COSEWIC
Assessment and Status Report

on the

Greater Sage Grouse
Centrocercus urophasianus

in Canada

Phaios subspecies (Centrocercus urophasianus phaios)
Urophasianus subspecies (Centrocercus urophasianus urophasianus)

ENDANGERED – urophasianus subspecies (Prairie Population)
EXTIRPATED – phaios subspecies (British Columbia Population)
2000
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**Production note:**
A first draft of this report from 1997 is on file with COSEWIC Secretariat. The Greater Sage Grouse (*Centrocercus urophasianus phaios* and *Centrocercus urophasianus urophasianus*) was formerly designated by COSEWIC as the Sage Grouse (*Centrocercus urophasianus*) Prairie Population (*Centrocercus urophasianus urophasianus*) and the British Columbia Population (*Centrocercus urophasianus phaios*). Throughout the status report the species is referred to as Sage Grouse. Please note that the status recommended in the Section “Evaluation and Recommended Status” of the report may differ from the latest assigned to the species by COSEWIC.

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Également disponible en français sous le titre Rapport du COSEPAC sur la situation du Tétras des armoises (*Centrocercus urophasianus urophasianus* et *Centrocercus urophasianus phaios*) au Canada.

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Assessment Summary – May 2000

Common name
Greater Sage Grouse (Prairie population)

Scientific name
Centrocercus urophasianus urophasianus

Status
Endangered

Reason for designation
This population, estimated to be between 550-800 individuals in 1997, is small and declining. Historic population levels and range have been greatly reduced due to limiting factors including: loss and fragmentation of sagebrush habitat on which the species depends, human disturbance, drought and harsh winter weather.

Occurrence
Alberta, Saskatchewan

Status history

Assessment Summary – May 2000

Common name
Greater Sage Grouse (British Columbia population)

Scientific name
Centrocercus urophasianus phaios

Status
Extirpated

Reason for designation
This subspecies was found in the south Okanagan Valley of British Columbia, but there have been no reports in the last century. It still exists in the United States.

Occurrence
Formerly British Columbia

Status history
British Columbia Population: Has not been reported since the 1960s. Designated Extirpated in April 1997. Status re-examined and confirmed in May 2000. Last assessment based on an existing status report.
Sage Grouse, commonly known as Sage Hens or Sage Chickens have the scientific name (*Centrocercus urophasianus*) which means "Spiny Tailed Pheasant." This name comes from the long pointed tail which is fanned out by males during mating displays on leks. Sage Grouse are true grouse, not pheasants as the scientific name implies.

Sage Grouse are the largest Canadian grouse and are sexually dimorphic; females average 56.1 cm (22.1 inches) long, and males average 74.7 cm (29.4 inches) long. They are brownish gray with blackish abdomens, black and white tails and whitish wing linings. Males have a white throat strap and a large white breast patch concealing yellowish air sacs which can be inflated during the spring breeding season. Females and young males are similarly patterned but are more cryptically coloured than adult males.

Sage Grouse inhabit the mixed grassland ecoregion in southeastern Alberta and southwestern Saskatchewan near the Montana border. Sage Grouse are dependent on sagebrush (*Artemisia tridentata* and/or *A. cana*) for nesting and wintering habitat and do not exist beyond the range of the plants. Sage Grouse are polygamous and concentrate at leks located in relatively flat areas near creek valleys.

Females lay an average of seven eggs in a nest which is usually located under a sagebrush plant. Young chicks feed primarily on insects and forbs which are replaced by sagebrush as the chicks mature. Habitat selection reflects this change in food preference. For instance, young broods are found in locations where insects and succulent forbs are abundant, while adults with no chicks are more commonly found in sagebrush habitats.

Sage Grouse populations are affected by parasites, predation, weather, pesticides, and habitat alteration. Golden Eagles and Coyotes are important predators of Sage Grouse. Severe weather may reduce productivity if prolonged. Organophosphate insecticides are toxic to Sage Grouse with over 60% mortality being reported. Collisions with vehicles cause mortality in Sage Grouse. Habitat impoverishment and conversion has also been a major factor in reduced Sage Grouse populations and abundance, particularly in the United States.
Populations tend to fluctuate and the validity of monitoring methods has been questioned; however, population monitoring surveys such as males per lek, lek abandonment, and hunter success have resulted in a significant range-wide downward trend. Sage Grouse are extirpated in Nebraska, New Mexico, Oklahoma and British Columbia. Saskatchewan Sage Grouse numbered about 400 in spring 1996 compared to more than 2000 in spring 1988. A similar decrease may be occurring in Alberta. The number of known active lek sites used by Sage Grouse during the 1990s has dropped to an average of 10.0 compared to an average of 21.3 for the period of 1968 through 1989, a 51.3% decrease. Only 8 leks were active in the spring of 1997, which represents a decrease of 61.9% (2.1% per year) from the 21 known active lek sites in 1968.

In Alberta, the species is a game bird and a season was opened each autumn from 1967 to 1995 inclusive. Alberta closed the hunting season in 1996. Saskatchewan listed Sage Grouse as a threatened species in 1987 and has not had a hunting season since the 1930s. Alberta lek sites are off limits to development activities during the breeding season but projects may occur when birds are not engaged in breeding activities. Many lek sites are listed in the Saskatchewan Wildlife Habitat Protection Act and are in Grasslands National Park. Development proposals for these lands are reviewed and development activities may not be allowed.

The species is physically protected from harm and most habitats have some protection. Protection of Sage Grouse habitat is insufficient in both jurisdictions. Not all lek and nesting habitat is reviewed for proposed development or alteration activities which may make seasonal use sites unsuitable for use by Sage Grouse. Agricultural conversion of Sage Grouse habitat to tame grass pasture or cropland continues to occur to a limited extent.
COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) determines the national status of wild species, subspecies, varieties, and nationally significant populations that are considered to be at risk in Canada. Designations are made on all native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fish, lepidopterans, molluscs, vascular plants, lichens, and mosses.

COSEWIC MEMBERSHIP

COSEWIC comprises representatives from each provincial and territorial government wildlife agency, four federal agencies (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biosystematic Partnership), three nonjurisdictional members and the co-chairs of the species specialist groups. The committee meets to consider status reports on candidate species.

DEFINITIONS

Species Any indigenous species, subspecies, variety, or geographically defined population of wild fauna and flora.

Extinct (X) A species that no longer exists.
Exirpated (XT) A species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E) A species facing imminent extirpation or extinction.
Threatened (T) A species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)* A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
Not at Risk (NAR)** A species that has been evaluated and found to be not at risk.
Data Deficient (DD)*** A species for which there is insufficient scientific information to support status designation.

* Formerly described as “Vulnerable” from 1990 to 1999, or “Rare” prior to 1990.
** Formerly described as “Not In Any Category”, or “No Designation Required.”
*** Formerly described as “Indeterminate” from 1994 to 1999 or “ISIBD” (insufficient scientific information on which to base a designation) prior to 1994.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list.

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.
COSEWIC Status Report

on the

Sage Grouse
Centrocercus urophasianus

in Canada

Prairie Population (Centrocercus urophasianus urophasianus)
British Columbia Population (Centrocercus urophasianus phaios)

Edited by
Colleen Hyslop

1998
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ABSTRACT

Sage Grouse (*Centrocercus urophasianus*) are large sexually dimorphic grouse found principally in the Big Sagebrush (*Artemisia tridentata*) and Silver Sagebrush (*Artemisia cana*) range of North America. The Big Sagebrush range extends to northern Montana and provides better habitat for Sage Grouse than Silver Sagebrush, thus the Sage Grouse in Canada are in more marginal habitat. The Canadian range extends from the Milk River area of southeast Alberta eastward to the Wood Mountain area of southern Saskatchewan.

In Canada, Silver Sagebrush is an essential habitat component for nesting sites, cover, and food. Sage Grouse prefer to nest near water and have the greatest nesting success when their nests are in sagebrush. Young chicks consume less sage than adults but dependence on Silver Sagebrush increases as they mature. Courting and breeding take place on leks located on fairly flat areas near creeks or by slopes. Lek activity occurs from late winter to late spring where males perform behaviours to attract selection by females for mating.

DESCRIPTION

Sage Grouse were officially described and given the taxonomic name (*Tetrao urophasianus*) by C.L. Bonaparte in 1828 (Bonaparte, 1828). The name was revised to (*Centrocercus urophasianus*) in 1831; two subspecies were then recognized, (*C.u. urophasianus*) and (*C.u. phaios*) (Aldrich, 1963). Current research suggests the need for a further revision recognizing the Gunnison Sage Grouse (*Centrocercus minimus*) as a full species (Braun, pers. comm.). This proposal also recommends that the common name for *C. urophasianus* become Giant Sage Grouse. Vernacular names include the Sage Chicken and Sage Hen (Patterson, 1952).

Sexual dimorphism is evident in Sage Grouse with males being larger and heavier than females (Table 1). Sage Grouse have cryptic plumage, females more so than males. Male Sage Grouse have a large white bib of specialized spiky feathers which conceal yellowish inflatable nuchal sacs on the breast, which are lacking in females (Fig. 1 and 2) (Girard, 1935). Sage Grouse also have long pointed rectrices (Girard, 1937) for which the species gets its scientific name “Spiny Tailed Pheasant” or (*Centrocercus urophasianus*).

<table>
<thead>
<tr>
<th></th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average weight</td>
<td>1.3 kg (3.15 lbs)</td>
<td>2.3 kg (5.65 lbs)</td>
</tr>
<tr>
<td>Average total length</td>
<td>56.1 cm (22.07 in)</td>
<td>74.8 cm (29.45 in)</td>
</tr>
</tbody>
</table>
Figure 1. Adult Male Sage Grouse in Display and in Relaxed Postures. (Photo: Sask. Environment and Resource Management (SERM).

Figure 2. Profile View of an Adult Male Sage Grouse in Display. (Photo: SERM)

**DISTRIBUTION**

**United States**

Sage Grouse and sagebrush have a similar distribution in the United States and both were found in at least fifteen states (Fig 3). *C. u. urophasianus* distribution included western Nebraska, North Dakota, South Dakota (Girard, 1935), northwestern Colorado, most of Montana, Idaho, Wyoming, Nevada, Utah, northwestern New Mexico (Girard, 1937), Oklahoma (Western States Sage Grouse Technical Committee (WSSGTC), 1995), and possibly western Kansas, and eastern Arizona (Eustace, 1996).
Sage Grouse are extirpated in the states of Arizona, Kansas, Nebraska, New Mexico, and Oklahoma (WSSGTC, 1995).

* C. *u. *phaios* are found in eastern Washington, Oregon, and California. In Oregon, the introduction of *C. u. urophasianus* has resulted in birds that are intermediate in form (Braun, pers. comm.).

* C. minimus* are most common in southwestern Colorado in particular the Gunnison Basin area. They also occur in southeastern Utah. Possibly the recently extirpated populations in Oklahoma and Arizona were also *C. minimus* (Braun, pers. comm.).

**Canada**

As in the United States, Sage Grouse in Canada are closely associated with sage flat habitats. *C. u. phaios* inhabited the Okanagan and Similkameen Valleys of B.C. until they were extirpated in 1918 (Cannings *et al.*, 1987).

Figure 3. Historic and Present Range of Sage Grouse in North America. (Adapted from Eustace, 1995b; WSSGTC, 1995, and Harris, unpub. data)
Presently, *C. u. urophasianus* is the only subspecies of Sage Grouse which occurs in Canada where it is at the northern limit of its range. The current range covers about 4000 km$^2$ of southeastern Alberta (Vriend and Gudmundson, 1996) (Fig. 4) and about 4300 km$^2$ in southwestern Saskatchewan (Harris, pers. comm.) (Fig. 5).

Historically the range of Sage Grouse was much greater. In Saskatchewan Sage Grouse were present in small numbers in the sage flats at Saskatchewan Landing Provincial Park (SLPP) as recently as 1965 (Roy, 1996). Also in 1965, a Sage Grouse was shot south of Anerley, which is 70 kilometres northeast of the Park (Roy, 1996). Anecdotal information suggests that Sage Grouse were also found in the Big Muddy valley (Harris, pers. comm.). Extrapolation of the range based on this information suggest a historical range of about 60,000 km$^2$. By the late 1980s that range had contracted to 15,000 km$^2$ (Weichel and Hjertaas, 1992) (Fig. 5). By 1994 the range had contracted further to only 4300 km$^2$ in three disjunct locations; Wood Mountain, Frenchman River Valley, and Govenlock adjacent to the Alberta population (Harris, pers. comm.) (Fig. 5).
Figure 5. Zones of Concentration of Sage Grouse in Saskatchewan.
Agricultural conversion of suitable habitat has not been a major factor in the past 20 years. Consequently, potential does exist for re-occupation of the former range as most of the recently used range is available for population recovery (Harris, pers. comm.).

Similarly in Alberta the range was much broader. Banasch (1985) and Gudmundson (pers. comm.) had reports and personal observations respectively of Sage Grouse occurring in the Milk River area of Alberta. In addition, anecdotal information suggests that Sage Grouse were found in the Walsh area north of the Cypress Hills (Harry Hargraves pers. comm., fide W. Harris; Jim Clark pers. comm., fide D. Eslinger). This would suggest an historical range two to three times that currently found in Alberta.

PROTECTION

United States

Sage Grouse are not protected by the United States Endangered Species Act. They were listed as a Category 2 species which means “a proposal to list the taxa as threatened or endangered is possibly appropriate but conclusive data on vulnerability or threat are unavailable” (WSSGTC, 1995); however, the USFWS no longer maintains a Category 2 list under its Endangered Species Act. Application has been made to include the "Gunnison" Sage Grouse and some regional populations of the Giant Sage Grouse in the United States Endangered Species Act. However, there is a freeze on the listing of new species and the application is on hold (Braun, pers. comm.). Sage Grouse are being considered for threatened or endangered status in California, Colorado, North Dakota, Utah, and Washington (WSSGTC, 1995). South Dakota lists Sage Grouse as endangered (Weichel and Hjertaas, 1992).

Canada

Saskatchewan

Sage Grouse are protected under the Wildlife Act which prohibits the capture, killing and possession of Sage Grouse. In addition, Sage Grouse were listed as a provincially threatened species in 1987. Guidelines have been developed which restrict activities near leks during the breeding season. Furthermore no permanent industrial development is permitted within 500 metres of a lek location.

Only one of 61 leks in Saskatchewan is on private land. Twenty four leks which occur on Crown land receive some level of protection in the Wildlife Habitat Protection Act (WHPA) and 22 leks are contained within the proposed borders of Grasslands National Park. The WHPA provides protection from agricultural conversion. The national park provides protection to both the birds and their habitats. Development proposals on lands listed in the WHPA are subject to review by Saskatchewan
Environment and Resource Management which may impose restrictions on habitat alterations or industrial activities.

The World Wildlife Fund identified Sage Grouse as a species in jeopardy in their 1989 Prairie Conservation Action Plan (PCAP) (Weichel and Hjertaas, 1992), which was endorsed by the province. In 1992, Weichel and Hjertaas released the *Recovery and Management Plan for Sage Grouse in Saskatchewan*. Despite some degree of habitat protection and the highest level of species protection available, some management objectives identified in the report have not been met. The plan recommended designating all habitat within 5 kilometres of primary leks and 3 kilometres of secondary leks, key brood habitats and winter habitats on provincial Crown land in the WHPA (Weichel and Hjertaas, 1992). They also proposed establishing long term easements for primary leks, brood or winter habitat on privately owned land. In addition to these recommendations, a 150 to 200 metre strip around wet meadows should be protected as these areas are heavily used by Sage Grouse (Anon., 1996). Implementation of these protection measures are recommended to further protect Sage Grouse habitat and reduce the risk of habitat alteration. The *Conservation Easement Act*, which was passed in 1996, will help to ensure better protection for habitat on privately-owned land as the Act compensates landowners for maintaining wildlife habitat.

**Alberta**

In Alberta, the Sage Grouse is protected under the *Wildlife Act*. The Act protects the species from harassment and abuse and also protects nest sites. The hunting season was closed in 1996 (Erickson, pers. comm.) after being opened briefly each fall since 1967.

Vriend and Gudmundson, (1995) state that most of the Sage Grouse habitat is on relatively secure crown land with three abandoned leks located on deeded land. Alberta's Natural Resources Service reviews oil and gas project proposals within the Sage Grouse range. Seismic activity is prohibited near leks during the strutting season (Dube, 1985). No protection for leks exists in Alberta if projects proceed outside the breeding season (Dube, 1985). Most of Madsen's (1995) 3.6 km (2 mile) radius plots around leks had oil/gas wells on them.

In Canada, Sage Grouse receive sufficient protection through provincial Wildlife Acts. However, not all Sage Grouse habitats are adequately protected and even authorized development may inadvertently make sites unsuitable for use by Sage Grouse.

It is recommended that developments be prohibited within one kilometre of leks and nesting areas year round in Alberta and Saskatchewan because of the potential for desertion by Sage Grouse.
POPULATION SIZE AND TRENDS IN NORTH AMERICA

North America

The declining Sage Grouse population trend as reported by most jurisdictions is not reflected in Christmas Bird Count (CBC) or Breeding Bird Survey (BBS) analysis because these survey methods do not survey Sage Grouse adequately (Sauer et al., 1994; Peterjohn, pers. comm.). Very few CBC or BBS surveys are located in the Sage Grouse range and BBS surveys are not timed to correspond to lek activities (Sauer et al., 1994).

Weichel and Hjertaas (1992) suggest as many as 8 to 10 million Sage Grouse may have existed throughout their range at the time of European exploration. Their estimate was based on the magnitude of sagebrush range lost or altered, and is supported by anecdotal evidence. At Bates Hole, Wyoming in 1886, Grinell watched as a flock of Sage Grouse flew up and turned the valley gray which reminded him of Passenger Pigeon flocks he saw as a boy (Girard, 1935).

Sage Grouse began to decline with settlement of their range. Excessive hunting and especially loss of habitat through agricultural conversion of sage flats, and the fragmentation of remaining habitat contributed to the decline of the Sage Grouse. The North American population was reduced to 1.5 million by 1970 (Johnsgard, 1973; fide Weichel and Hjertaas, 1992) and has continued to decrease (Wash. Dept. Fish and Wildl., 1995).

United States

Sage Grouse are extirpated from New Mexico, Nebraska and Oklahoma (Braun 1991). Spring lek counts from other areas had decreased by a minimum of 50-60% by the early 1950s (WSSGTC, 1995). The number of males per lek has declined recently in Colorado, Idaho, Montana, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming (WSSGTC, 1995). In 1973, Washington harvested 1800 Sage Grouse compared to a current population of only 600 (Wash. Dept. Fish and Wildl., 1995). North Dakota has seen its Sage Grouse population decline from an average of 236 between 1990 and 1994 to 111 in 1996 (Trego, 1997). The WSSGTC (1995) expects extirpation to occur in five Colorado counties within ten years.

Eustace (1996) found a significant decline of 23% in Montana’s Sage Grouse productivity. Productivity averaged 263 juveniles per 100 hens during 1962-79 and 202 juveniles per 100 hens during 1980-93 (Eustace, 1996). This decline in productivity was accompanied by a similar reduction in the population (Eustace, 1995a). Such relationships have been noted in other areas such as Washington which reported reduced recruitment with reduced lek attendance leading to lek abandonment (Wash. Dept. Fish and Wildl., 1995).

Evidence exists supporting the Sage Grouse’s tendency towards population fluctuations as seen in other grouse (Patterson, 1952). Eustace (1995a) reported four peaks in the Montana Sage Grouse harvest occurring at eight-year intervals, 1963-64,
1971-72, 1979-80, and 1987-88. In Idaho, Sage Grouse populations showed evidence of a ten year cycle (Rich, 1985). Alberta data also suggests the potential for an eight- to ten-year cycle (Lungle, pers. comm). If this pattern is true, 1995 and 1996 should be at the high point in the cycle based on the Montana analysis.

The Montana increase in the 1960’s coincides with the northern most appearance of Sage Grouse in Saskatchewan (Roy, 1996). Eustace hypothesizes that there is an undetermined extrinsic factor at work on Sage Grouse populations which operates on an eight-year cycle, but that more time is needed to ascertain this. The fluctuating nature of Sage Grouse populations does not mean they will rebound to previous peaks at the height of their cycle. The peaks have tended to be reduced with successive cycles (Eustace, pers. comm.).

Canada

British Columbia

In British Columbia the status was not well documented but it is thought that Sage Grouse were always rare (Campbell et al., 1990). The last confirmed naturally occurring Sage Grouse was shot by a prospector near Oliver in 1918 (Cannings, et al., 1987). A reintroduction attempt in 1958 was unsuccessful. There have been no confirmed British Columbia sightings since 1966 (Campbell, et al., 1990)

Saskatchewan

In 1988, 1994, 1995, 1996 and 1997 leks were surveyed at approximately the same three-week period each year beginning the second week of April (Harris, pers. comm.). This is in general accordance with the WSSGTC survey criteria (WSSGTC, 1996). Each survey year, an effort is made to locate additional leks. In 1989, extensive searches were carried out in areas with limited previous survey effort (Harris, et al., 1990). Also, an area of 3.2 kilometres radius around abandoned leks were searched for Sage Grouse in 1996. In 1996, the survey effort included known historic casual observation sites for a coverage of 106 sites of known Sage Grouse locations in southwest Saskatchewan based on Weichel and Hjertaas (1992) records. Lek counts were done four times in Grasslands National Park (Harris, pers. comm.). Some researchers argue against using lek counts to make population estimates because variation in male attendance at leks may skew results (Banasch, 1985).

Survey data analysis shows a decline of over 80 % in the abundance of Sage Grouse from the late 1980s to the mid 1990s. Lek counts in spring 1988 resulted in a minimum population estimate of 2000 Sage Grouse (Harris and Weidl, 1988) whereas the 1997 spring population was estimated at 250 birds (Harris, pers. comm.). Estimates are based on a 45:55 male to female ratio, a 50% allowance for males who were not present when leks were surveyed, and 15-33% unsurveyed leks (Weichel and Hjertaas, 1992).
Kerwin (1971) determined that lek counts in Saskatchewan had fewer males than in other parts of the species range indicating lower population densities compared to other locations. Lek surveys carried out in 1970 and 1971 had numerous morning and evening counts throughout the breeding season. In his Frenchman River valley study, lek counts averaged 26.6 males per lek in 1970 and 28.4 males per lek in 1971 (Kerwin, 1971); these values are lower than in two Wyoming counties (60 and 78 males per lek) (Patterson, 1952).

Lek attendance has declined since Kerwin did his work in the early 1970s. A review of sporadic long term data from 1970 showed an apparent increase in Sage Grouse numbers in 1987-88 compared to the period before 1986 or after 1989 (Weidl and Harris, 1987; Harris and Weidl, 1988; and Harris, unpub. data).

The number of males per active lek has decreased during the 1990s compared to the mid-1980s (Table 2). The rate of lek abandonment is an average of 7.2% per year over the period from 1987 to 1997.

<table>
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<tr>
<th>Year</th>
<th>Number of leks checked</th>
<th>Number of males</th>
<th>Number of males/active lek</th>
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<tr>
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<td>45</td>
<td>522</td>
<td>16.8</td>
</tr>
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<td>1988</td>
<td>43</td>
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<td>1997</td>
<td>27</td>
<td>61</td>
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</tbody>
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Alberta

Alberta’s Sage Grouse population was estimated at 3000 to 6000 birds in autumn 1968 (Vriend and Gudmundson, 1996). Spring surveys since that time indicate that the numbers of Sage Grouse, although potentially cyclic, are declining. During 1968, 613 active males were counted at leks. An average of 256 males was seen annually during the 1970s. This increased to an average of 306 annually during the 1980s and showed a dramatic decrease to an annual average of 136 since 1990. Surveys in the spring of 1997 enumerated 122 active males at leks in Alberta.

Fewer Sage Grouse are performing at leks (Table 3). The number of males at active leks appears to be somewhat cyclic in nature but the amplitude of the cycles is decreasing. During the 1990s there were an average of 13.5 males per active lek compared to an average of 23.3 during the period of 1968 through 1989. Perhaps more importantly, the average number of active leks has decreased to an average of 10.0 during the 1990s compared to an average of 21.3 from 1968 through 1989, a decrease of 51.3%. In 1997, there was an average of 15.3 males per active lek, somewhat higher
than the average of the 1990s, but there were only 8 active leks, a decrease of 61.9% from that of 1968 for an average annual lek abandonment rate of 2.1%.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of active leks</th>
<th>Number of males</th>
<th>Males/active lek</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968</td>
<td>21</td>
<td>613</td>
<td>29.2</td>
</tr>
<tr>
<td>1989</td>
<td>12</td>
<td>344</td>
<td>28.7</td>
</tr>
<tr>
<td>1994</td>
<td>8</td>
<td>70</td>
<td>8.8</td>
</tr>
<tr>
<td>1995</td>
<td>12</td>
<td>110</td>
<td>9.2</td>
</tr>
<tr>
<td>1996</td>
<td>11</td>
<td>136</td>
<td>12.4</td>
</tr>
<tr>
<td>1997</td>
<td>8</td>
<td>122</td>
<td>15.2</td>
</tr>
</tbody>
</table>

Lek desertion is also a concern. Of 21 known active leks in Alberta in 1968, only 5 remained active by 1997 and 16 (76.2%) had been abandoned. Some of these sites had been active from 1968 through 1991, a total of 24 years, prior to being abandoned. Further, in all of the Sage Grouse range in Alberta, the known number of active leks had decreased from a high of 21 in 1968 to only 8 in 1997 for an average annual abandonment rate of 2.1%. Gudmundson (pers. comm.) said primary leks with over 30 years of use by about 50 males are now deserted. Confidence in the application of these figures to a population estimate is low due to few new lek searches and the variability of lek attendance, but these results are consistent with the Saskatchewan trend.

Sage Grouse have demonstrated consistent use of lek sites for long periods. Some leks in Alberta have been consistently active since 1968, a period of 30 years. In Idaho there is evidence of lek use for 90 years; however, smaller leks are abandoned when populations are low (Dalke, et al., 1963). Many leks with a history of use in Alberta and Saskatchewan have been abandoned by Sage Grouse.

Any fewer than 500 Sage Grouse is not considered viable in the long term, particularly since the birds are found in three isolated areas (Braun, pers. comm.). Recent studies indicated that 500 Sage Grouse are insufficient and the number should be at least 5000 for population maintenance because only 10-15% of males actually breed (Anon., 1996).

Hunting

Historically, harvest levels of Sage Grouse were the highest of all game birds in nine states but by 1935 they were the leading game bird in only Montana, Wyoming, Idaho, and Nevada (Girard, 1937). Bent (1932) expressed concern over the declining numbers: “to save this fine bird from extinction, as civilization spreads, the open seasons for shooting it must be shortened and the bag limits reduced. Even then, it probably cannot be saved except on protected reservations.” Access to Sage Grouse was gained by new road construction and birds were shot with little regard for their needs (Patterson, 1952). Most jurisdictions followed the advice offered by Bent, Girard,
and Patterson. Hunting seasons and quotas were established to protect the species during the breeding season. In some jurisdictions hunting was discontinued.

By the 1960s regulated Sage Grouse hunting was permitted in Alberta and 11 states as a result of increased numbers of birds (Weichel and Hjertaas, 1992). Hunters bagged approximately 16.7% or 250,000 of an estimated total 1.5 million North American Sage Grouse by 1970 (Johnsgard, 1973; fide Weichel and Hjertaas, 1992).

Saskatchewan prohibited hunting the species during the late 1930s (Kerwin, 1971), a restriction which has continued to date. After several decades of protection, regulated hunting was reinstated in Alberta from 1967 through 1995. The season was discontinued in 1996 as a result of concerns and uncertainty about the status of Sage Grouse populations.

There is little reliable information available with respect to the harvest of Sage Grouse in Alberta. Following the first Sage Grouse season, a complete poll of all Sage Grouse hunters revealed that 408 hunters harvested 272 grouse (Vriend and Gudmundson 1996). Hunter check station efforts conducted from 1983 to 1987 provided some information on success and hunter effort, but do not provide a reliable estimate of total harvest because hunters reported voluntarily. However, this survey suggested that 230 hunters harvested about 250 birds in 1983 (Vriend and Gudmundson, 1996). Since 1988, Alberta has conducted an annual hunter telephone questionnaire of representative samples of hunters. However, because of small sample sizes the survey does not provide any reliable data on harvest levels for Sage Grouse.

Hunter success surveys were used to determine Sage Grouse populations trends in Montana. Significant declines (Z=0.0002) were evident when data from 1958 to 1979 and data from 1980 to 1991 were compared (Eustace, 1995a). Eustace (1995a) also found eight of the last 10 years had a harvest well below the 34-year average of 36,094 birds. In Montana, 99,138 Sage Grouse were harvested in 1964, and in 1993 the harvest dropped to only 7,716 birds (Eustace, 1996).

Montana hunters put in more effort for lower harvest levels. The number of hunters decreased by 34%, hunter days decreased by 49%, and the Sage Grouse harvest decreased by 70% between 1975-79 and 1989-93 (Eustace, 1996). The number of birds taken per day decreased from 1.4 to 0.8 from the 1975-79 to 1990-93 period (Eustace, 1996). This general decrease is further supported by a reduction in the number of Montana hunters which bagged four or more birds (Eustace, 1995a).

The impact of hunting on Sage Grouse populations is unclear. Crawford (1982) and Braun and Beck (1983) could not find a relationship between the harvest and the following spring's population. Harvests of 30% or less are believed to be compensatory but may become additive above 30% (Autenrieth et al., 1982; fide, Vriend and Gudmundson, 1995). Yet, Bergerud's (1983) literature review indicated natural mortality rates would be similar regardless of harvest levels and that hunting added to the mortality of the game bird populations by 25 to 27%. Weichel and Hjertaas (1992) stated that hunters could not be expected to avoid targeting the largest, most robust
individuals which are the more likely to survive and breed more successfully than smaller, weaker birds. Indeed, 72% of hunters in Alberta preferentially hunted those birds as trophies (Banasch, 1985).

Weather

Hot, dry weather has been suggested as a factor in reduced productivity and survival. Eustace (1996) found a significant correlation between the current year’s Sage Grouse productivity and the previous year’s rainfall. Higher production occurred in years following higher precipitation years (Eustace, 1996). Wallestad (1975) reported reduced productivity if total spring precipitation was insufficient for plant growth. Wetlands dry up, plants desiccate and have poor growth resulting in degraded foraging, nesting and winter habitat for Sage Grouse.

Conversely, cool, wet weather coinciding with the hatch of chicks may have a substantial negative effect on fall recruitment (Patterson, 1952). On the contrary, Wallestad (1975) reported no correlation between productivity and temperature or hatching period rainfall. Deep snow makes access to food difficult and may preclude use of a site in winter (Wash. Dept. Fish and Wildl., 1995).

Extended periods of drought or, arguably, heavy precipitation at critical times are factors in the decline of Sage Grouse populations. Below average annual precipitation occurred during the 1980s and early 1990s in both Alberta and Saskatchewan. Drought was also implicated in reduced hunter success in Alberta (Banasch, 1985). June precipitation in southeastern Alberta was 1.5 to 2 times the long term average of 57 mm in five of the six years preceding 1994 (Vriend and Gudmundson, 1996).

HABITAT

In the United States, Sage Grouse habitat in general corresponds to the distribution of sagebrush. Sage Grouse are more abundant in Big Sagebrush habitats than in Silver Sagebrush habitats. Abundant sagebrush escape cover within 300 to 650 m of leks was a primary habitat consideration in a Colorado study (Anon., 1996).

In the United States, sagebrush range has been mechanically and chemically (2-4-D) treated to remove sage in attempts to improve the range for livestock. The result was a reduction of over 50% in the land area occupied by sagebrush by 1951 (Patterson, 1952; Wallestad, 1975). Overgrazing by large numbers of domestic livestock further reduced the abundance of sagebrush. Sage Grouse numbers followed suit (Patterson, 1952).

In Canada, Sage Grouse distribution falls within the mixed grassland ecoregion. In this ecoregion plant communities are dominated by speargrass (*Stipa comata*), blue grama (*Bouteloua gracilis*), wheatgrasses (*Agropyron dasystachyum* and *A. smithii*), june grass (*Koeleria cristata*) and three-leaved sedge (*Carex filifolia*). Medium to finely textured brown chernozem soils are common. It is warm and dry with 1,655 growing degree days and
310 mm of annual precipitation. Mean January temperatures are -14.5 degrees Celsius and mean July temperatures are 19.1 degrees Celsius (Harris et al., 1983).

Detailed habitat evaluations have been carried out for Canadian lek sites. Topographical features associated with Saskatchewan leks are flat areas, low knolls, ridges along valley bottoms or creeks (Fig. 6 and 7) (Kerwin, 1971; Harris and Weidl, 1988).

In Saskatchewan, lek sites were measured for area and spacing in Saskatchewan. Sage Grouse leks range from 0.8 to 2.7 acres (0.3 to 1.1 ha) with a mean of 1.7 acres (0.7 ha). Leks were 3.5 km (2.2 miles) apart on average with a density of one lek per
36 km² (14 mi²) in suitable habitat, the lowest density within the Sage Grouse’s range (Kerwin, 1971). Kerwin (1971) believes lower lek densities in Saskatchewan are related to the lower suitability of silver sagebrush habitats for Sage Grouse compared to big sagebrush habitats.

Harris and Weidl (1988) evaluated the general lek habitat conditions in their Saskatchewan study. Leks were most frequent in sparsely vegetated bare areas, followed by short grass with some silver sagebrush, short grass with no silver sagebrush, bare sites with no vegetation, flat sites with silver sagebrush, and roads (Fig. 8 and 9). Heavy silver sagebrush, grazed pasture with tall clover and silver sagebrush, and russian wild rye each had one lek.
In Alberta, vegetation inventories were carried out at 25 leks in 1983. The most frequent vegetation was native grass with light silver sagebrush (47%), followed by native grass with heavy silver sagebrush (17%), native grass with medium silver sagebrush (12%), native grass with sparse silver sagebrush (9%), cultivation (7%), wet meadow (2%), and other (6%) (Vriend and Gudmundson, 1996). All leks in an Alberta study had wet meadows nearby (Dube, 1985; Banasch, 1985).

Vegetation evaluation was carried out at five abandoned and 12 active leks in Alberta during the summer of 1995. Madsen (1995) found most heavy and medium sagebrush plots around both active and inactive leks met the sagebrush canopy cover and height requirements (Table 4 and 5) for Sage Grouse foraging, loafing, breeding, nesting and wintering. The results showed silver sagebrush, forb and grass conditions were generally comparable between 1969 and 1995.

<table>
<thead>
<tr>
<th>Table 4. Plant Density Measurements in Sage Grouse Lek Habitat from Madsen, 1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat type</td>
</tr>
<tr>
<td>Heavy sagebrush</td>
</tr>
<tr>
<td>Medium sagebrush</td>
</tr>
<tr>
<td>Light sagebrush</td>
</tr>
<tr>
<td>Sparse sagebrush</td>
</tr>
<tr>
<td>Wet meadow</td>
</tr>
<tr>
<td>Cultivation</td>
</tr>
<tr>
<td>Miscellaneous</td>
</tr>
</tbody>
</table>

Sage Grouse generally nest close to lek sites as documented in a Montana study where the majority (68%) of nests were within 2.5 km of leks (Wallestad and Pyrah, 1974). The importance of cover to nest success has been documented in several studies (Gregg et al., 1994; Banasch, 1985; Connelly, 1991). Sage Grouse nesting in sagebrush with both lateral and vertical concealment have improved nesting success. Girard (1935) found all (n=50) nests situated under sagebrush plants near running water illustrating the importance of running water to nesting Sage Grouse.

<table>
<thead>
<tr>
<th>Table 5. Sagebrush Canopy Cover and Plant Height Requirements for Sage Grouse Lek Habitat (from Madsen, 1995)</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Canopy cover</td>
</tr>
<tr>
<td>Plant height (cm)</td>
</tr>
<tr>
<td>Comments</td>
</tr>
</tbody>
</table>

Sage Grouse broods use a variety of habitats during their development. In a Saskatchewan study young broods used silver sagebrush-grassland near nest sites for up to four weeks post hatching (Kerwin, 1971). Most broods (90%) then move to
succulent forb habitat, usually near water (Banasch, 1985). As broods mature they increase the amount of sagebrush in their diet and by autumn they move to sagebrush dominated habitats (Wallestad, 1971). In Canada, seasonal variations in nesting and brood rearing habitats are less noticeable than in the United States as most sagebrush habitat is associated with stream and river valleys.

Males and broodless hens use silver sagebrush-grassland vegetation types more and meadow habitats less than hens with broods (Kerwin, 1971).

Adult Sage Grouse preferentially select for creek bottoms and drainages where silver sagebrush occurs (Vriend and Gudmundson, 1995). Creek bottoms have more mesic conditions which produce taller, more robust plants for food and cover from avian predators than drier conditions. In addition, the local climate is milder in drainages which may reduce thermoregulatory expenditures by grouse (Hupp, 1987).

There is no significant differentiation between winter and summer habitat use. However, maintenance of sagebrush in drainages is a particularly important aspect of winter habitat management (Hupp, 1987; Remington and Braun, 1985) and may be the greatest limiting factor in Canada.

In the United States, habitat loss and degradation are believed to be related to the population decline (WSSGTC, 1995). In Canada, habitat loss due to agricultural conversion is not seen as a major problem in the recent population decline (Vriend and Gudmundson, 1995; Harris, pers. comm.). However, in the overall historical perspective 75% of the mixed grassland prairies have been ploughed or paved in the past (Holroyd, 1996) and this most certainly contributed to the overall long term decline.

**GENERAL BIOLOGY**

**Timing of lek activities**

Lek attendance by Sage Grouse varies according to health, reproductive stage, phase of the moon, snow cover, time of day, and presence of predators. In Alberta and Saskatchewan, lek activity can begin as early as late February depending on snow cover (Banasch, 1985; Harris and Weidl, 1988) and continues through to late May or early June (Banasch, 1985; Kerwin, 1971).

In Wyoming, peak attendance by females was about three weeks before that of males (Patterson, 1952). In Colorado and Idaho, female attendance peaked between the first and third week of April and then declined rapidly (Emmons, 1980) to less than ten percent of peak numbers after April 21 (Dalke, et al., 1963). Attendance at leks for subadult females was delayed about a week compared to adult female appearance at leks. Both adult and subadult females regularly had interlek movements between adjacent leks in a Montana study (Wallestad, 1975). Kerwin (1971) also found no evidence of interlek
movement by marked birds. This may have been either because of the significantly greater interlek distances in Saskatchewan, or because his sample size was limited.

Sage Grouse have a greater proportion of males attending leks than other lekking grouse (Emmons, 1980). Dominant Sage Grouse are consistently present almost every day and rarely move among leks. Subdominant males (subadults and less dominant adults) attend less frequently and rarely come within 40 feet (12.2 m) of the primary mating spots (Dalke, et al., 1963). Emmons (1980) found 79% of adult males and only 56% of subadult males attend leks during the peak attendance period for females (Emmons, 1980).

Dalke and his colleagues (1963) found a common peak for females and adult males (but different patterns) followed about ten days later by a peak for subadult males, after most of the females had quit the lek. Females attending leks after the peak are likely attempting to renest (Dalke, et al., 1963).

In Alberta, subadult males arrive at leks in mid-April with over 90% of all males present from April 26 to May 10 (Banasch, 1985). In Colorado, between 98-100% of adult males and 91-95% of subadult males attend leks in mid-May (Emmons, 1980).

The age and health of male Sage Grouse can affect their breeding success. Subadult Sage Grouse have reduced testicular development and lower spermatozoa production compared to adult Sage Grouse (Eng, 1963). Sage Grouse with chewing lice ((Lagopoeus gibsoni) and (Goniodes centrocerci)) or avian malaria are less likely than healthy males to be selected as mates by healthy adult females (Boyce, 1990). Subadult males (Eng, 1963) and diseased birds (Johnson and Boyce, 1991b) have lower reproductive success than mature and healthy males. Only 10 to 15% of male Sage Grouse are successful in breeding (Anon, 1996) so any reproductive advantage is important.

Fewer grouse participate in evening lek activities and those who do so remain for less time, dance with less intensity (Kerwin, 1971) and have a more scattered distribution than those engaging in morning lek activities (Weidl and Harris, 1987). Harris and Weidl (1988) suggested Sage Grouse begin dispersing from leks soon after sunrise and as the breeding season progresses. They also leave earlier the morning following an evening of bright moonlight (Harris and Weidl, 1988) when they can display at night. If no females are present at leks, male Sage Grouse also appear to lose interest in displaying and disperse early.

Accuracy of censusing Sage Grouse using lek counts is obviously dependent on timing. Initiation and length of lek activity is weather dependent and censusing must take into account annual weather variations if accurate population estimates are to be obtained. Estimates derived from single annual visits have a potential for erroneous population estimates. Repeat censuses over the long term are recommended to compensate for annual variations.
Nesting

Females initiate nesting soon after mating has occurred (Patterson, 1952). The average spacing between the laying of eggs is 1.3 days (Patterson, 1952). Girard (1935) found nests containing up to a dozen eggs, but the average clutch size is 7 to 9 eggs (Anon., 1996). Patterson (1952) reported 92.1% hatching success for 326 eggs. Incubation has been estimated to take between 25 and 27 days (Patterson, 1952; Dalke, et al., 1963). Chicks are precocial usually leaving the nest within an hour after hatching (Girard, 1935).

The largest brood seen by Girard (1935) was 11 chicks (n=3). Average brood size in Alberta was 3.4 chicks from July 8 to 26, 1985 (Banasch, 1985). Brood size declined in Wyoming from an average of 7.8 in the second week of June, to 5.2 in late July, to 3.8 in the second week of August (Girard, 1935). Average brood size in Saskatchewan was 4.5 chicks (Kerwin, 1971); however brood size was calculated according to the age of the chicks and no specific dates were provided to compare with other jurisdictions. Saskatchewan nesting success (hens with broods) was 61% (N=145) in 1970 and 41% (N=254) in 1971 (Kerwin, 1971).

Extra large broods are occasionally seen. Kerwin (1971) saw one brood of 15, a brood of 25 and a brood of 27 chicks under four weeks of age, each with one hen. Patterson (1952) reported a similar phenomenon which Kerwin (1971) proposed may be a dominant hen temporarily taking over broods. Another option is a “babysitter” may be on duty while the hens are off foraging. Adult females were more successful in raising broods than subadult females in a Montana study (Wallestad, 1975).

In terms of threats, lek nesting, and brood rearing habitats must be protected from disturbance if the species is to be given the best chance to increase in numbers. High quality cover is essential to both nesting and brood rearing.

Movements

Sage Grouse movements are commonly food related. Daily movements of Sage Grouse broods were modest, averaging 79 m (86 yards) in June, 202 m (221 yards) in July, and 131 m (143 yards) in August (Kerwin, 1971). Broods moved more in July than in June as they were larger and more able to travel to forage as their diet changed. When broods moved into hay meadows their daily movements decreased again (Kerwin, 1971).

Seasonal movements by adult Sage Grouse are greater than those of broods. Males moved a mean distance of 595 m (651 yards) from the lek in May and 660 m (722 yards) in June. The average daily movements of the adult males were 350 m (383 yards) in July and 376 m (411 yards) in August. These birds were moulting and adequate food and water was available locally so longer trips were not needed (Kerwin, 1971).

Longer distance movements may be caused by a lack of suitable winter habitat (Kerwin, 1971). Severe weather is thought to be responsible for the movement of Sage Grouse to more hospitable areas while milder weather results in dispersion of winter
flocks (Patterson, 1952). Flocks of hundreds flew southward over the Frenchman River at Eastend and Val Marie in late fall and early winter during the 1940s based on anecdotal reports (Harris, pers. comm.). Kerwin (1971) thought birds from his Frenchman River Valley study area move into Montana in the winter.

Although winter habitat may not be optimal, at least some Sage Grouse remain throughout the winter. Three Saskatchewan Christmas Bird Counts (CBC) are conducted annually Sage Grouse range. Sage Grouse were present in low numbers in five of 21 years on the Fort Walsh CBC (Houston, 1986; Houston, 1988; Harris, 1990). The Grasslands National Park CBC has recorded up to 19 individuals in seven of nine count years (Harris, 1991). The Govenlock CBC had Sage Grouse in 17 of 18 counts ranging from zero in 1992 (Harris, 1993) to 106 in 1979 (Renaud, et al., 1988). The 1979 count was carried out in blizzard conditions and the 106 grouse were walking into sage flats from surrounding areas (Harris, pers. comm.). Until 1986, a total of 248 Sage Grouse had been recorded on 25 counts over 45 years (Renaud, et al., 1988).

Social segregation

Sage Grouse are gregarious but generally organize themselves in separate flocks according to age and sex. Flocks of males are largest when birds from different leks gather to feed and rest for the day and smallest when they are moulting later in the summer (Patterson, 1952). By comparison, females are at a minimum in flock size at lekking time due to solitary nesting activities (Kerwin, 1971).

Diet

Sage Grouse have dietary requirements that vary with age, reproductive stage and season. Female Sage Grouse consuming high nutrient food (16-56% forbs) produce larger clutches and have larger healthier chicks than hens on nutritionally poorer diets (Barnett, 1992).

The primary food during the first week of a chick's life are insects (Klebenow and Gray, 1968). Insects use declines steadily from a high of 60% in one-week-old chicks to 5% in 12-week-old juveniles (Peterson, 1970). Chicks consume increasing amounts of forbs as insects decrease as a dietary component. Peterson (1970) found that one- to 13-week-old chicks preferred yellow goat's-beard (Tragopogon dubius), dandelion (Taraxicum officinale), pasture sage (Artemisia frigida), lobed prickly lettuce (Lactuca serriola), and alfalfa (Medicago sativa) over other plant species. Sagebrush becomes increasingly important to the chicks as they approach three months of age (Peterson, 1970).

Sagebrush provided 64% by volume of the food of 135 harvested Sage Grouse, followed by various forbs at over 23%, snowberry (Symphoricarpos rotundifolius) at 5%, with other items such as insects forming the remainder (Leach and Hensley, 1954). Kerwin (1971) noted that Sage Grouse in Saskatchewan consume thorny buffaloberries (Shepherdia argentea) and saskatoons (Amelanchier alnifolia). Adults consumed
19 percent by volume insect matter in August and none in September (Peterson, 1970). The change in diet may be due to the differing availability of insects.

Banasch (1985) found adult birds were less tied to succulent vegetation habitats than broods and were on average 110 metres from succulent forbs. A breakdown of feeding habitats included forage (45%), wet meadows (15%), light sage (13%), snowberry (8%), cereal (5%), and ditches (2%). Sage Grouse also consume considerable quantities of Alfalfa, clover, field peas, beans and potatoes in agricultural parts of Wyoming (Patterson, 1952).

The availability of water is also important to Sage Grouse distribution. Grouse prefer to drink running water, one to three times a day (Girard, 1935) and population densities are highest when surface water supplies are abundant and well distributed for use by Sage Grouse (Patterson, 1952).

The dietary requirements and location of Sage Grouse change as the birds develop and with the availability of their preferred food items. Sage Grouse consuming a nutritionally sound diet have better reproductive success than those eating a lower quality diet. Sage Grouse which are growing rapidly or are initiating reproductive stages eat a more nutritious diet than other Sage Grouse. The availability of moist or wet areas which have higher insect populations are essential to successful brood rearing.

**Captive Breeding/Transplanting/Lek relocation**

Sage Grouse have been translocated into Oregon, New Mexico, British Columbia, Montana, Wyoming, Idaho (Anderson, 1990) and Saskatchewan (Baran, pers. comm.). The earliest known transplant of Sage Grouse was of 200 birds taken from Wyoming and released in New Mexico beginning in 1936 (Patterson, 1952). Large numbers of Sage Grouse have been moved from one site to another over the years with little success.

Patterson (1952) captured and relocated 5881 Sage Grouse between 1940 and 1951. Sage Grouse returned to the area in which they were trapped from a distance of about 100 miles when the release site was south of the trapping site (Patterson, 1952). Fifty-seven juvenile Sage Grouse from Oregon were taken to an area north of Richter Lake, British Columbia. This relocation was seen as a failure because the birds were observed moving towards the United States. However, Sage Grouse were reported in the vicinity of Osoyoos in 1962, 1963, and 1966. Occasional reports of Sage Grouse persisting in the Richter Pass area are not confirmed (Cannings, et al., 1987). Transplant efforts resulted in relatively few birds appearing at leks in the release localities (Patterson, 1952).

Translocated Sage Grouse have low initial survival upon release. Sage Grouse were captured and released in Idaho during spring of 1986 and 1987. Relocated birds had lower (P=0.0001) survival in the first three weeks than during weeks four to 22. Five leks and seven nests resulted from this relocation (Musil, 1987).
In Saskatchewan, an attempt to reintroduce Govenlock Sage Grouse to the Saskatchewan Landing area in 1972 met with failure. Only one bird was caught due to persistent rain and on release the lone Sage Grouse flew out into the South Saskatchewan River where it perished (Roy, 1996; Baran, pers. comm.).

Sage Grouse are difficult to raise in captivity. At the Buttes Environmental Research Facility in Laramie, Wyoming they have been kept since 1985 and successfully reproduced after displaying in artificial leks (Spurrier, et al., 1994b). In another trial, captive breeding was deemed unsuccessful due to disease. Of 148 chicks captured, only eight chicks survived to maturity. These produced 41 eggs of which only 13 hatched and only two chicks survived beyond a few days (Johnson and Boyce, 1991a). Captive breeding is apparently marginal in terms of producing Sage Grouse for release.

An alternative strategy of moving dancing grounds has also been tried. Weichel and Hjertaas (1992) reported a relocation of an entire lek by Eng, et al. (1979). The lek site was relocated 3.2 kilometres to mitigate coal extraction activities at the original site. A four hectare area between the wintering area and the original lek was cleared of snow and sagebrush. Silhouettes and audio recordings of grouse displays were used to attract birds to the new site in two successive springs. Although the new lek was used, numbers declined over time.

Transplanting in Canada is possible as there may be the potential to obtain chicks from the Buttes facility. However, it is not recommended because:

- the cause of the general population decline is uncertain and it would be premature to initiate such an expensive program without sufficient causal data;
- transplanting Sage Grouse has met with limited success;
- Sage Grouse genetics have yet to be examined and relocation may result in inadvertent dilution of gene pools.

**LIMITING FACTORS**

The specific factors contributing to the recent decline in Sage Grouse distribution and abundance have not been identified. Factors shown to limit reproduction, survival, and expansion of some Sage Grouse populations are habitat degradation and conversion, human disturbance, development-related activities, inclement weather, predation, parasites, hunting, and collisions. Other factors which may have a significant effect on Sage Grouse populations are possible but have not been identified.

**Habitat**

Eustace (1995a) identified the conversion of Sage Grouse habitat to agricultural land in the United States as a major contributor in the decline in distribution and
abundance of the species. Between 1937 and 1967, five to six million acres of sagebrush range was eliminated in the United States (Schneegas, 1967).

The removal of sagebrush by the use of herbicides can reduce habitat quality and restrict Sage Grouse distribution. In one study, 96% of Sage Grouse were found in an unsprayed field, a quarter the size of the sprayed field (Martin, 1970).

Grazing

Certain grazing management practices can be detrimental to Sage Grouse. Season-long grazing reduces regrowth and residue that can affect nesting success (Anon., 1996). Heavy grazing removes vegetation which provides food, nest cover and insect habitat. Patterson (1952) found nesting density, in a moderately grazed pasture was one nest in nine acres (3.6 ha) compared to one nest in 23.5 acres (9.5 ha) in an overgrazed pasture. Long term heavy grazing weakens grasslands and is especially detrimental during drought (Abouguendia and Coupland, 1985).

Human disturbance

Petroleum developments are putting pressure on Sage Grouse and their habitat in Alberta (Dube, 1985) and Saskatchewan. During the winter of 1984/1985, oil well drilling and seismic exploration occurred on or near three leks in Alberta and in 1994 one well was drilled near a lek in Saskatchewan. Research was not carried out to ascertain the cause of reduced activity at these leks, however, increased traffic, roads and other human disturbances from the oil and gas developments decrease the chance for Sage Grouse to recover (W. Harris, 1995).

Sage Grouse are also prone to injury and death due to collisions with human made objects such as fences, power poles, and farm vehicles (Wallestad, 1975). In Saskatchewan juvenile Sage Grouse were killed by hay mowers (Kerwin, 1971).

Predation

Predators may effect Sage Grouse populations depending on the size of the predator and distribution and abundance of other prey populations. Golden Eagles (*Aquila chrysaetos*) are the most important aerial predator of grouse on leks (Hartzler, 1974). Sage Grouse avoid areas within 0.8 km (one-half mile) of powerlines because they are used as hunting perches by raptors (Anon., 1996).

The recently reintroduced swift fox (*Vulpes velox*) (Carbyn, 1996) is a potential predator of young Sage Grouse (Vriend and Gudmundson, 1996); however, limited data showed no evidence of swift fox predation but a more comprehensive evaluation is being carried out (Moehrenschlager, pers. comm.). Bobcats (*Felis rufus*) (Hartzler, 1974), weasels (*Mustela arizonensis*), domestic cats (*Felis domesticus*) (Girard 1935), and coyotes (*Canis latrans*) are reported predators of Sage Grouse (Harris and Weidl, 1988).
Eustace (1995) found no correlation between coyote and Sage Grouse numbers in a Montana evaluation. Guthery (1995) also determined that coyote predation has little effect on northern bobwhite (Colinus virginianus) or wild turkey (Meleagris gallopavo) recruitment. However, in Washington State predation was implicated in limiting population growth and causing 50% of Sage Grouse mortality (Wash. Dept. Fish and Wildl., 1995). Vriend and Gudmundson (1995) feel the impact of predators, such as coyotes cause short term but substantial fluctuations.

In Alberta, coyote numbers increased 135% between 1977-1989 and 1995-1996; the majority of the increase occurred during the 1990s (Gudmundson, 1996). Richardson’s Ground Squirrel, Pronghorn Antelope, White tailed Jackrabbits, and other species which formed the prey base for coyotes are reduced in abundance. Coyotes may be hunting Sage Grouse opportunistically in Canada.

The effects of predators on Sage Grouse populations in Canada is unknown but some predator populations such as Coyotes have increased considerably. Predator impact may be greater in areas of low quality cover than under improved cover conditions, when more search effort would probably be required to successfully locate a Sage Grouse nest, chick, or adult.

Other

The use of pesticides in general does not appear to be a significant factor because these products are not used to a great extent in the Canadian range of the Sage Grouse. Studies in the United States have identified mortality and injury resulting from insecticide poisoning. In particular, organophosphates which are contact and systemic insecticides are highly toxic to birds (Ali, 1996). Thirty to 64% of Sage Grouse exposed to dimethoate (an organophosphate) died and those that survived experienced depressed brain Cholinesterase (ChE) activity a symptom typical of organophosphate poisoning (Blus, et al., 1989).

Sage Grouse are hosts to parasites which effect survival. The most significant parasite of juvenile Sage Grouse in Saskatchewan is the tapeworm (Raillietina centroceri) which was a factor in 59% of evaluated juvenile mortality (Kerwin, 1971).

SPECIAL SIGNIFICANCE OF SAGE GROUSE

Sage Grouse are very showy when displaying on their leks and are among the 50 most sought after species of wildlife for viewing in Alberta. Tours to leks are offered by the Police Point Interpretive Centre (Butler, 1990) and Nature Saskatchewan. These tours are small and they help make people aware of the species and its habitat but they should have distance restrictions. Restricted lek viewing is applied in Washington state to reduce flushing which has been reported in Colorado. Washington is concerned lek viewing tours may be having an impact on breeding of Sage Grouse (Wash. Dept. Fish and Wildl., 1995).
The habitat of the Sage Grouse is home to many uncommon and species of conservation concern such as black-tailed prairie dog (*Cynomys ludovicianus*), swift fox, Long-billed Curlew (*Numenius americanus*), Mountain Plover (*Charadrius montanus*), Loggerhead Shrike (*Lanius ludovicianus*), Sage Thrasher (*Oreoscopites montanus*), Burrowing Owl (*Speotyto cunicularia*), and Ferruginous Hawk (*Buteo regalis*). Eastern short-horned lizard (*Phrynosoma douglassi brevirostre*), eastern yellow-bellied racer (*Coluber constrictor flaviventris*) and prairie rattlesnake (*Crotalus viridis viridis*) may also be found in their environs.

In addition to the above animals, plant species with fewer than six known locations may be found in the Saskatchewan range of Sage Grouse. Some of these plants are: picradeniopsis (*Bahia oppositolia*), tall woolly-heads (*Psilocarphus elatior*), dense flower knotweed (*Polygonum polygaloides*), and one-spoke oat grass (*Danthonia unispicata*).

Sage Grouse are only one of the grouse species to show recent declines in their population. The five native grouse species in Montana, regardless of habitat, declined in numbers and recorded their lowest harvest levels in 36 years during 1993 (Eustace, 1996). Sharp-tailed Grouse in Saskatchewan have experienced a substantial decline in the last decade but have increased in the last two years (Harris, pers. comm.). In addition, the Greater Prairie-Chicken (*Tympanuchus cupido*) which once lived in the southern parts of the prairie provinces is now officially extirpated in Canada (Johnsgard, 1975). As the above list of species of concern indicates, there is a significant widespread undetermined problem with the grassland ecoregion which is affecting a wide array of species.

EVALUATION AND PROPOSED STATUS

The Sage Grouse's restricted habitat, marginal distribution and range, and lek mating system would justify a vulnerable category if populations were higher and stable. However, the species is experiencing a serious overall range-wide decline and is extirpated in three states and one province. The recent downward population trend, high lek abandonment rate, and very low population size are most serious in Canada.

Lek attendance is down in both Alberta and Saskatchewan from historic levels. In Alberta, the number of males at active leks averaged 13.6 during the 1990s, exhibiting an all-time low of 8.8 males per lek in 1994, increasing to 15.2 in 1997. The low record of 1994 represents a 62% decrease from the average of 23.3 males per lek during the 1968 to 1989 period, while the average for the 1990s is a reduction of 42%. Saskatchewan's active leks had an average of 28.4 males each compared to 6.1 males in 1997. Not only are there fewer birds on leks, but the number of active leks has decreased. The number of active leks in Alberta has decreased from 21 in 1968 to only 8 in 1997, an average abandonment rate of 2.1% per year. More recently, the decrease has been from 12 active leks in 1989 to 8 in 1997 (33% reduction), for an average abandonment rate of 4.2% per year over the past 8 years, double that of the long term rate. Saskatchewan has averaged 7.2% abandonment rate per year between 1987 and 1997.
British Columbia's population is extirpated. Saskatchewan populations have decreased over 80% since 1987-88. There is a strong indication from spring lek counts that Alberta's population has declined considerably. Although there is no reliable estimate of the total Alberta population, it could be well below 1000 birds. Further decreases in populations in both Alberta and Saskatchewan are expected if current trends continue.

The major factors affecting Sage Grouse appear to be weather (related habitat degradation), poor reproductive success, development, predation, accidents, and disease. There are also problems which have not likely been identified and may be crucial to the survival of Canada’s Sage Grouse. All these factors increase in significance when consideration is given to the fact that the species is at the northern limit of its range in Canada and the silver sagebrush is marginal as habitat and forage compared to the big sagebrush.

Considering the above information it is recommended that the Prairie population of Sage Grouse (*Centrocircus urophasianus urophasianus*) be listed as endangered and the British Columbia population (*Centrocircus urophasianus phaios*) be listed as extirpated.

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LITERATURE CITED


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No information available at this time.