998a; Gregg *et al.* 1994; Delong *et al.* 2005; Watters *et al.* 2002), and the forb component of the understory makes up a critical component of the diet of pre-laying hens and chicks (Johnson and Boyce 1990; Barnett and Crawford 1994). Grazing practices that create a degree of patchiness in ground cover may be favourable for sage-grouse because they mimic the historical grazing regime that resulted in a mosaic of lightly, moderately, and heavily grazed areas on the landscape (Thorpe and Godwin 2003; Adams *et al.* 2004).

Generally, current grazing practices that promote range health are consistent with the needs of sage-grouse and the sustainability of the ranching economy (Adams *et al.* 2004). However, overgrazing is considered detrimental for sage-grouse habitat and also compromises range health required for long-term sustainability of livestock grazing (Adams *et al.* 2004). Heavy use by livestock can decrease cover and increase risk of nest predation, increase nest desertion, reduce productivity of hens or survival of broods, or alternatively, increase habitat avoidance or abandonment in heavy use areas (Beck and Mitchell 2000; Patterson 1952; Klebenow 1982; Connelly *et al.* 2004). Heavy livestock use can also make the range more permeable to invasion by exotic species, such as crested wheatgrass (*Agropyron cristatum*), that out-compete native grasses and degrade the area for use by sage-grouse (Ihli *et al.*1973; Connelly 1982). Livestock may also trample sagebrush seedlings and occasionally, nests. Overall, the intensity, timing and duration of grazing needs to be assessed on a case-by-case basis depending on existing range health, terrain, etc. Additionally, climatic considerations, particularly drought conditions, may require alterations of grazing practices (e.g., livestock exclusions or reductions in stocking intensity) to sustain rangeland health (Adams *et al.* 2004) and reduce competition for forage between livestock and sage-grouse (Canadian Sage Grouse Recovery Team 2001).

3.4 Water Management

Periodic flood events are required to sustain the health of silver sagebrush habitats (McNeil and Sawyer 2001, 2003). Impediments that alter the natural flow of water, such as dugouts, dams,

berms, and reservoirs, reduce the amount of available runoff and sedimentation, which compromises the health of silver sagebrush habitats (McNeil and Sawyer 2001, 2003). Between 1951 and 2001, the number of surface water impediments within the Alberta range of sage-grouse increased from 535 to 1890 (McNeil and Sawyer 2003). The total area of sage-grouse range potentially impacted by these impediments increased from 24.4% of the total area in 1951 to 80.7% of the total area in 2001. Hence, most of the area used by sage-grouse drains to impediments and sagebrush habitat has likely been degraded from reduced runoff and sedimentation (McNeil and Sawyer 2003). Water impediments may also reduce the availability of mesic habitats, which provide high-quality summer forage (insects and lush forbs) for chicks (Lungle and Pruss 2008). Mesic habitat is limited in Alberta (Aldridge 2000a), and Aldridge and Boyce (2007) suggest that removal of some impediments might help restore some of these areas. Water impediments may also attract livestock, and heavy use by livestock could degrade surrounding sagebrush habitat (Canadian Sage Grouse Recovery Team 2001; Lungle and Pruss 2008).

3.5 Energy Development

3.5.1. Oil and Gas Development

Petroleum development has been extensive in many parts of southern Alberta. Declines in the Alberta sage-grouse population coincide with periods of increased petroleum development in the late 1970s to early 1980s and also in the 1990s, although it is likely that other factors also contributed to these declines (Braun 1998; Braun *et al.* 2002; Lungle and Pruss 2008). To date, 1 533 wells have been drilled within the Alberta range of sage-grouse; however, only 26.8% are currently active (Table 1). The construction of wells and associated infrastructure results in localized loss of habitat and contributes to anthropogenic edge, which sage-grouse have been shown to avoid (Aldridge and Brigham 2003; Holloran 2005; Aldridge and Boyce 2007). Features such as roads and trails may fragment habitat for sage-grouse, and power lines and other infrastructure may provide perches for predators to hunt sage-grouse (e.g., Pruett *et al.* 2009). Increases in human activity (e.g., vehicle traffic) and noise associated with development may disrupt birds and alter their behaviour and use of habitat (Lyon and Anderson 2003; Holloran 2005; Aldridge and Boyce 2005; Blickley *et al.* 2012).

Table 1. Number and status of natural gas and oil wells within the current Alberta range of sage-grouse[1].

Well Site Status[1, 2]	Number of Well Sites	Percentage of Total Well Sites
Abandoned	170	11.1
Reclamation Certified	617	40.3
Reclamation Exempt	149	9.7
Suspended	186	12.1
Active	411	26.8
TOTAL	**1 533**	

[1] Source: ERCB Compliance and Management Database 2012
[2]Terms are defined in ERCB Directives 6, 13, and 20 at: http://www.ercb.ca/regulations-and-directives/directives

Numerous studies document decreased lek attendance (by males and females) associated with development, sometimes culminating in the abandonment of leks (Walker *et al.* 2007a). Declines in attendance are apparent up to 5 km from leks, but have been detected at much greater

distances (Lyon and Anderson 2003; Holloran 2005; Harju *et al.* 2010). In Alberta, sage-grouse have been observed to select patches of nesting habitat with low proportions of anthropogenic edge and brood-rearing habitat with lower densities of well sites (Aldridge and Boyce 2007). Wintering sage-grouse in Alberta completely avoid suitable habitats that occur within 1 200 m of a well or 100 m of anthropogenic edge and show only limited use of habitat within 1 900 m of a well or 300 m of edge (Carpenter *et al.* 2010). Sage-grouse also avoid wintering habitat that occurs near trails (Carpenter *et al.* 2010). Similar patterns of avoidance have been observed elsewhere in the species' range (Holloran 2005; Doherty *et al.* 2008; Harju *et al.* 2010). Brooding hens and their chicks may use risky habitats, such as trails and well pads, possibly because these areas often contain abundant invasive succulent forbs that attract foraging broods (Aldridge and Boyce 2007). However, survival of birds is likely to be poor in these open areas due to increased risk of road mortality or predation, making these areas attractive population sinks (Aldridge and Boyce 2007).

Ultimately, petroleum development may impact survival and reproduction of birds and may be contributing to population declines. In Wyoming, female sage-grouse that nested in areas disturbed by natural gas development had lower nest initiation rates and initiated fewer nests the following year compared to females nesting in areas undisturbed by development (Lyon and Anderson 2003). In Alberta, estimated chick survival decreased by 1.5 times for each additional well within sight of a nest (Aldridge and Boyce 2007). Sage-grouse are also known to have been killed by flying into power lines or poles or other infrastructure that may be installed with a development (Aldridge 2000a). Avoidance of habitat also may result in decreased survival or reproduction if, for example, birds are displaced to marginal habitats (Holloran 2005; Naugle *et al.* 2011).

3.5.2. Wind Energy Development

Wind energy development represents a potential emerging threat to sage-grouse in Alberta, Currently, there are no wind energy developments within the Alberta range of sage-grouse, and no provincial policy enabling their development on public lands within the province (K. Redden, pers. comm.). The *Wildlife Guidelines for Alberta Wind Energy Projects* indicate that these developments should be avoided in important habitats for endangered wildlife (Alberta Sustainable Resource Development [ASRD] 2011a). Setback and timing restrictions for all types of industrial developments near sage-grouse habitat specify that any development should occur farther than 3.2 km from leks and 1 km from sage-grouse habitat (ASRD 2011b) and are subject to specific mitigation depending on the infrastructure involved. The United States Fish and Wildlife Service (2012) suggests these developments could have adverse impacts on grouse at distances of three to five miles (or more) from active leks (Holloran 2005; Connelly et al. 2000). Grouse species have been shown to avoid wind energy development, possibly because associated transmission lines provide perches for raptors (Pruett *et al.* 2009).

3.6 Natural Disturbances and Climate

Observations from Alberta have shown that sage-grouse are highly susceptible to natural disturbances such as weather events and climatic cycles (C. Aldridge, pers. comm.). Spring snowstorms and flooding from severe rainstorms have caused nest failure and abandonment, and hailstorms have resulted in direct mortality of grouse (C. Aldridge, pers. comm.). In northern Montana, severe winter weather conditions have been associated with high overwinter mortality (Moynahan *et al.* 2006).

Drought conditions can reduce reproductive success and survival through minimal vegetative cover for nest concealment and hiding cover and reduced availability of forbs and insects important in the diet of pre-laying hens and chicks (Hanf *et al.* 1994; Fischer *et al.* 1996; Aldridge 2005; Holloran 2005). Drought may further reduce wet meadow/mesic habitat in Alberta that is already limited (Aldridge 2000a, 2005) but that is important for providing forage (i.e., forbs) for chicks. Drought conditions also may exacerbate the impact of other limiting factors, such as causing livestock to congregate in mesic areas or around water impoundments. Heavy livestock use in these areas could degrade sagebrush habitat and result in sage-grouse competing with livestock for forage (Madsen 1995, Aldridge 2005).

Conversely, above-average spring precipitation has been associated with increased sage-grouse nest and brood success (Gill 1966; Aldridge 2000a, 2005) and overall chick survival (Aldridge 2005; Holloran 2005).

3.7 Predation

Common predators of sage-grouse include great-horned owls (*Bubo virginianus*) (G. Court, pers. comm.), eagles, hawks, ravens (*Corvus corax*), coyotes (*Canis latrans*), and badgers (*Taxidea taxus*) (Patterson 1952; Autenrieth 1981; Schroeder *et al.* 1999). Common nest predators include coyotes, badgers, American crows (*Corvus brachyrhynchos*), black-billed magpies (*Pica pica*), ravens, raccoons (*Procyon lotor*), skunks (*Mephitis mephitis*), weasels, and foxes (Patterson 1952; Autenrieth 1981; Aldridge 1998a; Schroeder *et al.* 1999; Michener 2005). Within intact sagebrush-grasslands, predation is not considered to be a major limiting factor of sage-grouse populations (Braun 1998; Connelly *et al.* 2004). However, habitat alterations may intensify the impact predators exert on sage-grouse populations if they increase predator abundance or modify diversity, reduce availability of protective cover, or if the alterations increase associated features that facilitate predator foraging. Examples of the latter include fence lines or power lines that provide raptor perches, or roads or other anthropogenic edges that facilitate mammalian predator travel (Braun 1998; Connelly *et al.* 2004; Pruett *et al.* 2009). Coyotes, red foxes (*Vulpes vulpes*), and raccoons have increased across the Canadian prairies (Vriend and Gudmundson 1996; Aldridge 1998a), and common ravens, once absent from the Canadian prairies for many years, are increasing in numbers (D. Eslinger, pers. comm.). Increasing numbers of these common predators may contribute to declines in sage-grouse numbers.

3.8 Disease

Of the wide variety of parasites and diseases that affect sage-grouse, West Nile virus (WNv) has the greatest potential to exert population-level effects and impact species' recovery (Connelly *et al.* 2004). The virus was first documented in 2003 in four populations of sage-grouse in Alberta, Montana, and Wyoming, where it was associated with an estimated 25% decrease in late-summer survival of females compared to pre-WNv survival rates (Naugle *et al.* 2004). At one area along the Wyoming and Montana border, late summer survival of females was only 20% at one site where WNv was detected, compared to 76% at two sites where WNv was not detected (Walker *et al.* 2004); further, both male and female lek attendance declined dramatically at the WNv site the following spring (2004).

In 2004 across 12 monitoring sites in Canada and the U.S, female survival was 10% lower at four sites where WNv mortalities had been confirmed, compared to eight other sites where WNv mortalities had not been detected (Naugle *et al.* 2005). However, the impact of WNv on sage-grouse is dependant on mosquito production, which varies with summer weather conditions (Walker *et al.* 2007b). Lower temperatures in 2004 may have reduced or delayed productivity of mosquitoes that transmit the virus to birds (Naugle *et al.* 2005). Sage-grouse appear to be highly susceptible to the virus once infected (Clark *et al.* 2006), and there is little evidence that sage-grouse are resistant to the disease (Walker *et al.* 2007b). In Wyoming, only 10% of tested birds had antibodies to the virus, indicating they had survived exposure to the virus (Walker *et al.* 2007b). Given the high susceptibility and low resistance of birds to WNv, small and fragmented populations are particularly at risk (Naugle *et al.* 2004). Climate change might enhance WNv transmission to sage-grouse by causing mosquitoes to infect birds earlier in the summer or by driving birds to move to wetter areas where mosquitoes breed (Naugle *et al.* 2004; Zou *et al.* 2007; Schrag *et al.* 2011). Anthropogenic developments or activities that increase the amount of standing water (e.g., coal bed methane, livestock watering) could provide additional breeding sites for mosquitoes carrying the virus (Walker *et al.* 2007b).

3.9 Recreational Activities

The prominent breeding displays of males at lek sites generate considerable interest from birdwatchers, naturalists, ecotourists, and nature photographers. Unfortunately, this interest may result in disturbance of birds. Aldridge (2000a) observed that birds disturbed at lek sites will not return until the next day. Repeated disturbance of birds could reduce breeding success and potentially result in abandonment of lek sites (Aldridge and Brigham 2003). Given the small size of the Alberta population and the sensitivity of birds to disturbance, the locations of leks are not provided to the public, and a moratorium on visits to leks has been proposed to reduce human disturbance at these sites until the population recovers (Lungle and Pruss 2008).

Hunting of sage-grouse was permitted in Alberta until 1995, but it is unlikely to be associated with the historical or recent decline of this species in the province. Harvest opportunity was limited to a short season and possession limits were small (Canadian Sage Grouse Recovery Team 2001; Lungle and Pruss 2008). The sage-grouse population in Saskatchewan has not been hunted since 1938, but it has exhibited a similar decline as witnessed in Alberta, suggesting that factors other than hunting have contributed to these declines.

3.10 Other Human Disturbance/Activity

Sage-grouse may be killed on roads (Patterson 1952) and often collide with fences in sagebrush habitat (Christiansen 2009). Mortality rates of birds from collisions with fences may be underestimated if birds are not recovered before being scavenged or if they survive long enough to move away from the fence line (Wolfe *et al.* 2007). In a study in Wyoming, sage-grouse accounted for 86% (n=170) of bird strikes/mortalities recorded along a 7.6 km section of fence line (Christiansen 2009). Marking portions of the fence line using various types of specialized markers reduced sage-grouse mortality by 61% (Christianson 2009).

Invasion of exotic plants can compete with native plant species and potentially degrade sage-grouse habitat. For example, sage-grouse abundance is low in sagebrush habitat where crested wheatgrass is the dominant non-native understory vegetation (Ihli *et al.* 1973; Connelly 1982). Invasion of exotic plants is often associated with human activities such as road construction, industrial development, livestock feeding, and cultivation.

Although the use of pesticides has caused mortality of sage-grouse in other jurisdictions (e.g., Blus *et al.* 1989), these products are not widely used within the Alberta range of sage-grouse and are unlikely to represent a significant threat to sage-grouse.

4.0 CRITICAL HABITAT

Critical habitat is defined in the federal *Species at Risk Act* (2002) as "the habitat that is necessary for the survival or recovery of a listed wildlife species". The inaugural Alberta recovery plan for sage-grouse did not identify critical habitat, pending the results of several studies aimed at delineating this habitat (Alberta Sage Grouse Recovery Action Group 2005). However, it noted that leks are important habitat for sage-grouse and that existing land use management tools (e.g., industrial setback distances and timing restrictions) should be used to help ensure that these areas are not compromised pending a formal designation of critical habitat (Alberta Sage Grouse Recovery Action Group 2005).

An explicit identification of sage-grouse critical habitat across the Canadian range is also absent from both federal recovery strategies (2001 and 2008), but a partial identification was subsequently provided in 2009 as an addendum to the 2008 federal strategy (Lungle and Pruss 2009). This listing of critical habitat (approximately 165 km^2) included all habitat identified as "source" habitat in Alberta for nesting and brood rearing (Aldridge 2005; Aldridge and Boyce 2007), as well as all leks in Alberta (n = 18) and Saskatchewan (n = 11) considered active (defined as leks where at least one displaying male has been observed since 2000). Importantly, the critical habitat identified in this addendum was considered to be a "necessary, but not sufficient" delineation of habitat required for the species' survival and recovery in Canada (Lungle and Pruss 2009). It was noted that additional work is needed for a comprehensive identification of the species' habitat requirements necessary to meet the conservation and recovery objectives outlined in the federal strategy (Lungle and Pruss 2009). More recently, a

revised model of critical habitat for sage-grouse in Canada has been proposed (Parks Canada Agency unpublished data December 2010; Figure 4, below) that includes 2 934 km^2 of habitat in Canada, of which approximately 1 571 km^2 occurs within Alberta. Similar to earlier work (Aldridge 2005; Aldridge and Boyce 2007), the model includes habitat that would be considered source habitat for nesting, brooding, and wintering sage-grouse. Breeding habitat (leks) is not included in this model but still represents critical habitat as identified by Lungle and Pruss (2009). Most active lek sites within Alberta (ca. 75%) falls within the area specified by the model (D. Gummer, pers. comm.), but a small number remain outside the boundaries of the identified habitat.

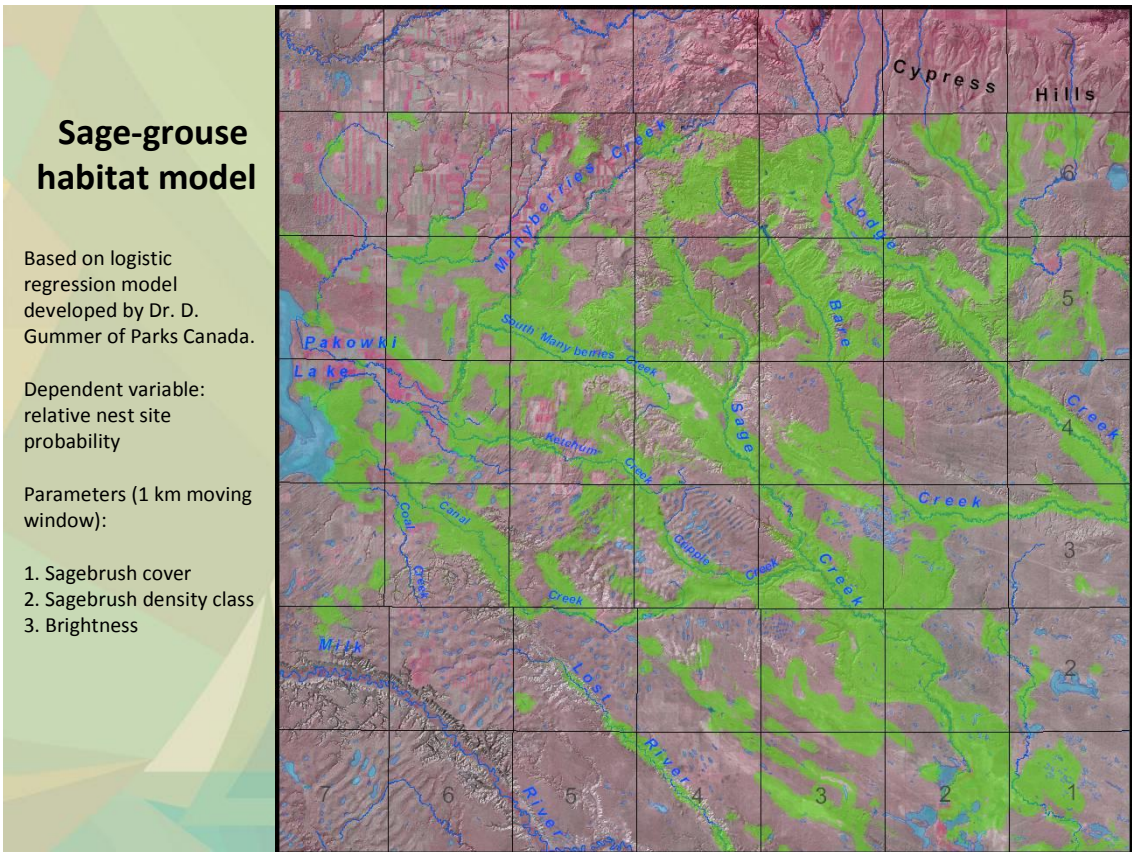

Figure 4. Proposed critical habitat for sage-grouse nesting, brood-rearing and winter survival in southeastern Alberta (Parks Canada Agency unpublished data 2010).

The proposed model of critical habitat for nesting, brooding, and wintering has been consolidated with information on the location and extent of known breeding habitat (lek sites) and used to guide habitat conservation and management within Alberta. The Parks Canada model has been used internally by the Government of Alberta to develop a land management tool that identifies "Conservation and Development Zones" to manage surface land use within the range of sage-grouse. Each identified zone is linked to land use goals that identify its importance to sage-grouse (and other native species) and its potential for industrial access and priority for habitat reclamation. The intent of this approach is to facilitate limited continued resource utilization, where possible, and promote long-term conservation and remediation of sage-grouse

habitat. Importantly, this approach has been reviewed and endorsed by petroleum industry stakeholders within the range of sage-grouse in Alberta (D. Eslinger, pers. comm., K. Redden, pers. comm.).

Critical habitat is officially identified under the Species at Risk Act by posting the final version of the critical habitat, usually in a Recovery Strategy or Action Plan, on the SARA Registry. The critical habitat may be revised in subsequent recovery documents. Current information on the critical habitat for this species is available on the SARA registry <www.sararegistry.gc.ca>.

5.0 KNOWLEDGE GAPS AND RESEARCH PRIORITIES

The *Alberta Greater Sage-Grouse Recovery Plan 2005-2010* presented a prioritized list of research topics related to sage-grouse ecology and habitat based on the deficiency of available information associated with each topic and the urgency of having the information for management (Table 2). In addition to these topics, it was also noted that research should be conducted on potential areas for reclamation. All of the highest priority research topics identified in the inaugural recovery plan and several of the lower priority topics have been investigated either within Alberta or elsewhere in this species' North American range since 2005 (Table 2).

Table 2. Prioritized research topics from the inaugural Alberta recovery plan and studies undertaken to investigate them since 2005.

Research Priority	Research Related to Sage-grouse in Alberta
Priority 1	
Epidemiology of West Nile virus	Naugle *et al.* 2005; Clark *et al.* 2006; Walker *et al.* 2007b; Zou *et al.* 2007; Schrag *et al.* 2011
Ecology of silver sagebrush	Jones *et al.* 2005; Hickman 2010
Viability of population	Aldridge 2005; Aldridge and Boyce 2007
Priority 2	
Disturbance effects	Aldridge 2005; Holloran 2005; Aldridge and Boyce 2007; Walker *et al.* 2007a; So 2008; Pruett *et al.* 2009; Carpenter *et al.* 2010; Harju *et al.* 2010; Naugle *et al.* 2011; Blickley *et al.* 2012
Core habitat	Parks Canada Agency unpubl. data, December 2010
Extent of range	Parks Canada Agency unpubl. data, December 2010
Socioeconomic impacts	
Priority 3	
Genetic diversity	Bush 2009; Bush *et al.* 2010; Bush *et al.* 2011
Priority 4	
Predation effects	
Grazing management	
Water management	
Soil-borne disease	
Climate change	Schrag *et al.* 2011
Cultivation in Montana	

Priority 1: high management urgency (MU), high deficiency in available information (AI); Priority 2: high MU, less deficiency in AI; Priority 3: low MU, high deficiency in AI; Priority 4: low MU, less deficiency in AI.

Of the items identified in Table 2 that still require investigation, priority should be given to the following research areas:

- Factors limiting survival, productivity (e.g., nest success and chick survival), and recruitment, with particular attention placed on predation of nests and chicks and the contribution of water impoundments to availability of critical forage (forbs) for chicks;
- Composition of predators within the Alberta range of sage-grouse and mechanisms of control or habitat modification to reduce predation risk; and
- Connectivity of sagebrush habitat between Alberta and Montana to prioritize areas for conservation or management (e.g., intervention or reclamation); the ultimate goal would be to enhance the potential for interaction between sage-grouse in Alberta and core sage-grouse populations in Montana.

Other studies to support the recovery of sage-grouse should:

- Investigate the response of the sage-grouse population to habitat restoration and reclamation activities, with particular attention focused on reclamation of industrial developments, restoration of agricultural lands, and modification or removal of water management developments. This information should be used to adaptively manage sagebrush habitat;
- Evaluate the effectiveness of the translocation program at enhancing the Alberta sage-grouse population. This evaluation is expected to be conducted by university researchers and will include an examination of health of translocated birds (including WNv exposure), demographics (e.g., nest initiation, nest success, fledging success, and survival), seasonal movements, and habitat use in relation to sagebrush habitat and anthropogenic developments;
- Evaluate whether or not the Conservation and Development Zone approach is an effective tool for managing industrial development on public lands in a manner that positively contributes to sage-grouse habitat restoration and sage-grouse recovery; and
- Evaluate the effectiveness of conservation offset programs that identify opportunities for reclamation and restoration of sage-grouse habitat on private and public lands. Key to the success of conservation offset programs is endorsement and cooperation by both industry and landowners.

6.0 RECENT RECOVERY AND CONSERVATION EFFORTS

The *Alberta Greater Sage Grouse Recovery Plan 2005-2010* outlined recovery strategies and actions necessary to recover greater sage-grouse in Alberta. Many of the recovery actions were implemented, but several were not completed due to insufficient staff and financial resources, or are still ongoing. Key actions and research that have been completed or are ongoing are described below.

6.1 Ongoing Research and Recovery Initiatives

- Annual lek surveys to monitor population size and trends;
- Initiation of a pilot program to translocate 40 birds from northern Montana in spring 2011 and 2012, with the intent to translocate additional birds in the subsequent three years, pending results of the pilot program. In 2011, two of the nine translocated female sage-grouse initiated nests and one nest hatched. Preliminary results for birds translocated in spring 2012 indicate that 11 females initiated nests, but again, only one nest hatched. Levels of nest depredation were very high. Additionally, a number of translocated bird were killed by predators (Smits *et al.* 2012). Research will continue to evaluate the success of current and future translocated birds;
- Successful implementation of the MULTISAR program in southeastern Alberta. This program promotes range health on native range, restoration of cultivated lands to sagebrush-grassland habitat, and education regarding sage-grouse and its conservation needs. In Alberta, the MULTSAR program has worked with landholders on 17 properties encompassing 116 950 acres within the Milk River Watershed since 2007. Approximately 70 000 acres are managed for sage-grouse (Rumbolt *et al.* 2011), including approximately 37 000 acres of sage-grouse critical habitat. MULTISAR participants have completed 53 enhancements to improve wildlife habitat for species at risk including the restoration of native grasslands on 1 390 acres (B. Downey, pers. comm.);
- Initiation of a research project to (1) review types and impacts of energy development on sage-grouse (So 2008); (2) review land use guidelines across the species' range; and (3) evaluate Alberta's land use guidelines with recommendations on potential updates (J. So, pers. comm.);
- Ongoing development of conservation offset programs that identify opportunities for reclamation on private and public lands within the range of sage-grouse; and
- Initiation of a research project to investigate the potential relationship between sage-grouse dynamics (e.g., lek persistence) and the temporal and spatial changes of development in southeastern Alberta (S. Dalton, pers. comm.).

6.2 Completed Research and Recovery Initiatives

- Protection of all known active and inactive leks via 30 acre protective notations (PNTs); PNTs restrict industrial surface access and development;
- Research on nesting and brooding habitat use, as well as predicted population viability of the Alberta sage-grouse population in relation to characteristics of sagebrush habitat and anthropogenic development on the landscape (Aldridge 2005; Aldridge and Boyce 2007);
- Distribution and promotion of beneficial management practices for livestock grazing in sagebrush-steppe habitat (Adams *et al.* 2004);

- A silver sagebrush density and distribution mapping project (Jones *et al.* 2005) was completed and used in the development of the critical habitat model for nesting, brooding, and wintering sage-grouse (Parks Canada Agency unpublished data December 2010);
- Development of an ALCES® model (Forem Technologies Ltd. 2004) that estimates declines in the industrial footprint within sage-grouse range over the next 50 years (Chernoff 2008);
- Addition (by Alberta Energy) of subsurface addenda to all new subsurface mineral sales within sage-grouse habitat. This provides up-front information to industry prior to mineral sales regarding surface access limitations required for sage-grouse habitat protection;
- The *Draft Land Use Standards to Achieve Sage Grouse Recovery and Conservation* (ASRD 2009) were completed, which specify timing and setback guidelines for various types of activities associated with agricultural or industrial developments based on current scientific literature;
- Development of a land management tool ("Conservation and Development (C & D) Zones") to integrate sage-grouse habitat protection into surface land use decisions (see Critical Habitat). The C & D Zone approach is being cooperatively utilized at the field level to guide operational decisions in relation to activities of the local petroleum industry;
- Implementation of the province-wide Enhanced Approval Process for surface industrial applications. New applications for surface development require consultation with ESRD if they occur within 3.2 km of a lek or 1 000 m of sage-grouse habitat and may require additional mitigation (timing and setbacks) outlined in the *Draft Land Use Standards to Achieve Sage-grouse Recovery and Conservation* (ASRD 2009);
- Establishment of a protective notation covering the 42 townships that comprise the current range of sage-grouse. This notation prohibits public land sales and flags possible restrictions for surface access on all new surface dispositions (developments). New dispositions are subject to negotiations using C & D Zones and updated land use standards;
- Research that evaluated sagebrush community response to past wellsite and pipeline reclamation efforts has been completed; this information will be used to develop best management practices for future reclamation in sagebrush habitats (Hickman 2010);
- An investigation of potential barriers to sage-grouse conservation and recovery associated with government legislation, policy, and organizational structure (Cook 2010);
- Research on winter habitat use of Alberta sage-grouse in relation to characteristics of sagebrush habitat and anthropogenic development on the landscape (Carpenter *et al.* 2010);
- Completion of a number of sage-grouse habitat securement, acquisition, and enhancement projects by non-government organizations including Alberta Conservation Association, Pheasants Forever, Medicine Hat/Alberta Fish and Game Association, Nature Conservancy of Canada, and their partners. These projects have included purchase of habitat lands, purchase of conservation easements, removal of old building sites and rubbish, removal or modification of fences to be more wildlife friendly, and restoration of marginal annual cropland to native grasslands. One conservation easement has been completed covering 5 425 acres. Additionally, 2 889 acres have been purchased and are under management to promote conservation of sage-grouse and other wildlife;

- Development of a translocation protocol for sage-grouse augmentation (Suitor *et al.* 2010);
- Completion of genetics work to examine population structure and diversity of the Alberta sage-grouse population (Bush *et al.* 2011); and
- Alberta is signatory to three Memoranda of Understandings (MOU's) that facilitate inter-jurisdictional cooperation and coordination of conservation of trans-boundary species and habitats, including sage-grouse and sagebrush habitat. These MOU's include the Northern Sagebrush Steppe Initiative, Western States Association of Fish and Wildlife Agencies Sage-grouse Comprehensive Conservation Strategy, and Western Governors' Association Wildlife Corridors Initiative.

7.0 RECOVERY STRATEGY

7.1 Biological and Technical Feasibility of Recovery

The recovery team believes that recovery of sage-grouse is possible and will be facilitated by the following:

- There is remaining habitat to support sage-grouse at increased population levels;
- There is significant technical information (e.g., sage-grouse habitat use, grazing history of southeastern Alberta, sagebrush ecology and restoration) available from recent research projects to define management actions that will aid in recovery;
- There is interest from many in the local community to participate in sage-grouse recovery;
- Petroleum industry representatives have expressed a commitment to sage-grouse recovery; and
- Numerous government agencies, academic institutions and conservation groups are working towards sage-grouse habitat conservation and population recovery.

The current Alberta population of sage-grouse is likely too small to increase on its own to a size necessary to support recovery of the species. For this reason, the translocation of sage-grouse to Alberta was initiated in the spring of 2011 to augment the breeding population. As discussed above, formal evaluation of the effectiveness of translocations is a priority and will continue. The degree of immigration (natural population augmentation) of birds from neighbouring populations is not known, but evidence of genetic diversity in the Alberta population suggests that gene flow is occurring (Bush 2009; Bush *et al.* 2011).

Several of the identified threats can be mitigated to protect and enhance habitat available to sage-grouse, thereby increasing the species' likelihood of recovery. For example, sustainable grazing practices can conserve habitat for sage-grouse and at the same time contribute to the local grazing economy. Reclamation of inactive industrial developments can restore these areas for potential use by sage-grouse. Reductions in infrastructure associated with active developments

(e.g., burying power lines) may reduce the impact of that infrastructure on sage-grouse. Additionally, there is increasing need for cooperation among governmental agencies and departments to consider the needs of sage-grouse in land use decisions. Cook (2010) stressed the importance of enhanced cooperation and coordination among agencies in facilitating conservation and recovery actions for sage-grouse in Alberta. Examples of enhanced coordination include:

- Alberta Energy worked with ESRD to implement the notification of restricted surface access for new subsurface mineral sales activities; this serves to reduce disturbance to critical habitat and/or the range of sage-grouse;
- Divisions within ESRD cooperated to apply a protective notation to sage-grouse range that may impact surface access to new dispositions; and
- "Conservation and Development Zones" have been developed by ESRD and the University of Calgary, in consultation with industry, to coordinate industrial development and sage-grouse habitat conservation (see Critical Habitat).

Cook (2010) also suggested that sage-grouse conservation and recovery would be facilitated by developing provincial legislation that would protect wildlife habitat for *Endangered* and *Threatened* species, and by incorporating needs of sage-grouse in regional plans. The Conservation and Development Zone approach to surface land use planning within sage-grouse range provides a method for protecting critical habitat for sage-grouse. Regional resource management plans (specifically the South Saskatchewan Regional Plan) are being developed as part of the new Alberta Land Use Framework (LUF). Such planning exercises provide opportunities for integration of sage-grouse recovery goals directly into management plans, potentially reducing the cumulative impact of multiple resource developments on the species.

7.2 Guiding Principles

The conservation and management of greater sage-grouse in Alberta will be guided by the following principles:

- Recovery of greater sage-grouse is possible and desirable;
- Further loss of habitat and individuals due to anthropogenic developments is unacceptable and preventable;
- This recovery plan is based on the assumption that all stakeholders within sage-grouse range, including all affected branches of government, share responsibility for sage-grouse recovery. Commitment and action by all of these parties will be necessary to achieve recovery;
- A cooperative partnership approach to recovery that involves landowners, lessees, industry and other agencies is essential. This approach includes shared stewardship, compatible land use, local commitment to management initiatives, and development of collaborative partnerships;

- This plan recognizes that humans will continue to engage in activities that contribute to the economy in areas where sage-grouse occur. The Plan will therefore strive to identify effective and feasible recovery strategies;
- The recovery process will be based on the latest available science and be guided by the concept of adaptive management, whereby specific actions are implemented, evaluated, and revised, as necessary, to improve the outcome; and
- Lack of information or scientific certainty should not impede implementation of actions believed to be necessary to achieve the goals of this recovery plan.

7.3 Recovery Goals

The *Alberta Greater Sage-Grouse Recovery Plan 2005–2010* identified two main goals for recovery:

1. Enhance and maintain habitat for sage-grouse to satisfy life-cycle requirements in support of a viable population within its remaining historical range.

2. Achieve recovery of the sage-grouse population to a level that provides for sustainable recreational viewing and hunting.

Given continued declines in the sage-grouse population to extremely low levels, these goals are now considered long-term goals. Immediate, specific steps must be taken to prevent extirpation of this species. These steps are captured under short-term goals that are meant to provide immediate guidance to wildlife managers and other stakeholders, and are also steps that will support the long-term recovery goals.

Short-term goals to prevent extirpation of sage-grouse from Alberta are as follows:

1. Restore, and prevent further loss of, identified critical habitat in Alberta through immediate implementation of updated land use standards, Conservation and Development Zones, and enhanced land stewardship.

2. Increase suitable habitat available for sage-grouse through accelerated reclamation of industrial developments and restoration of marginal annual cropland.

3. Reverse population decline in Alberta through population augmentation, predator management, and habitat remediation.. By 2018, the Alberta population will show a positive trend in the number of strutting males at leks and the number of active leks.

7.4 Recovery Objectives

Long-term goals 1 and 2 are supported by the following objectives:

- Protect critical breeding, nesting, brood-rearing, and wintering habitat for sage-grouse;

- Enhance nesting, brood-rearing, and wintering habitat;
- Restore and enhance habitat quality on both public and private lands through appropriate range management practices and industrial reclamation;
- Modify daily operational activities of the energy industry to be more compatible with sage-grouse recovery;
- Manage and mitigate impacts of resource development on habitat used by sage-grouse during all life cycle stages;
- Create recreational viewing opportunities when the species reaches sustainable population levels; and
- Restore hunting opportunity when the species is de-listed.

Short-term goals 1, 2 and 3 are supported by the following objectives:

- Manage and mitigate the footprint of industry and foster good stewardship in industrial planning and development to conserve, restore, and maintain sage-grouse habitat;
- Ensure that land use standards are implemented by industrial developers during development;
- Disseminate information on the effects of industrial activities and agricultural practices. Promote stewardship activities to mitigate these effects;
- Provide a framework to encourage reclamation of abandoned oil and gas facilities in important sage-grouse habitat;
- Provide incentives for conversion of annual cropland into native grassland in key habitat areas;
- Work collaboratively with non-government conservation organizations to facilitate the conservation and enhancement of sage-grouse habitat;
- Promote population recovery through translocation of sage-grouse from northern Montana using established translocation protocols, and monitor the effectiveness of the translocation program;
- Develop methods for captive breeding sage-grouse for subsequent release into the wild as another tool for population augmentation;
- Assess predator composition and populations within the range of sage-grouse and develop and implement strategies to reduce predation on sage-grouse;
- Maintain the moratorium on viewing sage-grouse at lek sites to limit disturbance; and
- Maintain the moratorium on hunting while the population is recovering.

7.5 Strategies for Recovery

Livestock, grazing, and oil and gas extraction are the most common land uses in sage-grouse habitat, and, as such, it is important to focus recovery on activities that will minimize impacts resulting from these industries. To this end, best practices for sage-grouse management must be communicated to those organizations and individuals who make management decisions in those industries. Strategies for reaching the recovery goals include the following:

Habitat Conservation and Management: all actions related to maintaining, conserving, and restoring habitat for sage-grouse. This includes refining BMPs; encouraging rangeland stewardship to enhance the quality of sage-grouse habitat; evaluating new industrial developments with the best available land use mitigation tools; integrating sage-grouse habitat requirements into regional plans; and continuing to support non-government conservation initiatives such as land securement and stewardship programs.

Population Management and Enhancement: all actions related to increasing the survival and productivity of sage-grouse. These may include monitoring population size, distribution, and trends; population augmentation through translocation and/or captive breeding; preventing human disturbance at leks; predation management; and disease documentation.

Research: Undertake applied research studies that will both inform the recovery process for sage-grouse and monitor the effectiveness of recovery actions.

Information and Outreach: actions related to communicating information about sage-grouse and their management to land managers, industry, recreational users, other stakeholders, and the public for the purpose of fostering stewardship and increasing awareness of the species and its habitat.

Plan Management and Administration: activities related to the operation of the Alberta greater sage-grouse recovery team and liason with other provincial, national, and international sage-grouse recovery initiatives.

Resource Acquisition: actions related to securing funding and other resources required to deliver identified actions in this Plan.

8.0 ACTION PLAN

8.1 Habitat Conservation and Management

1. Conduct impact assessments of anthropogenic disturbance influencing all known lek sites to determine habitat viability.
2. Conduct surveys for new lek sites every 3 to 5 years once a positive population trend is established.

3. Establish (for new leks) or maintain (existing leks) protective notations to cover a minimum radius of 3.2 km (Connelly *et al.* 2000) around all known lek sites regardless of whether they are active or not.
4. Maintain the protective notation covering the range of sage-grouse in Alberta (42 townships) to inform new surface sale dispositions.
5. Maintain the protection notation covering the range of sage-grouse in Alberta (42 townships) requiring mitigation on existing surface disposition agreements.
6. In consultation with agriculture and industry, periodically review and update land use guidelines on disturbance management.
7. Use the Conservation and Development Zone approach as a tool under the single regulator process to evaluate all industrial developments proposed within the range of sage-grouse.
8. Encourage Alberta Energy to maintain subsurface addenda on all new mineral sales. This is an administrative tool used to flag restrictions like surface access in environmentally sensitive areas such as the sage-grouse range and allows the petroleum industry to be advised of restrictions at the time of mineral sales.
9. Prioritize and schedule reclamation of industrial sites and develop best management practices for reclamation. .
10. Implement reclamation at prioritized sites, following identified best management practices.
11. Through range health assessment workshops and the MULTISAR program, further inform ranchers on recognizing key habitat types that support sage-grouse during various life cycle stages.
12. Encourage landowners to investigate and collaborate with programs such as MULTISAR; such programs help landowners steward their lands in ways that maintain the long-term profitability of their operations while contributing to species at risk conservation and recovery.
13. Measure range health scores at certain sites at repeated intervals of three to five years. The target for range health scores would be 75% or higher on 36 sage-grouse monitoring sites and 75% or higher on 100% of measured leases over five years (those leases subject to periodic renewal inspections during the sage-grouse monitoring cycle) (Adams *et al.* 2004).
14. Identify sites where grazing disturbance is not optimal and encourage lessees or landowners to enhance plant community structure on sites.
15. Promote stocking rates and rotational grazing practices that improve the quality of sage-grouse habitat.
16. Through the MULTISAR program, provide incentives to landowners and lessees for appropriate land management.
17. Restore cultivated lands using conservation offset programs that provide incentives for landowners.
18. Inventory human use (e.g., vehicle counts along roads) in key habitat areas.
19. Remove anthropogenic structures (e.g., old buildings, raptor nesting platforms, etc.) that provide artificial habitat and refugia for predators of sage-grouse.

20. Investigate the feasibility of decommissioning, burying, or moving power lines out of sage-grouse habitat.
21. Bury or decommission power lines at high-risk sites.
22. Investigate the feasibility of decommissioning gravel pits that are in or adjacent to sage-grouse habitat.
23. Support non-government habitat conservation initiatives within sage-grouse range by assisting with resource acquisition and technical support.
24. Assess how well the Conservation and Development Zones approach manages industrial development within sage-grouse range in Alberta.
25. Evaluate how well conservation offset programs with industry and landowners enhance habitat for sage-grouse.
26. Coordinate with the Land Use Framework process to ensure that needs of sage-grouse are incorporated into the South Saskatchewan Regional Plan.

8.2 Population Management and Enhancement

1. Continue annual counts at lek sites.
2. Translocate up to 40 sage-grouse females from Montana (pending approval) to Alberta each spring using established protocols. If deemed necessary, translocate males to the population to increase breeding potential.
3. Opportunistically monitor disease prevalence in birds (e.g., WNv) by testing birds found deceased.
4. Implement predator control strategies once appropriate control mechanisms are identified in order to increase survival and nest success.
5. Maintain moratorium on viewing until population recovers to sustainable levels.
6. Maintain the hunting ban until the population has recovered to a point deemed robust enough to withstand a sustainable harvest.
7. Work with the Calgary Zoo Centre for Conservation Research to establish an experimental captive-rearing program for population augmentation purposes. Captive rearing could be initiated under certain conditions as prescribed by Brichieri-Columbi and Moehrenschlager (2012).
8. Evaluate the effectiveness of the translocation program in augmenting the sage-grouse population in Alberta.
9. Provide direction and support for NGO appropriate projects such as marking fence lines/guy wires with reflectors in an attempt to prevent mortality through collisions by sage-grouse.

8.3 Research

1. Investigate the response of the sage-grouse population to habitat restoration and reclamation activities, with particular attention focused on reclamation of industrial developments, restoration of agricultural lands, and modification or removal of water management developments. This information should be used to adaptively manage sagebrush habitat.
2. Investigate factors limiting survival, productivity, and recruitment of sage-grouse, with particular attention focused on predation of nests and chicks.
3. Investigate the composition of predators of sage-grouse across all life-cycle stages and investigate mechanisms of control and/or habitat modification to reduce predation.
4. Assess connectivity of sagebrush habitat between Alberta, Saskatchewan, and Montana; prioritize areas for conservation and stewardship to enhance the potential for connection between sage-grouse in Alberta and Saskatchewan to core populations in Montana.

8.4 Outreach and Information

1. Disseminate the *Alberta Greater Sage-grouse Recovery Plan 2013-2018* to the ranching community, industry, other agency partners, and the public.
2. Distribute information on the effects of land uses on sage-grouse and on ways to mitigate these effects (e.g., provide copies of *Beneficial Grazing Management Practices for Sage-grouse* [Adams *et al.* 2004] to the ranching community).
3. Distribute maps of sage-grouse nesting, brood-rearing, and wintering habitat to producers to encourage them to steward these areas in ways that benefit sage-grouse.
4. Provide guidelines to land managers and lessees on the use, construction, and location of watering-site developments and cross-fencing, and on the use and location of salting areas in sage-grouse habitat.
5. Periodically update the Alberta Species at Risk Program website with information on sage-grouse recovery activities.

8.5 Plan Management and Administration

1. Host annual recovery team meetings to review progress on plan implementation.
2. Hire a biologist to facilitate implementation of the Plan, coordinate research on sage-grouse, and disseminate information on sage-grouse to stakeholders.
3. Enter population data into the Fish and Wildlife Management Information System (FWMIS) database and other centralized databases following each field season.
4. Communicate with other Alberta recovery teams and government agencies active in sage-grouse range to ensure a coordinated approach.

5. Liaise with provincial, national, or international wildlife management agencies and initiatives to ensure continuity and flow of new information regarding conservation of sage-grouse and sagebrush habitat. Such agencies and initiatives include the Northern Sagebrush Steppe Initiative, Western States Association of Fish and Wildlife Agencies Sage-grouse Comprehensive Conservation Strategy (Western Agencies Sage- and Columbian Sharp-tailed Grouse Technical Committee), and Western Governors' Association Wildlife Corridors Initiative.
6. Liaise with local conservation agencies and initiatives to identify opportunities to work with these groups to enhance available habitat for sage-grouse. Such groups include MULTISAR, Nature Conservancy of Canada, Pheasants Forever, Alberta Conservation Association, and the Society of Grassland Naturalists.

8.6 Resource Acquisition

1. Communicate the needs for funding recovery plan activities to ESRD, other government agencies, industry partners, and conservation groups, in order to adequately resource plan implementation.
2. Assist other government agencies, non-government organizations, industry, and other stakeholders in their efforts to secure resources to fund recovery activities.

9.0 TIMETABLE FOR IMPLEMENTATION AND SCHEDULE OF COSTS

The following schedule provides a timeline for implementation of recovery activities and an estimate of the total costs associated with their implementation. This budget represents best estimates only and should be considered as guidance for plan implementation. The in-kind portion of the total is indicated in parentheses following the total. In kind support includes salaries of government staff as well as operational costs.

The cost of implementing the recovery plan is estimated at $2 980 000 over five years, not including costs for captive breeding. This budget figure does not include the full costs of the Southeastern Conservation Offset Pilot that is currently under development with Alberta Agriculture and Rural Development. Based on available funds and budget restraints, it is anticipated that a variety of agencies will participate in the funding and implementation of these activities.

Plan	Action	Lead Agency(s)	Cost (thousands/year)					Total
			2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	
8.1	**Habitat Conservation & Management**							
1	Impact assessments at leks	ESRD	5		5			10 (5)
2	Surveys for new leks	ESRD					20	20 (5)
3	PNTs around all leks	ESRD					2	2 (2)
4	PNT to inform new dispositions	ESRD AB Energy					1	1 (1)
5	PNT for mitigation on existing dispositions	ESRD Industry					1	1 (1)
6	Disturbance management guidelines	ESRD Ranchers Industry					10	10 (5)
7	C&D tool for industrial developments	ESRD AB Energy	3	3	3	3	3	15 (10)
8	Subsurface addenda on new mineral sales	AB Energy					1	1 (1)
9	Reclamation schedule and develop BMPs	ESRD	30	20				50 (25)
10	Implement Priority Reclamation	Industry AB Energy	20	20	20	20	20	100 (25)
11	Key habitat identification by ranchers	ESRD MULTISAR Ranchers	10	10	10	10	10	50 (0)
12	Landholder–MULTISAR collaborations	ESRD MULTISAR Ranchers	10	10	10	10	10	50 (40)
13	Range health assessments	ESRD		10			10	20 (0)
14	Enhance plant community structure	ESRD	5	5	5	5	5	25 (20)
15	Stocking rates and grazing practices	ESRD	2	2	2	2	2	10 (10)
16	Incentives for appropriate land management	ESRD MULTISAR	20	20	20	20	20	100 (20)

Plan	Action	Lead Agency(s)	Cost (thousands/year) 2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	Total
17	Restore cultivated lands	ESRD ACA MULTISAR ABARD Industry	100	100	100	100	100	500 (100)
18	Inventory human use in key habitat areas	ESRD		3			3	6 (0)
19	Remove anthropogenic structures	ESRD	10	10	15	15	15	65 (0)
20	Investigate decommissioning or burying power lines	ESRD	2	2	2	2	2	10 (10)
21	Decommissioning/burying power lines	Industry			20		20	40(0)
22	Investigate gravel pit decommissioning	ESRD		2		2		4 (4)
23	Support for non-government habitat conservation initiatives	ESRD	5	5	5	5	5	25 (25)
24	C&D Zone tool evaluation	ESRD universities	30	30				60 (60)
25	Conservation offset program evaluation	ESRD; ACA ABARD; ABMI	10	10	10	10	10	50 (10)
26	Coordinate with LUF	ESRD	2	2	2	2	2	10 (10)
							SUB-TOTAL:	**1235 (389)**
8.2	**Population Management and Enhancement**							
1	Annual lek counts	ESRD	5	5	5	5	5	25 (25)
2	Translocations from Montana	ESRD MFWP		100	100	100	100	400 (200)
3	Monitor disease prevalence	ESRD	2	2	2	2	2	10 (0)
4	Implement predator control strategies	ESRD	50	50	50	50	50	250 (75)
5	Moratorium on viewing	ESRD	2				1	3 (3)
6	Moratorium on hunting	ESRD					1	1 (1)
7	Captive breeding program experiment	ESRD	TBD	TBD	TBD	TBD	TBD	TBD
8	Translocation program evaluation	ESRD universities	30	30	30	30	30	150 (50)
9	NGO appropriate projects	NGOs	5	5	5	5	5	25 (0)
							SUB-TOTAL:	**864 (354)**
8.3	**Research**							
1	Habitat restoration and reclamation	ESRD universities			25	20	20	65 (10)
2	Survival/productivity/recruitment	ESRD universities	10	10	10	10	10	50 (25)
3	Predator composition and control	ESRD universities	10	10	10	10	10	50 (25)
4	Sagebrush habitat connectivity between Alberta, Saskatchewan and Montana	ESRD MFWP; SKENV			10			10 (0)

Plan	Action	Lead Agency(s)	Cost (thousands/year)					Total
			2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	
							SUB-TOTAL:	**175 (60)**
8.4	**Information and Outreach**							
1	Recovery plan	ESRD	2	1	1	1	1	6 (3)
2	Information on land use effects & mitigation	ESRD	1	1	1	1	1	5 (2)
3	Distribute sage-grouse habitat maps	ESRD	1	1	1	1	1	5 (5)
4	Guidelines on watering-sites, cross-fencing, and salting	ESRD	2	2	2	2	2	10 (4)
5	Update SAR Program website	ESRD	1	1	1	1	1	5 (5)
							SUB-TOTAL:	**31 (19)**
8.5	**Plan Management and Administration**							
1	Recovery team meetings	ESRD	1	1	1	1	1	5 (0)
2	Implementation biologist	ESRD	115	115	115	115	115	575 (0)
3	Database management	ESRD	2	2	2	2	2	10 (10)
4	Liaison with other recovery teams & government agencies	ESRD	2	2	2	2	2	10 (10)
5	Liaison with other jurisdictions	ESRD	5	5	5	5	5	25 (10)
6	Liaison with local conservation initiatives	ESRD	3	3	3	3	3	15 (15)
							SUB-TOTAL:	**640 (45)**
8.6	**Resource Acquisition**							
1	Communicate funding needs	ESRD	2	2	2	2	2	10 (10)
2	Assist other organizations to secure funding	ESRD	3	3	3	3	3	15 (15)
							SUB-TOTAL:	**25 (25)**
	TOTAL		**518**	**615**	**615**	**577**	**645**	**2 970**

ABARD: Alberta Agriculture and Rural Development; ABMI: Alberta Biodiversity Monitoring Institute; ACA: Alberta Conservation Association; ESRD: Alberta Environment and Sustainable Resource Development; MFWP: Montana Fish, Wildlife and Parks; MULTISAR: Multiple Species At Risk Program; SKENV: Saskatchewan Environment; TBD: to be determined.

10.0 SOCIO-ECONOMIC CONSIDERATIONS

Greater sage-grouse is an iconic prairie species with high public interest (Lungle and Pruss 2008); its spectacular breeding displays and use of traditional leks garner interest from birdwatchers, naturalists, photographers, and ecotourists (Lungle and Pruss 2008). Landowners and lessees with leks on their properties are very protective of the species and its habitat (Canadian Sage Grouse Recovery Team 2001). Sage-grouse was hunted in Alberta, primarily as a trophy species, until 1995. However, there is evidence that it was hunted for food by Aboriginals and European settlers, despite its poor taste (McAdam 2003; Lungle and Pruss 2008).

Two key industries that operate in sage-grouse habitat have the potential to be impacted by the recovery actions. A brief assessment of the costs and benefits of this plan for ranching and the oil and gas industry are outlined below.

10.1 Activities Related to Ranching

Actions associated with grazing are mainly focused on maintaining a range health score (RHS) at a minimum of 75%. Monitoring is already being done on public lands in the area, and there will be some effort directed at promoting an RHS of 75% or higher on private lands as well. Maintaining RHS at a minimum of 75% would be considered to be part of the normal grazing management objectives in the sage-grouse range and will be addressed through grazing lease agreements with ESRD. Unsatisfactory grazing lease assessments require remedial management to achieve acceptable long-term range health levels. Prudent ranch management aims to manage for relatively stable stocking rates, which is largely achieved through conservative stocking rates that maintain range health and a more stable forage supply. Potential economic stressors unrelated to the recovery plan could include increases in property taxes and land values. Future incentives such as extended grazing lease tenure might be considered for providing improved levels of rangeland stewardship.

10.2 Oil and Gas Industry

In this recovery plan, actions are aimed at minimizing the footprint of industrial activity within sage-grouse habitat through land use standards, the use of Conservation and Development Zones, and reclamation. Current guidelines, such as the AEUB Information Letter, 2000-1 *Principles for Minimizing Surface Disturbance in Native Prairie and Parkland Areas* (Alberta Energy and Utilities Board 2002) and the *Recommended Land Use Guidelines for Grassland and Parkland* (ASRD 2011), specify means to ensure minimal disturbance on native prairie. The currently small size of the Alberta sage-grouse population requires increasing protection of important habitat for sage-grouse. The Conservation and Development Zone approach will help protect critical habitat for sage-grouse while facilitating continued resource utilization. This approach has been endorsed by industrial stakeholders within the range of sage-grouse.

11.0 MULTIPLE SPECIES AT RISK AND RELATED RECOVERY STRATEGIES

Implementation of the actions contained within this plan should be generally beneficial to other native species utilizing the same landscape as sage-grouse. There is no apparent contradiction with other current species recovery plans that are in place. The strong focus that has been placed on land use and habitat restoration should be beneficial to a variety of species associated with the silver sagebrush steppe.

12.0 PLAN EVALUATION AND AMENDMENT

The *Alberta Greater Sage-grouse Recovery Plan 2013-2018* will guide recovery of sage-grouse for five years or until an updated recovery plan is in place after that period. The greater sage-grouse recovery team will meet annually to monitor the implementation of recovery actions.

Evaluation of the effectiveness of recovery actions will be based on targets identified in the action plan. Progress reports will be made available through various means (e.g., annual recovery implementation updates, Species at Risk project reports). At the end of five years, the Plan will be updated by the team chair, as needed, and the recovery team may be convened if major changes are required.

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14.0 PERSONAL COMMUNICATIONS

C. Aldridge, Assistant Professor, Colorado State University and U.S. Geological Survey. 2012.

G. Court, Provincial Wildlife Status Biologist, ESRD. 2012.

S. Dalton, M.GIS. Candidate, University of Calgary. 2012.

B. Downey, Wildlife Biologist, Alberta Conservation Association. 2012.

D. Eslinger, Senior Wildlife Biologist, ESRD. 2012.

D. Gummer, Ecologist, Parks Canada. 2012.

K. Redden, Land Management Specialist, ESRD. 2012.

J. So, M.E.Des. Candidate, University of Calgary. 2011.