MANAGEMENT PLAN AND CONSERVATION STRATEGIES FOR GREATER SAGE-GROUSE IN NORTH DAKOTA

PREPARED UNDER DIRECTION OF
NORTH DAKOTA GAME AND FISH DEPARTMENT
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EXECUTIVE SUMMARY

Growing concern about the status of sagebrush (*Artemisia spp*.) on western rangelands and declines in sage-grouse (*Centrocercus urophasianus*) numbers led to petitioning the Fish and Wildlife Service of the U. S. Department of Interior to protect populations in some western states under provision of the federal Endangered Species Act (ESA). Loss of sagebrush-grasslands in some western states has approached or exceeded 50 percent. Such habitat loss in North Dakota may be a factor in the decline of sage-grouse in the state. In December, 2004, the USFWS ruled that the Greater sage-grouse does not warrant protection under the ESA.

A Memorandum of Understanding (MOU) for the conservation and management of sage-grouse was signed by member states of the Western Association of Fish and Wildlife Agencies (WAFWA) and federal natural resource management agencies. Members of these organizations have agreed to work cooperatively to develop conservation plans for sage-grouse in each of eleven western states.

Purpose of the Plan

The mission of the North Dakota Game and Fish Department (NDGFD) is to protect, conserve and enhance fish and wildlife populations and their habitats for sustained public consumptive and appreciative use. The NDGFD operates under a series of legal mandates, comprised of legislation and legislative intent that dictates the Department's responsibilities and its authorities in carrying out these responsibilities. The *Management Plan and Conservation Strategies for Sage-grouse in North Dakota* was developed to fulfill the mission statement as it relates to sage-grouse in North Dakota.

Distribution and Habitat Needs of Sage-grouse

Sage-grouse are native to the sagebrush steppe of western North America and their distribution closely follows that of sagebrush, primarily big sagebrush (*A. tridentata*). Distribution of sage-grouse in North Dakota is restricted to approximately 800 square miles in western Bowman County, western Slope County, and southern Golden Valley County.

Sage-grouse in North Dakota are largely non-migratory, although there may be some short seasonal movements between summer and winter habitats. The following seasonal habitats are important for survival of sage-grouse:

- *Breeding Habitat:* Strutting grounds or "leks" where breeding actually occurs, are key activity areas and most often consist of clearings surrounded by sagebrush cover. Literature reports that sagebrush canopy cover at feeding and loafing sites in the vicinity of leks is 20-50 percent with an average of 32 percent.

- *Nesting Habitat:* Sage-grouse invariably prefer sagebrush for nesting cover, and quality of nesting cover directly influences nest success. Successful nesting requires concealment provided by a combination of shrub and residual grass cover. Sage-grouse most frequently select nesting cover with a sagebrush canopy of 15-31 percent. Research findings suggest that about two-thirds of nests occur within two miles of a lek.

- *Brood-rearing Habitat:* Areas providing abundance and diversity of succulent forbs, an important summer food source for young sage-grouse, provide key brood-rearing habitat. Research indicates that sage-grouse broods prefer relatively open stands of sagebrush during

summer, generally with a canopy ranging from 1-25 percent. As palatability of forbs declines, sage-grouse move to moist areas that still support succulent vegetation, including alfalfa fields, roadside ditches, and other moist sites. During summers of high precipitation, sage-grouse may remain widely distributed throughout the entire summer due to the wide distribution of succulent forbs.

- *Winter Habitat:* Sage-grouse generally select relatively tall and large expanses of dense sagebrush during winter. Wintering areas include sagebrush stands on relatively flat sites with a 20 percent canopy and an average height of 10 inches. The importance of shrub height increases with snow depth. Snow depth can limit availability of wintering sites to sage-grouse.

Population Dynamics

From 1946 through 1951, sage-grouse population surveys consisted of observers walking through big sagebrush areas and noting numbers of sage-grouse flushed. This provided a crude index of sage-grouse population numbers on an annual basis. In 1951, birds were located and counted while they were on their strutting grounds in March and April. Two years later, in 1953, an aircraft was used to locate grounds and make spring counts. Most counts were then made by air until the 1960's when a gradual shift was made from air to ground counts. Today all counts are made from the ground while most surveys (searching for grounds) are made by air.

During early Dakota territorial and statehood years annual sage-grouse seasons were opened concurrently with sharp-tailed grouse and prairie chickens. The season on sage- grouse was closed in 1923 but was re-opened in 1964 and has been open every year since that time except for 1979. Season regulations (few days, one bird limit, mid-week season) limits hunter participation and harvest while allowing nearly everyone who so desires to hunt sage-grouse.

Wing data have been gathered annually since the season was re-opened in 1964. The small population and Department regulations to restrict harvest have resulted in a very limited sage-grouse wing collection. A post card survey collects data pertaining to days hunted, area hunted, and hunter success. Estimates over the last fourteen years indicate averages of 124 hunters per year and 47 sage-grouse harvested per year which is a hunter success rate of about 38 percent.

Juvenile mortality during the first few weeks after hatching is typically high and can increase when drought reduces availability of important food sources, such as insects and forbs, or herbaceous understory, used as hiding and escape cover. Survival rates for adult sage-grouse are generally considered to be high, and thus population declines are usually not related to high levels of predation on adult birds. Adult hens are most vulnerable to predation during the nesting period, whereas adult males are most vulnerable during the spring breeding season.

Issues Requiring Conservation Actions

During the conservation planning effort, eight risks to sage grouse and their habitat were identified. Twelve issues are listed with possible conservation actions to reduce those risks. The issues are:

- *Fire Management:* Benefits, detriments, and relative frequency of fire on sage-grouse habitats often are subjects of disagreement. Use of prescribed fire in the sagebrush community can result in a net loss of sagebrush and concerns those desiring to maintain a mature sagebrush community. Some land managers consider fire an effective tool to manage sagebrush stands

with dense sagebrush cover and suppressed herbaceous cover. Both prescribed and wild fires can have cumulative effects on sagebrush habitat and wildlife species that depend on it.

- *Grazing Management:* Many western rangelands were over-stocked with livestock in the late-1800s and early 1900s, thus altering the composition and productivity of some sagebrush and other vegetative communities. Effects of livestock on sage-grouse habitat, and on the birds, may be positive, negative, or neutral depending on the specific grazing prescription and on the ecological site. To minimize the potential impact of removing important understory vegetation, flexible grazing management programs need to be planned and implemented while considering needs of sage-grouse. Research is needed to identify and evaluate effects of various grazing management plans on the interaction of sage-grouse, commodity production, and other societal values.

- *Harvest Management:* Sage-grouse generally have a low average productivity rate, but also are one of the longest lived. Although some believe that hunting is detrimental, direct effects of hunting on sage-grouse are small when compared to other forms of mortality. A strategy of adaptive harvest management should be implemented to reduce uncertainty about effects of harvest on sage-grouse populations.

- *Noxious Weed Management:* Landowners/managers have a statutory responsibility to develop management plans for treatment of noxious weeds on land they own and/or manage. Noxious weeds displace more desirable native plant species and cause significant adverse biological and economic effects by reducing productivity of healthy rangeland. Chemical control of weeds is efficient although it poses some short-term toxicological risk to sage-grouse and other wildlife. Reduction of forbs important to sage-grouse during brood rearing could have more serious consequences, with the magnitude of these effects dependent on the scale of treatment.

- *Mining and Energy Development:* Many of the nation's oil and gas resources lie under sage-grouse habitats across the western U.S., from which development and production activities could potentially affect sage-grouse if habitats are lost, fragmented, or degraded. Effects of oil and gas development on sage-grouse are not extensively documented, however, and long-term impacts after reclamation are not clearly understood.

- *Outreach and Education:* Effective conservation of sage-grouse requires collaboration between federal and state land and wildlife managers, private landowners, extension service, and other interests to develop and implement appropriate regional protection strategies. Most information about shrub-steppe habitats and sage-grouse is contained in technical manuscripts. However, conservation of sage-grouse and other sagebrush-associated species requires local involvement and user friendly information.

- *Power Lines and Generation Facilities:* Power lines provide additional hunting perches for raptors in otherwise treeless areas. Power lines most likely impact grouse near leks, in brood-rearing habitat, and in wintering areas that also support large numbers of wintering raptors. Construction of new power lines contributes to habitat degradation when accompanied by new roads or other infrastructure, e.g., pipelines, fences, etc. Utilities commonly make power poles safe for raptors to use as perches, which poses a dilemma in sage-grouse habitat.

- *Predation:* The effects of predators on sage-grouse populations and issues surrounding predator control concern landowners, wildlife managers, and the public. Composition and abundance of

avian and mammalian predator populations have changed since termination of widespread predator control in the early 1970s. Although many native mammals and birds may prey upon sage-grouse eggs, juveniles, or occasionally adults, grouse populations cycle from lows to highs despite ongoing predation. Predators taking wildlife is an expected component of natural mortality.

- *Recreational Disturbance:* Sage-grouse may draw human recreational activities such as viewing, monitoring, and photographing, to seasonally important habitats. Monitoring sage-grouse populations and habitats is essential at leks and other critical habitats. Recreation and monitoring should be considered cumulatively as part of assessing approaches for managing human disturbance of sage-grouse.

- *Roads and Motorized Vehicles:* Roads and off-road travel can impact sage-grouse and their habitats in a variety of ways that include habitat fragmentation and loss and a potential decline and/or shift in grouse populations. Vehicle use, both on and off roads, has increased significantly over the past few years and has impacted habitat quality. Severity of impacts may be directly related to the amount of vehicle travel occurring.

- *Vegetation:* Past management of rangelands, including plowing, has altered the density, structure, composition, and presence of sagebrush communities and has in some cases created a variety of conditions that do not meet the desired condition described for sage-grouse seasonal needs. Restoring or enhancing sage-grouse habitats requires diverse strategies. Disagreements often arise regarding the ecological role, or successional relationships, of "old" or "decadent" stands of sagebrush, the need to manipulate sagebrush communities, method of control, and extent of treatment.

- *Managing Other Wildlife in Sage-grouse Habitat:* The effect of other species of native herbivores, e.g., large ungulates and prairie dogs, on habitats that they share with sage-grouse may be problematic if intensive use and foraging degrades the quality of habitats that grouse use for nesting and brood-rearing. Streamside riparian areas, springs, wet meadows, and other mesic sites, which also attract other herbivores, become increasingly important as the summer season progresses. Periods of drought often increase adverse impacts. Successfully resolving or mitigating these potential conflicts with wild herbivores depends on willingness of managers to objectively assess impacts that might occur as a result of excessive herbivory and other land uses.

In developing conservation strategies, North Dakota utilized published guidelines for sage-grouse populations and habitats (Connelly, J.W., M.A. Schroeder, A.R. Sands, and C.E. Braun. 2000. Guidelines to manage sage-grouse populations and their habitats. Wildlife Society Bulletin 28(4):967-985) and drew extensively from the Montana state plan (Montana Sage-Grouse Work Group. 2004. Management Plan and Conservation Strategies for Sage-grouse in Montana-Final. Montana Fish, Wildlife and Parks, Helena. 131 pp + appendices.). Appreciation is extended to Montana for permission to use much of their plan.

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INTRODUCTION

A growing concern over loss and fragmentation of big sagebrush *(Artemisia tridentata)* (hereinafter referred to as sagebrush) in western states that support Greater Sage-grouse (*Centrocercus urophasianus)* populations resulted in eight petitions being filed with the Fish and Wildlife Service of the U.S. Department of Interior (FWS) to protect sage-grouse under provisions of the Endangered Species Act (ESA). A summary of these petitions can be found at the following web site: http://nevada.fws.gov/public/petitionsummaryJan04.pdf In December, 2004, the Fish and Wildlife Service ruled that the Greater sage-grouse does not warrant protection under the Endangered Species Act.

Loss of sagebrush in some western states has approached or exceeded 50 percent (Dobler 1994, Knick 1999). Estimates of regional declines in sage-grouse have ranged from 17 to 47% throughout their range and fewer than 2000 breeding males are estimated to inhabit North Dakota (Connelly and Braun 1997; Braun 1998). Recent census data obtained by the ND Game and Fish Department show a decreasing trend in total males counted over the last 25 years while number of sage-grouse males/strutting ground has not changed significantly over the same period (ND Game and Fish Dept. unpublished data).

Purpose of the Plan

The mission of the North Dakota Game and Fish Department is to protect, conserve and enhance fish and wildlife populations and their habitat for sustained public consumptive and appreciative use. The Game and Fish Department operates under a series of legal mandates, comprised of legislation and legislative intent that dictates the Department's responsibilities and its authorities in carrying out these responsibilities. The *Management Plan and Conservation Strategies for Sage-grouse in North Dakota* was developed to fulfill the mission statement as it relates to sage-grouse in North Dakota.

Goal of the Plan

The goal is to provide for long-term conservation and enhancement of sagebrush steppe/mixed-grass prairie habitats in North Dakota in a manner that will support a self-sustaining sage-grouse population, a diversity and abundance of other wildlife species, and human uses.

This plan provides biological information, identifies where information gaps exist and will facilitate data collection required for future management decisions. The plan is meant to be adaptive in allowing for the incorporation of new information into conservation actions that the plan describes and is intended to be flexible enough to adapt to local situations. It establishes a format to achieve objectives established by the plan for both sage-grouse populations and their habitat and to guide local management. It lays out a framework that allows for local and public input that will be instrumental in implementing conservation actions and delineates possible sources for securing funding and resource information related to sage-grouse and their habitats.

This plan will also serve to help the Western Association of Fish and Wildlife Agencies (WAFWA) in their efforts to provide the FWS with information pertinent to evaluation of conservation efforts that are being directed at assuring long term viability of sage-grouse throughout their range.

Several other conservation plans have been developed by individual states to address sage-grouse declines in those states. In developing this plan North Dakota relied heavily on work that those states (particularly Montana and Wyoming) have done and have used those plans as a template for this work.

Given the close proximity and association of sage-grouse populations in North Dakota with populations in Montana and South Dakota this plan attempts to recognize problems and conservation efforts that reflect our local situations but will remain compatible with conservation efforts being implemented in those states.

Elements of the plan as directed by the ESA and the PECE policy

In dealing with the ESA the FWS has established five criteria that it takes into consideration when it receives a petition for listing a species. These criteria are used in analyzing available data and threats to the species. The five categories that the FWS uses to assess populations at risk are:

1. Present or threatened destruction, modification, or curtailment of habitat or range;
2. Overuse for commercial, recreational, scientific or educational purposes;
3. Disease or predation;
4. Inadequacy of existing regulatory mechanism;
5. Other natural or manmade factors affecting the species continued existence.

In addition, in 2003 the FWS adopted a set of criteria for evaluating conservation plans. This Policy for Evaluation of Conservation Efforts (PECE) was printed in the Federal Register Vol. 68, March 28, 2003. This policy directs that any conservation action that is undertaken under the auspices of a species conservation plan must include an evaluation that will allow the FWS to determine if the action is truly a conservation effort that will be implemented.

In order for a conservation effort to affect the listing decision, PECE requires the FWS to ensure that the effort's implementation is highly probable and will be sufficiently effective. In order to make that evaluation all proposed conservation actions must include the following:

1. To assess the certainty that the action will be implemented:
    A. Describe staffing and funding;
    B. Describe the legal authority of the parties agreeing to the conservation effort and provide proof of their commitment to proceed;
    C. Describe any legal procedure that must be followed in order to implement a project and provide proof that the requirements have been met;
    D. Describe any permits or permission that must be obtained to proceed with the effort and provide information indicating why you think these will be obtained;
    E. Provide information on who will be participating in the action and estimates of what level of participation is expected;
    F. Laws needed to implement an action must already be in place;
    G. Provide information stating why you believe the funding for the action will be forthcoming;
    H. The action has a schedule to begin and end;
    I. Proof all parties involved with the action are in agreement to its implementation.

2. To assess the effectiveness of the action:
    A. Describe the nature and extent of the threats and how the action will reduce those threats;
    B. Describe incremental objectives for the action and dates when they are expected to be attained;
    C. Identify the steps necessary to implement the action;

D. Identify the scientific parameters that will be used to monitor progress and how they will be measured;
E. Provide progress reporting schedules and parameters;
F. Show that principles of adaptive management are incorporated in the action.

The project must have explicitly stated objectives and dates for achieving them, steps necessary to implement the efforts, and standards for measuring progress. In addition, laws and regulations necessary to implement the conservation effort must be in place and there must be a high level of certainty that funding is available to carry out the project.

MOU's entered into with WAFWA

Growing apprehension about the status of sagebrush steppe, declines in sage-grouse numbers and concern about the long term viability of the species prompted the WAFWA and federal natural resource management agencies to enter into a Memorandum of Understanding (MOU) in July 2000. Under that agreement the western states, the U.S. Forest Service (USFS), the Bureau of Land Management (BLM) and the FWS agreed to cooperatively develop plans for the long term conservation of sage-grouse.

WAFWA Guidelines

The Western Association of Fish and Wildlife Agencies charged a team of biologists to update sage-grouse habitat management guidelines (Braun et al. 1977). The updated guidelines (Connelly et al. 2000) were written to pre-empt, reverse, or mitigate population declines and maintain viable populations of sage-grouse.

The WAFWA guidelines, based on a compilation of literature, describe site conditions required to meet seasonal habitat needs of sage-grouse. However, the guidelines do not describe a desired condition for habitat on a landscape scale, plant composition, and structural characteristics across all sagebrush communities in which sage-grouse occur. For that reason, some federal agencies are currently developing a strategy to assess landscapes, meet WAFWA guidelines for sage-grouse, support communities of other animals that use sagebrush habitats, and prescribe management strategies at multiple scales.

The guidelines acknowledge information gaps and regional variation in habitat structure and composition and suggest that local biologists apply quantitative data from habitat and population monitoring to address local conditions. This planning process has considered the WAFWA guidelines as a technical reference to develop conservation strategies that will maintain or enhance sage-grouse populations and habitat.

Federal agencies have agreed to incorporate sage-grouse guidelines when authorizing any activities or revising land use and activity plans in areas where sage-grouse are known to occur. An Interagency Steering Committee representing BLM and USFS has been formed to address sagebrush habitat and conservation planning issues across federal and state boundaries and develop a consistent approach for incorporating conservation needs into federal land management plans.

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SECTION I: STATUS OF SAGE-GROUSE

GEOGRAPHIC DISTRIBUTION

North America

Sage-grouse are native to the sagebrush steppe of western North America. Their distribution closely follows that of sagebrush, primarily big sagebrush (Braun 1998). The species originally occupied portions of 16 states and three Canadian provinces. Sage-grouse presently occur in 11 western states and two provinces, having disappeared from scattered areas around the periphery of its original range, including Arizona, British Columbia, Kansas, Nebraska, New Mexico, and Oklahoma. Much of the species' historical range has been greatly reduced by alteration or elimination of sagebrush habitat (Aldrich 1963) (Figure 1).

North Dakota

The sage-grouse is the largest member of the North American grouse family and second only to the wild turkey in size of all the gallinaceous birds in America. In pioneer times this grouse was the leading upland game bird in nine western states. The species was never widespread in North Dakota and is presently confined to the southwestern portion of the state (Johnson and Kune 1989). The North Dakota population is not isolated but is contiguous with sage-grouse populations in Montana and South Dakota.

Credit for first visual sighting of the sage-grouse has been extended to the Lewis and Clark Expedition. Although these men apparently did not see the bird in North Dakota they did report it in the vicinity of the Marias River in Montana on June 5, 1805. They later reported it to be common west to the plains of the Columbia River.

Unlike sharp-tailed grouse there has been meager prehistoric and historic evidence to suggest that sage-grouse were ever present in North Dakota beyond their present range. Sage-grouse are at the present time limited to southwestern North Dakota where scattered populations are found in three counties; Bowman, Slope, and Golden Valley (Figure 2).

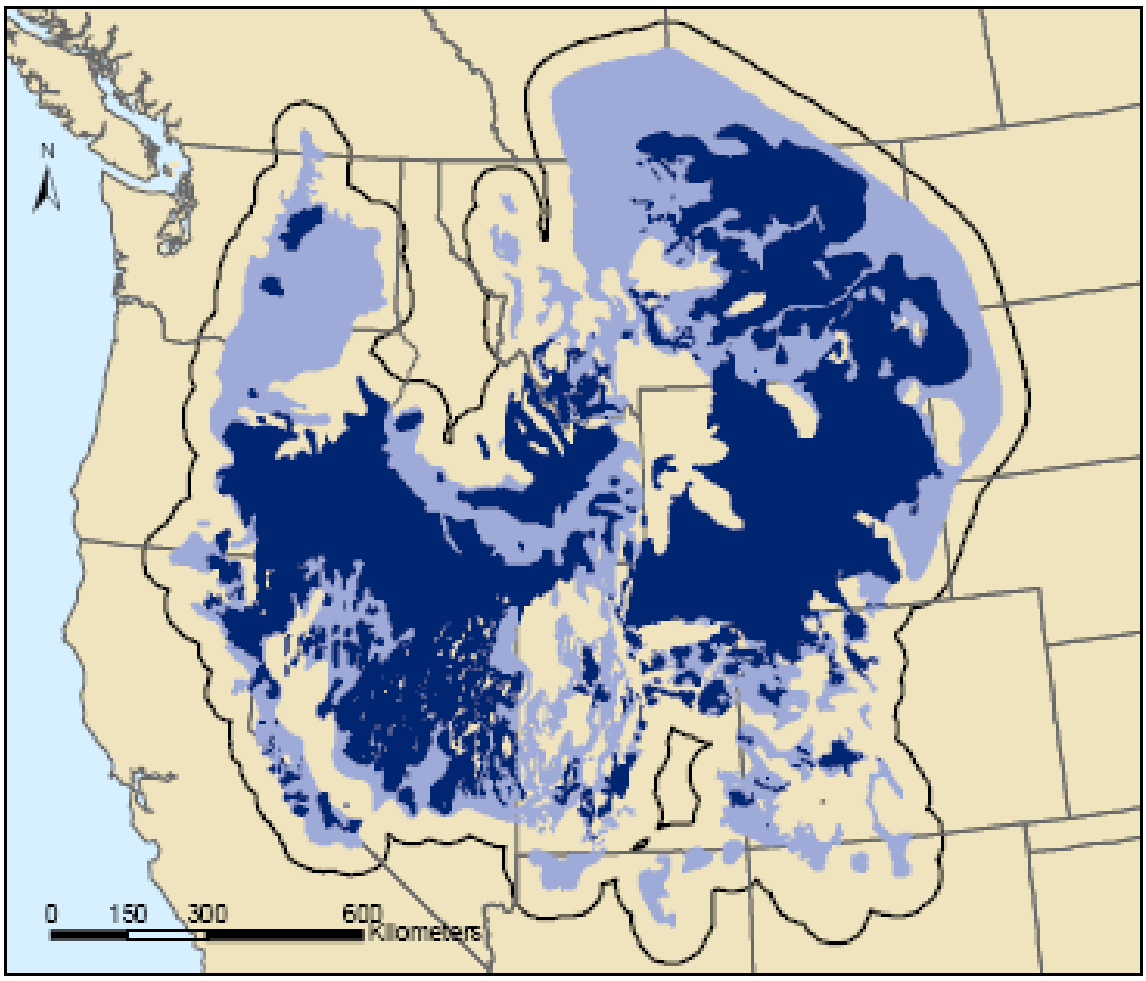
Archeologists report sage-grouse remains have been found at only two of 29 sites where sharp-tailed grouse remains were found in numerous digs made in the Dakotas the past 25-30 years. The two sites where they were found were in the Indian village, Like-A-Fishhook, and the white man's Fort Stevenson military post. Both sites are in McLean County and date from the second half of the 19th century. Based on the sample size of only a few birds at both sites it's highly probable the birds were killed on a hunt farther to the west of both village sites. In the case of the Indian village they may have been killed and their feathers saved to be used on ceremonial fetes (Johnson op. cit.).

Although Audubon himself did not see sage-grouse, members of the 1843 expedition on the Missouri River sighted the bird (Johnson op.cit.)

Over 100 years later Johnson and Knue (1989) in their treatise on upland birds in North Dakota offered their view on the future status of the sage-grouse within the state when they said: "The "cock of the plains" is not destined to become an important game bird in North Dakota. Neither will he ever come under severe criticism by ranchers of the Badlands. Because the wastelands are his element it has been thought he would never be put under stress of habitat destruction. But there is one final reminder which might be kept in mind. Within recent years man has speeded up his efforts to locate new sources of

organic and mineral materials – examples being oil, oil shale, coal, uranium, and copper. Much of this activity is in the western U.S. and where it occurs it has been destructive to sage-grouse and big game habitat. Conservationists must be continually on the lookout for the changes this activity may make on sage-grouse populations."

Fig. 1. Current distribution of sage-grouse and pre-settlement distribution of potential habitat in North America (Schroeder 2004). For reference, Gunnison sage-grouse in southeastern Utah and southwestern Colorado are shown.

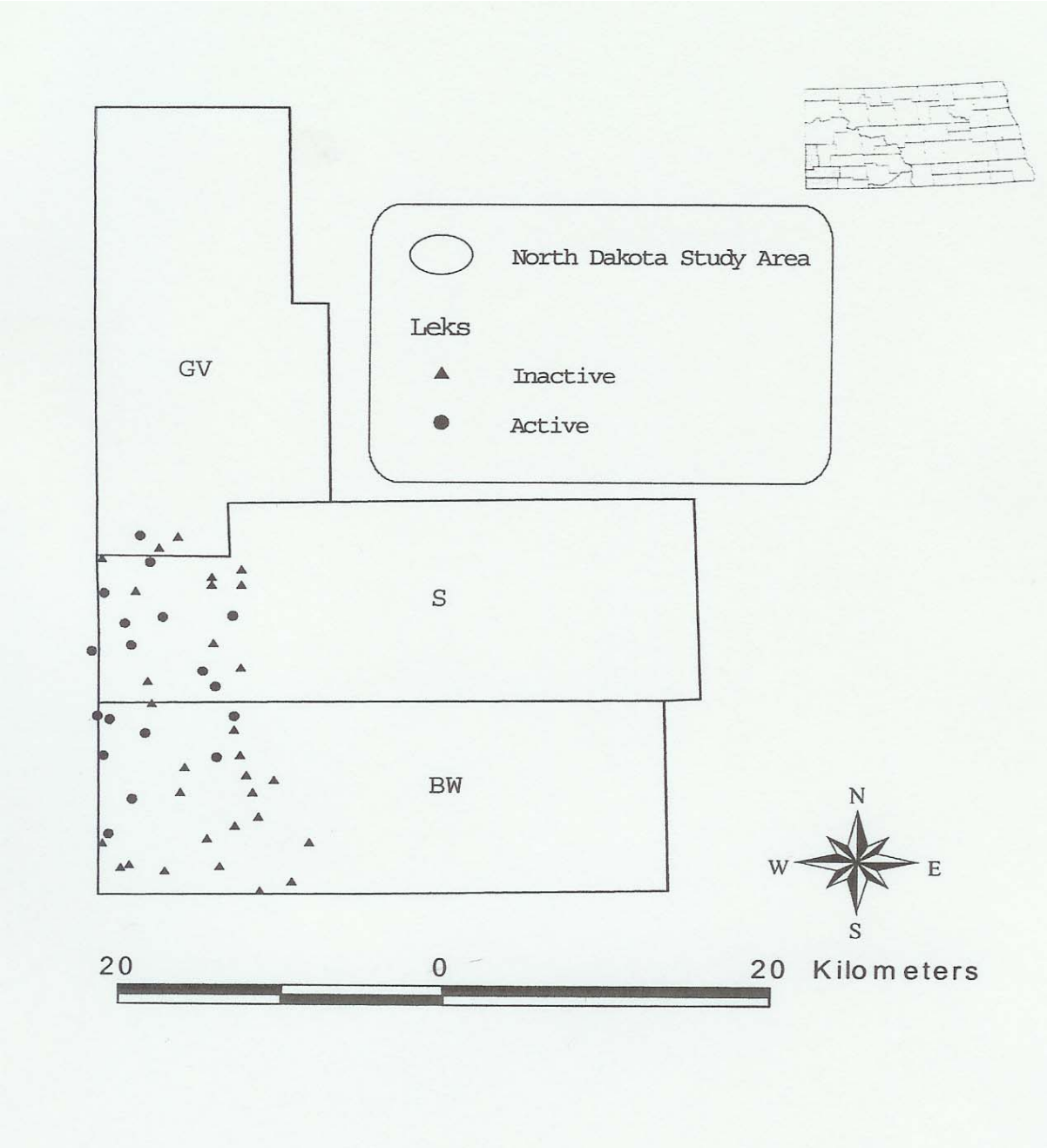


Pre-Settlement
Distribution of Potential Habitat

Current Sage-grouse Range

From: Conservation Assessment of Greater Sage-grouse and Sagebrush Habitats, Connelly et al. 2004

Figure 2. Active and inactive leks locations in North Dakota, 2002



From: Smith 2003

Habitat Status

A clear-cut example of the importance of habitat to a wildlife species is illustrated by the life history of the sage-grouse. In North Dakota and other areas of western United States, this grouse is found only where big sage and closely related plants are growing. Many early travelers noted the grouse-sagebrush relationship. Roosevelt wrote that the bird was found "only where the tough, scraggly wild sage abounds, and it feeds for most of the year on sage leaves." Another early observer, Captain Bendire,

believed the sage plant to be important to the bird but quoted other people who thought the plant important only when other more desirable foods were lacking (Johnson op. cit.).

The bird utilizes the sage plant for both food and cover. Most nests are found in this cover and over 75 percent of its annual food supply comes from the plant. In winter the grouse feeds almost entirely on sage. Young birds in the first three or four months of life feed on insects, but by their first autumn have turned to the plant for their sustenance (Johnson op. cit.). As a result of this diet Johnson also noted that late in the season the flesh of the bird takes on a "sagey tang" which is particularly noticeable in mature grouse. Many early observers believed sage-grouse to be unique because they did not have a gizzard which made their dependence on soft leafy vegetation more important. But, although the organ is relatively undeveloped compared with other game birds, it is present. Since the sage-grouse feed primarily on the herbaceous leaves of the sage plant, and does not require grit in its diet, there is no need for a highly developed gizzard.

The bird is restricted to extreme southwestern North Dakota because big sage is found only in significant acreage in that area. In 1963 a letter from the state's Dean of Botanists, Dr. O. A. Stevens of North Dakota State University stated:

> "The distribution of *Artemisia tridentata* in North Dakota has not changed materially since 1880....I still cannot map it accurately.....It seems to occupy mainly the severely eroded places or sometimes wash from such places; essentially limited to the Badlands, especially the southern part."

Because sagebrush grows in semi-arid range lands the problems of habitat destruction for this grouse have not been as pronounced as for other species. An example is the sharp-tailed grouse which lives on grasslands that are more susceptible to cultivation and changing land use patterns. Overgrazing by livestock on the rangelands of the western United States was, and is, an important limiting factor on sage-grouse and other game. It was most noticeable in the period 1900-1930's but during the years 1940 to 1975 it was estimated that in the western states "5-6 million acres of sagebrush range had been treated by burning, spraying, plowing, disking, chaining, cutting and beating in an attempt to convert these ranges to grasslands species" (Western States Sage-grouse Committee 1974).

Smith (2003) believed that loss of habitat for sage-grouse has remained somewhat static since the early 1970's. In his thesis he states:

> "Based on analysis of the current (i.e., 1999) satellite imagery, tilled ground appears to be playing a role in the abandonment of leks in North Dakota. However, when I looked at this relationship, using early satellite imagery (1972-1976) and more recent imagery (1999-2000) there was no increase in the amount of tilled ground associated with the inactive areas since the early to mid 1970's. If tilled ground is a factor in the abandonment of leks, its effects likely began previous to 1972."

Since 1980 there has been a slowdown in sagebrush eradication attempts. Much of this is due to a lack of funds from private and governmental sources, plus a stepped-up interest by various conservation-minded groups for protecting all types of wildlife habitat. There is always a possibility of a renewed interest in an eradication program for sagebrush in the future. If it should occur sage-grouse populations in those specific areas could be depleted (Johnson and Knue 1989).

POPULATION DYNAMICS

Winter Population Surveys

From 1946 through 1951, sage-grouse population surveys consisted of observers walking through big sagebrush areas and noting numbers of sage-grouse flushed. This provided a crude index of sage-grouse population numbers on an annual basis. Several large big sagebrush areas in Bowman and Slope Counties were walked annually in winter (usually February) (ND Game and Fish Department Data Files). In addition to the population data, information was recorded on big sagebrush distribution.

Spring Strutting Ground Counts

In 1951 a new method of censusing the birds was initiated. Birds were located and counted while they were on their strutting grounds in March and April. Grounds were located by individuals driving through the sage-grouse range and making periodic listening stops. Some grounds had been located earlier incidental to other work and landowners reported some grounds. Two years later, in 1953, an aircraft was used to locate grounds and make spring counts. Most counts were then made by air until the 1960's when a gradual shift was made from air to ground counts. Today all counts are made from the ground while surveys (searching for grounds) are made by air. Aircraft continue to be used to locate strutting grounds that have moved.

Approximately 17 strutting grounds are censused each spring and numbers of male sage-grouse recorded has varied from 542 in 1958 to 111 in 1996. Over the past twenty-five years (1980 through 2004) total males counted has varied from 111 to 380. The average numbers of males per lek has varied from 32.3 in 1952 to 7.4 in 1996. Over the last twenty-five years the average number of males per lek peaked at 16.6 per ground in 2000 and was at a low in 1996 at 7.4 males. These counts serve as indicators of the size and trend (increasing or decreasing) of the overall population but data are compared on a year-to-year basis for management purposes (Table 1).

The sage-grouse range, within the boundaries determined in 1950 in North Dakota, has been searched by aircraft in its entirety twice in the last 25 years, in 1980 and again in 1999. Prior to 1980 not all sage-grouse strutting grounds had been located, thus trend data from 1980 to the present are more reliable. Data from the past 25 years show a significant decrease in total numbers of males, but not a significant decrease in males per strutting ground (Figure 3). State Game and Fish Department personnel have always conducted the counts but due to shortage of staff and time, counts have been compressed into a one week period, the third week of April. Counts have extended into the fourth week of April when weather disrupted counts during the third week. During all annual surveys each strutting ground is censused at least twice with some being censused three times as time allows. Summing the highest number of males seen on each ground determines the "Total Males" censused for the state (Table 1).

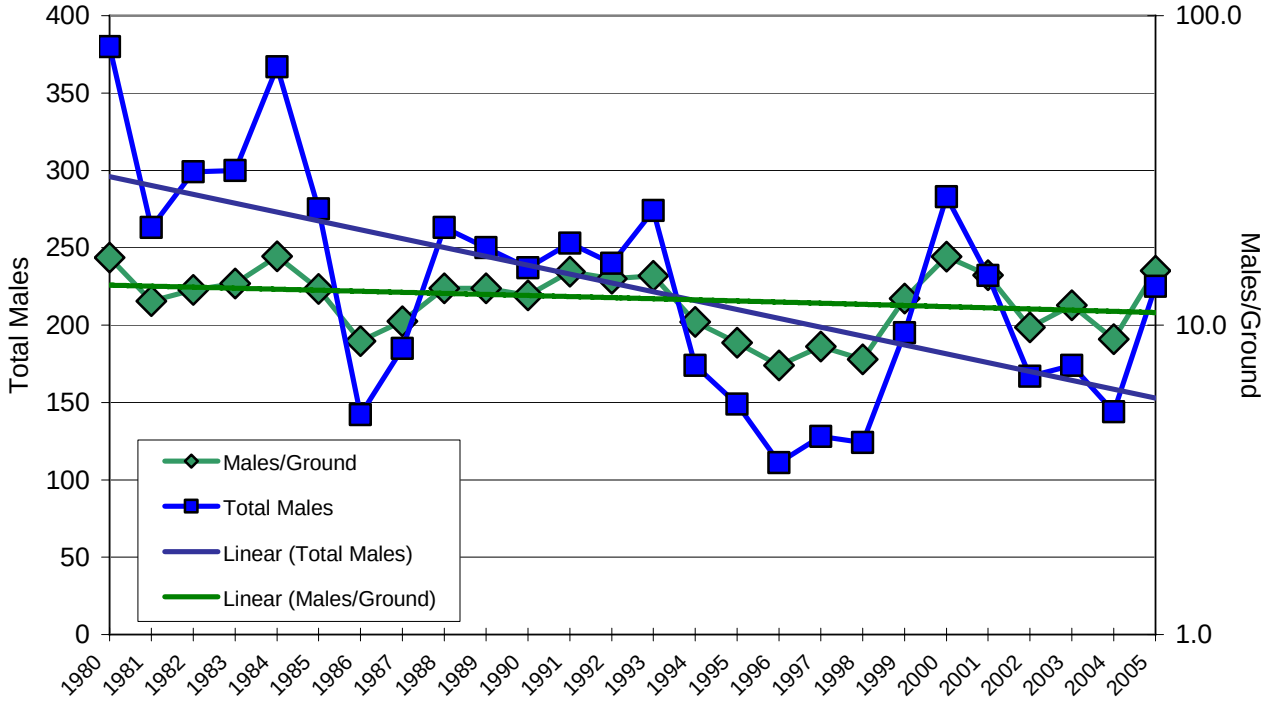
Harvest and Harvest Surveys

During early Dakota territorial and statehood years annual sage-grouse seasons were opened concurrently with sharp-tailed grouse and prairie chickens. As might be expected, early seasons were very liberal. Until 1887 there was no limit on the number of birds that could be taken and until 1890 hunters could hunt all of Dakota Territory which included South Dakota. A limit of 25 was initiated in 1887; the season was reduced from 103 days to 73 days in 1897, and reduced further to 43 days in 1899.

Table 1. Summary of long-term sage-grouse lek surveys in North Dakota, 1951-2005.

YEAR	TOTAL MALES	TOTAL GROUNDS	MALES/GROUND
1951	353	11	32.1
1952	388	12	32.3
1953	542	18	30.1
1954	297	15	19.8
1955	---	---	---
1956	353	18	19.6
1957	251	18	13.9
1958	306	20	15.3
1959	332	20	16.6
1960	---	---	---
1961	255	14	18.2
1962	---	---	---
1963	302	14	21.6
1964	285	18	15.8
1965	204	21	9.7
1966	183	19	9.6
1967	240	17	14.1
1968	236	15	15.7
1969	413	15	27.5
1970	291	17	17.1
1971	277	16	17.3
1972	298	16	18.6
1973	294	17	17.3
1974	270	16	16.9
1975	169	15	11.3
1976	181	18	10.1
1977	213	16	13.3
1978	209	17	12.3
1979	131	13	10.1
1980	380	23	16.5
1981	263	22	12.0
1982	299	23	13.0
1983	300	22	13.6
1984	367	22	16.7
1985	275	21	13.1
1986	142	16	8.9
1987	185	18	10.3
1988	263	20	13.2
1989	250	19	13.2
1990	237	19	12.5
1991	253	17	14.9
1992	240	17	14.1
1993	274	19	14.4
1994	174	17	10.2
1995	149	17	8.8
1996	111	15	7.4
1997	128	15	8.5
1998	124	16	7.8
1999	195	16	12.2
2000	283	17	16.6
2001	232	16	14.5
2002	167	17	9.8
2003	174	15	11.6
2004	144	16	9.0
2005	225	15	15.0

Figure 3. Summary of Sage-Grouse Lek Surveys
ND 1980-2005



Daily limits were reduced from 25 to 10 in 1909, and then to 5 in 1917. The season on sage-grouse was closed in 1923.

The sage-grouse hunting season was reopened in 1964 and has been open every year since that time except for 1979. The season in 1988, though scheduled for three days, was only open for ½ day due to an extreme fire danger situation. For the past 20 years, the season has been open three days each year, always opening on Monday and closing on Wednesday with both daily and possession limits being one sage-grouse. The season traditionally opened on the Monday following the opening of the sharp-tailed grouse season; however in 2004 it opened two weeks later to try and reduce the harvest of adult females (ND Game and Fish Department Data Files). The reason for these regulations (short season, one bird limit, week-day season) is to limit hunter participation and thus harvest, while still allowing anyone the opportunity to hunt sage-grouse. This system has been in place since 1964, and has allowed the Game and Fish Department to avoid the cost and work load of conducting a lottery for a very limited number of sage-grouse permits.

Wing data have been collected annually since the season was reopened in 1964. Most wings have been collected by department personnel through contact with hunters in the field but additional wings have been collected through use of wing barrels and a wing envelope survey. From 1964 through 2002, data have been collected on 1,426 sage-grouse wings (Table 2). The small population and Department regulations to restrict harvest results in a very limited sage-grouse wing collection. Numbers of wings collected each year do not provide a large enough sample to make accurate determinations of annual age ratios, sex ratios, and numbers of young per adult hen in either the fall bag or the fall population. The sample of immature wings collected from 1964 through 2002 that could be aged is 701. From these wings a mean hatch date of June 8 was calculated (Table 3).

Table 2. Composition of age and sex classes for sage-grouse, North Dakota 1964-2004.

Year	Adult Males	Adult Females	Immature Males	Immature Females	Total Birds	Age Ratio	Young/ Adult Hen
1964	16 (62%)	4 (15%)	3 (12%)	3 (12%)	26	0.30	1.50
1965	6 (32%)	6 (32%)	3 (16%)	4 (21%)	19	0.58	1.17
1966	2 (6%)	5 (15%)	14 (43%)	12 (36%)	33	3.71	5.20
1967	12 (20%)	20 (33%	11 (18%)	17 (28%)	60	0.88	1.40
1968	13 (21%)	11 (18%)	19 (31%)	18 (30%)	61	1.54	3.36
1969	15 (23%)	22 (34%)	11 (17%)	16 (25%)	64	0.73	1.23
1970	11 (16%)	18 (27%)	28 (42%)	10 (15%)	67	1.31	2.11
1971	20 (26%)	13 (17%)	20 (26%)	24 (31%)	77	1.33	3.38
1972	20 (17%)	28 (24%)	37 (32%)	31 (27%)	116	1.42	2.43
1973	6 (9%)	27 (41%)	14 (21%)	19 (29%)	66	1.00	1.22
1974	5 (8%)	19 (32%)	10 (17%)	26 (43%)	60	1.50	1.89
1975	21(32%)	17 (26%)	14 (21%)	14 (21%)	66	0.74	1.65
1976	4 (10%)	12 (31%)	13 (33%)	10 (26%)	39	1.44	1.92
1977	13 (62%)	3 (14%)	2 (10%)	3 (14%)	21	0.31	1.67
1978	2 (4%)	19 (41%)	15 (33%)	10 (22%)	46	1.19	1.32
1979	No season						
1980	5 (24%)	15 (71%)	1 (5%)	0	21	0.05	.07
1981	4 (13%)	6 (20%)	13 (43%)	7 (23%)	30	2.00	3.33
1982	5 (12%)	18 (42%)	9 (21%)	11 (26%)	43	0.87	1.11
1983	6 (9%)	20 (28%)	20 (28%)	25 (35%)	71	1.73	2.25
1984	11(22%)	15 (31%)	11 (22%)	12 (25%)	49	0.88	1.53
1985	1 (17%)	1 (17%)	2 (33%)	2 (33%)	6	2.00	4.00
1986	4 (12%)	7 (21%)	10 (30%)	12 (36%)	33	2.00	3.14
1987	3 (17%)	6 (33%)	4 (22%)	5 (28%)	18	1.00	1.50
1988	No wings collected						
1989	6 (22%)	11 (41%)	6 (22%)	4 (15%)	27	0.59	.91
1990	0 (0%)	3 (23%)	2 (15%)	8 (62%)	13	3.33	3.33
1991	5 (31%)	3 (19%)	7 (44%)	1 (6%)	16	1.00	2.67
1992	7 (32%)	7 (32%)	7 (32%)	1 (4%)	22	0.57	1.14
1993	5 (36%)	5 (36%)	2 (14%)	2 (14%)	14	0.40	.80
1994	3 (38%)	2 (25%)	1 (12%)	2 (25%)	8	0.60	1.50
1995	3 (20%)	4 (27%)	6 (40%)	2 (13%)	15	1.14	2.00
1996	3 (11%)	7 (26%)	8 (30%)	9 (33%)	27	1.70	2.43
1997	3 (13%)	6(25%)	6 (25%)	9 (37%)	24	1.67	2.50
1998	4 (14%)	8 (28%)	9 (31%)	8 (28%)	29	1.42	2.13
1999	2 (8%)	8 (32%)	8 (32%)	7 (28%)	25	1.50	1.88
2000	4 (7%)	23 (41%)	14 (25%)	15 (27%)	56	1.07	1.26
2001	2 (10%)	14 (70%)	2 (10%)	2 (10%)	20	0.25	.29
2002	1 (3%)	17 (57%)	6 (20%)	6 (20%)	30	0.67	.71
2003	0 (0%)	3 (38%)	2 (25%)	3 (38%)	8	1.67	1.67
2004	3 (43%)	1 (14%)	2 (29%)	1 (14%)	7	0.75	3.00
Totals	256(18%)	434(30%)	372(26%)	371(26%)	1,433	1.08	1.71

To measure hunter success, post cards are mailed and/or handed out to known sage-grouse hunters prior to the hunting season and are also handed out to all hunters contacted in the field. The post cards request data pertaining to days hunted, area hunted, and success for the entire season (Table 4). While this survey works for measuring hunter success (birds/hunter, days/hunter, and county of harvest), it cannot be used to determine the total number of sage-grouse hunters. To make that determination, a small game hunter questionnaire is mailed to a sample of both resident and non-resident hunters each fall following close of the hunting season. This questionnaire is used to determine total harvest and hunter participation for a number of waterfowl and upland game species, including sage-grouse.

Here again, small numbers of hunters, and few questionnaires from sage-grouse hunters, mean large confidence intervals for number of hunters and total harvest. Estimates over the last fourteen years indicate averages of 124 hunters per year and 47 sage-grouse harvested per year which is a hunter success of about 38%. The harvest is less than 4% of the estimated fall population which falls well below the 10% maximum suggested by Connelly et al. (2000).

Needs

Prior to 2001, no research had been done on sage-grouse in North Dakota. Movements of grouse from leks to nesting and brooding areas is unknown. Movements from summer to winter habitat are unknown and amounts and distribution of nesting, brooding, and winter habitat are unknown. To correct this situation, two research projects were initiated (see Attachment III). Initial efforts at habitat restoration or improvement will center on breeding areas since this is an identified habitat area.

Table 3. The distribution of estimated hatching dates for immature sage-grouse shot during hunting seasons in North Dakota, 1964-2004.

	1964-2004	
Weekly Period	**Birds**	**%**
2. May 8-14	1	.1
3. May 15-21	12	1.7
4. May 22-28	59	8.2
5. May 29-June 4	145	20.2
6. June 5-11	165	22.9
7. June 12-18	160	22.3
8. June 19-25	90	12.5
9. June 26-July 2	58	8.1
10. July 3-9	21	2.9
11. July 10-16	8	1.1
Total	719	100.0
Mean	6.47	
Mean Hatch Data	June 8	

Table 4. Sage-grouse hunting statistics collected during sage-grouse seasons in North Dakota, 1991-2004, *postcard surveys only*.

	91	92	93	94	95	96	97	98	99	00	01	02	03	04
Number of Hunting Parties	26	32	34	41	40	47	57	69	59	61	61	53	74	30
Number of Hunters	47	46	48	46	50	66	92	96	103	108	112	84	122	43
Number of Hunter Days	62	66	86	93	94	108	149	178	174	168	181	143	215	67
Hours Hunted /Hunter/Day	5.4	4.8	5.0	4.8	5.2	5.5	5.8	6.3	6.2	5.2	6.2	5.7	7.1	6.6
Sage-grouse Harvested	18	32	13	12	13	36	33	33	29	58	30	22	15	12
Sage-grouse/Hunter	.38	.70	.27	.26	.26	.55	.36	.34	.28	.54	.27	.26	.12	.28

Reproduction

Due to a limited population in North Dakota, few broods are reported each year, and in some years, no broods are reported. The population simply does not lend itself to any type of brood survey with the exception of reporting incidental brood observations. Not enough of these are recorded in any one year to be meaningful.

Other states with large populations and large wing samples can ascertain reproduction through examination of age ratios from the wing sample. North Dakota wing samples are too small to make these determinations with an average of less than 40 wings per year. Exceptional years, as 1980, when the sample of 21 wings included only one immature (Table 2) can indicate little or no reproduction.

Mortality

Juvenile Mortality – Juvenile mortality during the first few weeks after hatching is typically high, and nearly 40 percent of the young hatched in a given year die by early September (Wallestad 1975). Juvenile mortality rates can increase when drought reduces availability of insects and forbs for food, and important escape cover (herbaceous understory) is limited by poor growing conditions.

Over a 10-year period, Wallestad and Watts (1973) documented an average mortality rate of 56 percent in central Montana from the egg-laying period in April to the opening of the upland bird season in September. This included an average nest mortality of 30 percent and an average juvenile mortality to 1 September of 37 percent. The authors assumed a juvenile mortality rate from 1 September to 1 April (fall-winter) at least equal to that of yearling hens (65 percent) which would yield an annual juvenile mortality rate of 85 percent.

Adult Mortality – Survival rates for adult sage-grouse are generally considered to be high. The following, taken from the Range-wide Conservation Assessment for Greater Sage-grouse and Sagebrush Habitats (Connelly et al. 2004) illustrates this point:

> Zablan (2003) estimated survival for 6,021 banded sage-grouse in Colorado using bands recovered from hunters. They estimated survival to be 59.2% (95% CI, 57.1 – 61.3%) for adult females, 77.7% (95% CI, 71.8 – 75.3%) for yearling females, 36.8% (95% CI, 35.4 – 44.8%) for

adult males, and 63.5% (95% CI, 56.9 – 64.6%) for yearling males. They recovered 1 female = 9 years old, 3 females = 8 years old, and 3 males = 7 years old. Females had higher survival than males and adults had lower survival than yearlings. Wittenberger (1978) and Bergerud (1988) suggested that yearling males remain inconspicuous during their first year and thus have a better chance of surviving to adulthood. Male survival was estimated to be 59% in Wyoming (June 1963), 58-60% in Idaho (Connelly et al. 1993, Wik 2002), and 29.6% in Utah (Bunnell 2000). In contrast, female survival was estimated to be 67-78% in Wyoming (June 1963, Holloran 1999), 48-75% in Idaho (Connelly et al. 1993, Wik 2002), 57% in Alberta (Aldridge and Brigham 2001), 60.6% in Colorado (Hausleitner 2003) and 36.8% in Utah (Bunnell 2000).

In contrast, pheasant populations usually have turnover rates that may approach more than 80% annually. Pheasant hen mortality rates greater than 80% have been recorded as a result of severe climatic conditions, predation, and other factors (Dumke and Pils 1973, Warner and David 1982, Perkins et al. 1997).

Predation – Both avian and mammalian predators take sage-grouse. Bullsnakes are also considered an effective nest predator in some areas (Montana Sage-grouse Work Group 2004). Predators destroyed 13 percent of known nests on the Yellow Water Triangle in Montana (Wallestad and Pyrah 1974). Nest predators included coyotes (*Canis latrans*), badgers (*Taxidea taxis*), and magpies (*Pica pica*). In the same study, nearly 40 percent of juvenile sage-grouse succumbed to some form of mortality between hatching and early fall, although the proportion attributable to predation was unknown. Golden eagles (*Aquila chrysaetos*) and hawks, including the marsh (*Circus cyaneus*), Swainson's (*Buteo swainsoni*), red-tailed (*B. jamaicensis*), and rough-legged (*B. lagopus*) posed the most probable threat to young birds (Wallestad 1975).

Adult hens are most vulnerable to predation during the nesting period, and low quality nesting cover increases the risk of predation. Adult males are most vulnerable during the spring breeding season while associated with the leks (Wallestad op. cit.). Habitat alterations in the vicinity of leks, especially the construction of power poles or other perch sites for raptors, can affect male survival. Increased perch sites can also affect habitat security in brood rearing and wintering areas. Fragmented habitat may increase predation pressure on adult sage-grouse by forcing birds into more marginal areas for foraging, travel, or roosting. (Connelly et al. 2000)

Dynamics of many predator populations are determined largely by abundance of their primary prey species, which are usually rodents or rabbits rather than grouse (Bump et al. 1947, Angelstam 1986, Myrberget 1988). Environmental conditions that influence changes in primary prey populations, e.g. rodent populations decline as a result of drought, can affect changes in foraging strategies of both mammalian and avian predators, thereby increasing encounters with grouse or grouse nests.

Disease and Parasites – West Nile virus (WNv) was detected for the first time in sage-grouse in Montana, Wyoming and Alberta during late summer 2003 (Naugle et al. 2004). Mosquitoes (especially *Culex tarsalis*) are thought to be the principal vectors of the disease and migratory birds appear to be the major introductory host. The presence of a large sample of radio-instrumented sage-grouse on several research study sites provided an opportunity to detect eight mortalities in Wyoming, four in Montana and five in southeastern Alberta (Walker et al. 2004). Future monitoring will be necessary to document the impact on population trends and the role of the virus in terms of observed mortality rates in subsequent years. Five birds (hunter harvested) in North Dakota tested negative for WNv in 2003 while three sage grouse harvested in 2004 tested negative for WNv.

Simon (1940) described parasites commonly found in sage-grouse in Wyoming. The incidence and infestation of all parasites except the protozoan *Tritrichomonas* was higher in young birds than in adults. Most sage-grouse were infected with tapeworms but exhibited no serious ill effects. He found two species of coccidia that infect sage-grouse, *Eimeria angust* and *E. centrocerci.* Outbreaks of coccidiosis may locally decimate populations of sage-grouse.

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SECTION II: POPULATION AND HABITAT OBJECTIVES

POPULATION OBJECTIVES:

Population objectives for sage-grouse in North Dakota are two fold. The first deals with distribution of the population across their range in the State and the second with density or numbers of males surveyed on strutting grounds during the annual spring census.

Distribution

There has been meager prehistoric or historic evidence (see Section I) published to suggest that sage-grouse were ever present in North Dakota beyond their present range (Johnson and Knue 1989).

In 1950, active sage-grouse leks were found over approximately 800 square miles in North Dakota (Bowman, Slope, and Golden Valley Counties). In early years, there was no attempt to locate all sage-grouse strutting grounds but efforts concentrated east of the Little Missouri River. It is believed that there were probably none, or very few at most, strutting grounds east of those grounds located during the early years (1951-1955). As census efforts were intensified, more strutting grounds were located in the interior and western edges of the sage-grouse range, but grounds along the eastern fringe began to disappear. The distribution of active sage-grouse leks currently covers approximately 490 square miles of range. This is about a 40% reduction in the size of the area where leks are found. Big sagebrush habitat has not been totally eliminated in the abandoned area, and one objective is to re-establish big sagebrush in this area and provide linkage to the remaining habitat and promote sage grouse expansion into this formerly occupied range.

<u>Distribution Objectives:</u>

(1) Maintain the current distribution, or stop the shrinkage of the sage-grouse range and distribution;
(2) Develop and improve habitat conditions in the former range by restoring sage brush and providing linkage to those sagebrush areas still remaining. Programs to accomplish these goals can be found in Section V.

Numbers

Early counts of sage-grouse that were made during winter were total numbers of birds. As the census evolved to a strutting ground count, males were differentiated from females and counts were compared annually using just the number of males. The number of active strutting grounds has varied from a high of 23 in both 1980 and 1982 to a low of 11 in 1951, the first year of census. The total number of strutting ground locations, including active, inactive, and historical is 49. From 1951 through 1979, no effort was made to locate all strutting grounds in North Dakota. The first aerial survey was made in 1980 and seven new locations were found with strutting sage-grouse, but none were found outside the existing sage grouse range. During early years (early 1950's) all the grounds located were large grounds (ten or more males). Many grounds during recent years have fewer than ten males and while there were undoubtedly some of those grounds present in the 1950's, none were censused.

The North Dakota Participative Management document (PAMA) that was written and adopted in 1992 (North Dakota Game and Fish Department 1992) included sage-grouse. At that time the sage-grouse

objective was a spring population of 300 male sage-grouse. The plan was revised in 2002 and the sage-grouse management goal was adjusted to 250 male sage-grouse. This goal was last reached in 2000, and the average number of males counted the last five years has been 200.

Numbers Objective:

The numbers objective will initially remain at 250 males surveyed during the spring census. The number can be reached by: (1) habitat improvement in the current sage-grouse range to increase number of strutting grounds or increase the number of males on current active grounds; and/or (2) re-establishment of grounds in the former range as habitat becomes available or is re-connected to existing habitat.

HABITAT OBJECTIVES:

Examining landscape patterns of sagebrush, e.g., distribution of patches, patch size and connectivity, helps us understand ecosystem processes, disturbance regimes, and current versus historical conditions. Combining information about landscape patterns with data about the structure, composition, and ecological condition of sagebrush communities gives us the ability to assess whether conditions are favorable to sage-grouse and other sagebrush-dependent species. Sage-grouse habitats that are identified as supporting stable or increasing populations would carry a priority for maintenance. Recent efforts to reclassify sagebrush cover using improved remote sensing technology and training data offer a tool to complete assessments.

Within this context, habitat objectives for sage-grouse in North Dakota are:

1) A sagebrush shrub cover capable of supporting the life history requirements of sage-grouse and other wildlife that use sagebrush should be present across the range of the species. This should include a variety of sagebrush patch sizes that emphasize areas with a central core of habitat in large contiguous blocks. Patches of habitat should be well dispersed throughout the range. Patches may be configured in blocks, islands, corridors, and mosaic patterns, but they should be arranged such that connectivity is maintained.

2) The shrub cover should include a mix of height classes with a herbaceous understory adequate for meeting seasonal habitat requirements of sage-grouse (see Attachment I)
    a) In habitats consisting of predominately silver sagebrush (*A. cana*) manage sites with the potential to support this species of sagebrush in a manner that maintains at least 50 percent of those areas in canopy cover of >0 to 25 percent.
    b) In habitats that include predominately Wyoming big sagebrush, manage sites with ecological potential to maintain sagebrush over at least 60 percent of those areas in a canopy cover of 5 to >25 percent.

3) Maintain a herbaceous understory emphasizing multiple species of native forbs and grasses.

4) Emphasize restoration and rehabilitation of sagebrush in areas that are capable of supporting sagebrush and contribute to the distribution and connectivity of patches.

At more localized scales the desired condition relies on site potential, ability of the site to meet seasonal needs of sage-grouse, and/or other available information. Measurements of shrub and herbaceous cover are often required to determine if the desired condition is being met and/or maintained.

Wildlife objectives for sagebrush communities will be determined based on: a) local knowledge about current habitat use; b) potential to support a variety of species including sage-grouse; c) existing native shrub cover patterns and sagebrush-associated characteristics; d) existing herbaceous cover and condition; e) frequency and reasonably foreseeable likelihood of disturbance, e.g. fire; f) locations of seedings or condition of shrub cover on adjacent areas; and g) importance of the area to seasonal needs of sage-grouse.

The following should be considered in setting management objectives at the local level.

1) Based on local knowledge about current habitat use by sage-grouse, the vegetation characteristics and desired condition of the area may vary depending on the seasonal use by sage-grouse, other wildlife species, and/or other resource values, e.g. livestock grazing.

2) Emphasize restoration and rehabilitation of sagebrush communities in areas that are capable of supporting sagebrush and contribute to the distribution and condition of habitat for seasonal uses. For example, crucial winter habitats, which typically are a fraction of the sagebrush available on wintering areas, carry a high priority for maintenance or restoration.

3) Modify activities and management actions on public land and/or private land under federal or state-funded programs to reduce or minimize habitat loss if such actions would degrade or fragment sage-grouse habitat.

Desired Conditions for Sage-grouse Habitats

Based on studies done in other Western States the following are presented as the range of desired conditions that are currently believed to be most suitable for sage-grouse habitat in North Dakota. As data becomes available from studies conducted on habitat within the State, and as seasonal habitats are better delineated, the ranges for the categories of Suitable, Marginal and Unsuitable Habitat may be expected to change. It is important to keep in mind the proceeding discussion when applying the following criteria to sagebrush habitats.

Breeding Habitat

Nesting cover and food availability are key components of breeding habitat suitability. Generally, sagebrush stands with a robust understory of grasses and forbs provide excellent sage-grouse habitat.

Table 5. Nesting and early brood-rearing habitat features (Montana Sage-grouse Work Group 2004).

Habitat Feature	Indicator	Suitable Habitat	Marginal Habitat	Unsuitable Habitat
Nesting Cover	Big sagebrush canopy cover	≥ 15% but ≤ 25%	10-14% or 26-35%	<10% or >35%
Nesting Cover	Big sagebrush height	12-30 inches	10-12 inches or 31-40 inches	<10 inches or > 40 inches
Nesting Cover	Big sagebrush growth form	Spreading form, few if any dead branches	Mix of spreading and columnar growth forms present	Tall, columnar growth form with dead branches
Nesting Cover	Herbaceous perennial grass and forb height	≥ 7 inches	5 - <7 inches	< 5 inches
Nesting Cover & Food	Perennial grass canopy cover	≥ 15%	5 – 14%	<5%
Nesting Cover & Food	Forb canopy cover	≥ 10%	5 - <10%	<5%
Food	Forb richness[1]	High	Low	Very low

[1]Relative to ecological site descriptions.

Late Brood-Rearing Habitat

Food availability (forbs) in proximity to good escape cover is an important habitat feature of sage-grouse brood-rearing areas. Healthy riparian, wet meadow and upland plant communities are important as these areas provide brood-rearing habitat. Abundance, diversity, and availability of forbs are crucial. Agricultural fields with good escape cover nearby can provide important sage-grouse brood-rearing habitat (Connelly et al. 2000). In these cases, sagebrush cover on adjacent lands will be an important habitat component.

Table 6. Late brood-rearing habitat features (Montana Sage-grouse Work Group 2004).

Habitat Feature	Indicator	Suitable Habitat	Marginal	Unsuitable Habitat
Food	Riparian and wet meadow plant community	Mesic or wetland plant species dominate wet meadow or riparian area	Xeric plant species invading wet meadow or riparian area	Xeric plant species along water's edge or near center of wet meadow
Cover and Food	Riparian and wet meadow stability	No erosion evident; some bare ground may be evident but vegetative cover dominates the site	Minor erosion occurring and bare ground may be evident but vegetative cover dominates the site	Major erosion evident; large patches of bare ground
Food	Forb availability in uplands and wetland areas	Succulent forbs are readily available in terms of distribution and plant structure	Succulent forbs are available though distribution is spotty or plant structure limits effective use	Succulent forbs are not available due to site condition or plant structure
Cover	Proximity of sagebrush cover	Sagebrush cover is adjacent (< 100 yards) to brood-rearing area	Sagebrush cover is in close proximity (100 - 300 yards) of brood-rearing areas	Sagebrush cover is unavailable (> 300 yards).

Winter Habitat

Sagebrush cover and availability are the most important habitat indicators for food and cover needs of sage-grouse during winter.

Table 7. Winter habitat features (Montana Sage-grouse Work Group 2004).

Habitat Feature	Indicator	Suitable Habitat	Marginal Habitat	Unsuitable Habitat
Cover and Food	Sagebrush canopy cover	10-30%	5- 9%	< 5%
Cover and Food	Sagebrush height	Normal height relative to site potential	Hedged shrubs, slightly shorter relative to site potential	Severely hedged shrubs and short relative to site potential

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SECTION III: RISKS TO SAGE-GROUSE

Sage-grouse in North Dakota are faced with risks that are common across the range of the species in the western United States. The following describes activities that are believed to pose the most serious threats to long term viability of sage-grouse within their current range in North Dakota. It is important to note that the following discussion is meant to analyze risks that are present on the landscape and is not intended to assign culpability or responsibility to any individual, entity or industry. The intention of this discussion is to provide information on risks to the species and to promote instigation of actions that will help mitigate these risks. Specific issues associated with these risks in North Dakota, as well as mitigation measures to help address them, are discussed in Section IV.

LOSS OF HABITAT AND HABITAT EFFECTIVENESS

Habitat can be lost to the species through a number of activities. The extent (acres) of such losses and duration of time before sagebrush returns to the landscape are two of the factors that must be considered when mitigating for such activities. When large, long term losses of sagebrush-grasslands occur due to any circumstance, proximity of remaining habitat becomes much more important to long term viability of sage-grouse populations. Activities and rangeland treatments at levels that reduce the base acreage or effectiveness of those remaining acres of sage steppe become much more significant to the viability of local sage-grouse populations (Braun 1998, Schroeder et al. 2000).

Conversion of Habitat and Rangeland Alterations:

Conversion of native sagebrush stands to cropland or pasture through plowing, mechanical treatment or chemical removal of plants is one of the more common methods such losses occur. Plowing generally results in long term loss of habitat as sagebrush will not recover under continuous cropping. Plowing often takes place on areas having deep soils and little topographical relief, which are also areas favored as wintering sites for sage-grouse. Losses of winter ranges, which usually make up a small portion of yearlong ranges, have been shown to result in long term losses of populations (Swenson et al. 1987).

Mechanical and chemical treatments have been used in the past to remove large blocks of sagebrush in some western states. These two types of treatments can also be used to achieve specific goals on smaller sites where control, removal or enhancement of sagebrush has been determined to be in the best interest of the sagebrush community.

Burning and spraying of sagebrush has been shown to reduce or alter both the understory and canopy cover of treated communities (Connelly et al. 2000, Wambolt et al. 2002). Effects of fire as a treatment vary with the species of sagebrush and size of areas being treated. Sagebrush species that regenerate from seed such as Wyoming big sagebrush can take more than 30 years to recover from a fire (Welch 2005) and can be eliminated if the site treated is too large. Species that re-sprout from crowns and roots, e.g., silver sagebrush, three-tip sagebrush (*A. tripartita*) and some forms of mountain big sagebrush, can re-establish if the fire intensity is not too high.

Timing and scale of herbicide application reduces sagebrush and/or the forb component and could reduce production and survival of grouse through reduced nutritional levels and increased predation. Indirect effects of persistent application of herbicides are an alteration of the composition and diversity of plant species and may be significant enough to affect availability and quality of the insect component. Any significant loss of a food source critical to early survival of chicks also may have a long-term effect

on populations (Potts 1986). Available literature on effects of herbicide application on sage-grouse is almost entirely limited to effects of sagebrush reduction or removal.

Industrial Development:

Oil and gas development structures, roads, pipelines, storage facilities as well as mines, electrical generation facilities (wind turbines), transmission lines and other infrastructure associated with industry can decrease the available habitat base and/or effectiveness of habitat (Braun et al. 2002, Lyon and Anderson 2003). Both transmission lines and fences provide perches for raptors and have been found to increase the risk of collision mortalities (Borell 1939, Aldridge 1998). The overall effect of such structures on a population is unknown; however, sage-grouse use of an area has been shown to increase with distance from power lines (Braun 1998).

Roads related to oil and gas development have been associated with a reduction in nesting success, increased disturbance to grouse on leks and during brood rearing (Braun 1998). In Wyoming, sage-grouse hens with successful nests were found to locate their nests further from roads in oil and gas fields than unsuccessful hens (Lyon and Anderson 2003).

In the interior Columbia Basin, increased road density has been found to be related to increased human population, loss of habitat, increased agriculture and increases in invasive plant species (Wisdom et al. 2002).

Grazing:

Sagebrush communities often provide quality grazing opportunities for a variety of wildlife and livestock. Native vegetation associated with sagebrush-grasslands in North Dakota did evolve with grazing by a number of herbivorous species. However grazing does have the ability to alter composition and productivity of any vegetative community and timing, duration and intensity of grazing can and does influence effectiveness of the sagebrush community for sage-grouse. Grazing directly affects plants within sagebrush-grassland habitats and can alter soil and microclimate within the plant community. Similar rates of grazing can have different affects on sage-grouse depending on whether it occurs on nesting, brood rearing or winter ranges.

Beck and Mitchell (2000) identified both positive and negative direct effects of livestock grazing on sage-grouse habitat. Light to moderate grazing by cattle or managed grazing systems can improve both quantity and quality of summer forage, i.e., forbs, for sage-grouse. Heavy to severe grazing reduces habitat quality, which may lead to increased nest predation or nest desertion, and may pre-empt use of a site by grouse altogether. Residual grass cover following grazing is essential to maintaining quality of nesting habitat.

Noxious Weeds and Invasive Plants:

Noxious weeds and the spread of non-native plant species have become widespread across the range of sage-grouse over the last 50 years. Infestations of some invasive species as club moss (*Selaginella densa*, cheatgrass (*Bromus tectorum*), and bluegrass *Poa sp.*) has resulted in reduced densities of native species within sagebrush-grasslands of North Dakota (NRCS file data). The extent to which these undesirable species have affected sage-grouse in North Dakota is unknown but Great Basin states have documented the loss of millions of acres of sagebrush to cheatgrass and subsequent fires. In North Dakota noxious weeds are those that are difficult to control, easily spread, and injurious to public health,

crops, livestock, land and other property. Chapter 63.01.1-01 of the North Dakota Century Code states: It shall be the duty of every person in charge of or in possession of land in this state, whether as a landowner, lessee, renter or tenant, under statutory authority or otherwise, to eradicate or to control the spread of noxious weeks on those lands (Anonymous 1998). Noxious weeds currently posing problems in the sage-grouse range in North Dakota are leafy spurge (*Euphorbia esula),* Canada thistle *(Cirsium arvense*), and in certain instances, field bindweed (*Convolvulus arvensis*). A recent invader that needs close monitoring and control is salt cedar (*Tamarix* spp.) (Anonymous 2003).

Introduction and spread of invasive species occurs through several means, the most common being along transportation routes and waterways. Disturbed ground often serves as an initial point for establishment and the level of disturbance is directly proportional to the susceptibility of an area to invasion. Wildlife in general are probably not major endozoochorous vectors of leafy spurge. Grouse and deer could possibly disperse very low numbers of viable leafy spurge seeds, whereas turkeys are not likely vectors (Wald 2003).

Human activities are the most common source for these disturbances. Roads, agriculture, and natural resource development often result in establishment of new weed beds. Natural elements can also play a role in both establishing and spreading of invasive species. Wildfires, floods and prolonged drought can disturb topsoil and cause plant losses over large areas. Burrowing activities of small animals and localized over-use by livestock and/or wild ungulates can also contribute to establishment and consequential spread of invasive weed species. Off road travel by motor vehicles has also been shown to spread weed seeds (Anonymous 2000).

PHYSICAL THREATS TO SAGE-GROUSE

Recreation:

Recreational activities such as viewing of leks, riding off road vehicles (ORV's) and other activities that result in concentrating recreational activities can result in disturbances to leks, nesting and brood rearing areas or winter ranges. Many activities have become more popular with the advent of "four wheelers" that allow more people access to what were formerly felt to be remote areas. These types of activities are expected to increase during the immediate future.

Recreational hunting of sage-grouse has long been a tradition within the western states and provides economic, recreational and cultural benefits. Information gathered from harvested birds provides information on annual productivity of sage-grouse and the influence of weather on productivity. Information from harvested birds also provides insight into numbers of males that will be attending leks in future years. Hunting can contribute to population declines or slower recovery of populations when combined with loss of habitat, poor weather conditions and high predation rates. Hunting seasons need to be based on good biological information and be adaptable to changing conditions. This becomes more important as habitat and populations diminish.

Predation:

Over the tens of thousands of years that sage-grouse have been adapting to the sagebrush steppe in the western United States, predators have been on the scene. The role that predators play in regulating sage-grouse numbers is highly dependent on quantity and quality of habitat available to any given population of birds in conjunction with ongoing weather patterns and availability of a variety of other prey species (Braun 1998).

Habitat degradation can make both nesting and brooding sage-grouse more vulnerable to both avian and mammalian predators. Degradation of the sagebrush canopy and/or understory can increase vulnerability of grouse and nests to the existing predator community, may alter the predator community, or both. Mammalian predator populations in degraded habitats often shift toward species that are smaller and more numerous (red fox, raccoon, striped skunk) and away from species that have evolved with sage-grouse (coyote, badger). Similar shifts in mammalian predator communities can also accompany intensive predator control programs, e.g., red fox numbers can increase when coyote populations are controlled (Montana Sage Grouse Work Group 2004). Avian predators such as golden eagles have long co-existed with sage-grouse.

Predator control, which is expensive and only effective for a short term, has seldom been recommended for improving populations of prairie grouse (Schroeder and Baydack 2001). Biologically, long term consequences of predator control are poorly understood and under some circumstances may be counterproductive to long term viability of prairie grouse. Many avian predators of sage-grouse are now legally protected and control substances such as 1080 and other poisons have been prohibited. However, if land use changes continue to degrade sagebrush habitats and predators are shown to negatively impact sage-grouse populations, direct predator control actions may assume greater management importance (Nelson 2001).

Disease and Parasites:

Sage-grouse are susceptible to a variety of diseases and host a number of parasites, such as coccidiosis (Schroeder et al. 1999) Wide spread infections or infestations can locally increase sage-grouse mortality, although this is a rare occurrence. WNv has been documented to kill sage-grouse in Wyoming, Alberta, and Montana (Walker et al. 2004). Radio collared sage-grouse from ongoing studies in those states have been closely monitored to determine possible impacts of the virus on sage-grouse. Tests for WNv require samples from birds that have died within 24-48 hours, which is difficult to achieve without intensive monitoring. At this time, the impact of WNv is being monitored but has not been well-quantified.

Weather:

Weather patterns affect sage-grouse through a number of cause and effect relationships. Cold wet weather during hatching can result in loss of chicks to hypothermia; however wet springs often result in increased green-up and an increase in the variety of forbs, and consequently insects, on the sage-steppe thereby increasing chick survival. Hot dry weather during summer concentrates sage-grouse on riparian areas or other green sites such as alfalfa fields. Such concentrations can lead to increased predation and facilitates the spread of diseases as WNv.

Droughts and dry cycles can reduce the abundance and duration of herbaceous understory in sagebrush grasslands to levels that jeopardize sage-grouse survival. Long cold winters with deep snows that cover sagebrush plants on winter ranges can also be a threat to survival as sage-grouse are totally dependent upon sagebrush as food during winter months.

Sage-grouse managers must be aware of both annual and long term fluctuations in weather patterns. Short term fluctuations will help determine annual and near future population status while long term weather patterns have a greater effect on condition of habitats occupied by the population and will play a larger role in determining the long term trend of the population.

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SECTION IV: CONSERVATION ISSUES AND ACTIONS

An issue is any unresolved conflict that has the potential to affect the biological, ecological, social, or economic environment, including wildlife and habitats. This section describes relevant issues. Conservation actions that address each issue include measures or "tools" to resolve or minimize conflicts and meet objectives for sage-grouse habitats and populations. Conservation actions that appear in this section establish a framework for making decisions and offer a range of options to address specific issues.

As noted in the previous portions of this plan North Dakota has a relatively small population of sage-grouse occupying only a small portion of the State. These issues and actions are consequently not meant to be broadly applied throughout the range of the sage-grouse but on a local basis when conditions warrant such actions to conserve either numbers or habitat. Not all of these issues are currently relevant to sage-grouse in North Dakota, however, they do affect sage-grouse in other states and are included in this discussion to provide land managers, and others, with the information needed to resolve or minimize conflicts associated with each should the need arise.

Issues considered to be of current or future importance to sage-grouse in North Dakota are: fire; harvest management; livestock grazing management; mining and energy development; noxious weed management; outreach, education, and implementation; power lines and generation facilities; predation; recreational disturbance of sage-grouse; roads and motorized vehicles; vegetation; and other wildlife.

Fire Management

Fire has always been present in sagebrush communities. Benefits and detriments to sage-grouse habitats and relative frequency of fire often are subjects of disagreement. Fire has been a factor in the loss of mature sagebrush habitat and affects sagebrush communities differently depending on the species of sagebrush. Fire management actions are divided into two categories; suppression of wildfires, and prescribed fire. Both wild and prescribed fires can have cumulative effects on sagebrush habitat and species that depend on it.

Prescribed fires are planned events with specific objectives; however, changes and variation in conditions at the site can change the actual outcome. Use of prescribed fire in the sagebrush community will result in a net loss of sagebrush and is of concern to those desiring to maintain a mature sagebrush community and associated wildlife.

Wildfires are less predictable and unplanned, and they have the most significant effect in the densest sagebrush. Suppression actions serve to protect sagebrush communities, human life, and community protection.

How can we minimize impacts of wildfire or prescribed fire on sage-grouse habitat?		
Goal	**Issue**	**Conservation Actions**
Manage prescribed fire in big sagebrush habitats to result in no net loss.	Reduction of sagebrush by prescribed fire.	1) Sites should not be burned unless: a) biological and physical limitations of the site are identified and clearly understood and any impacts on sage-grouse are identified and considered, including sagebrush recovery time. b) wildlife and range management objectives for the site are clearly defined and understood. c) post burn habitat management objectives are defined along with monitoring capabilities as well as funding to implement post burn management. Manage grazing, reseeding or other activities that influence the outcome of rehabilitation in a manner that achieves the desired future condition of the burned site.
Manage wildfire in sagebrush habitats to result in no net loss.	Reduction of sagebrush by wildfire.	1) Schedule annual coordination meetings—with appropriate resource staff including fire specialists, wildlife biologists, range ecologists, and local fire suppression personnel—to incorporate new sage-grouse habitat and other wildlife habitat information needed to set wildfire suppression priorities related to resources. Distribute updates to fire dispatchers for initial attack planning. 2) Incorporate known sage-grouse habitat information into each Wildfire Situation Analysis to help determine appropriate suppression plans and prioritize multiple fires. 3) Retain unburned areas of sage-grouse habitat, e.g., interior islands and patches between roads and fire perimeter, unless compelling safety, resource protection, or control objectives are at risk.
	Rehabilitation and restoration of sagebrush-grasslands.	1) Assure that long-term wildfire rehabilitation objectives are consistent with the desired natural plant community. 2) Re-vegetate burned sites in sage-grouse habitat within one year. Areas disturbed by heavy equipment will be given priority consideration. 3) Emphasize native plant species adapted to the site that are readily available and economically and biologically feasible. 4) Monitor the site and treat for noxious weeds. 5) Allow a minimum of two growing seasons of rest from grazing by domestic livestock unless there are specific restoration objectives using livestock.

	Proactive treatments that could reduce the risk of loss of habitat critical to sage-grouse.	1) Develop criteria for managing fuels and other risks to sage-grouse habitat. 2) Identify critical sage-grouse habitats and prioritize on the basis of risk of loss to wildfire. 3) Develop appropriate actions on a site by site basis, e.g., using existing roads as fire breaks.

Harvest Management

Hunting is a direct form of mortality to sage-grouse but is compatible with healthy sage-grouse populations although some do think that "surplus birds" should not be removed from what they see as a species "at risk."

Sage-grouse abundance is affected by long- and short-term population changes. Long-term population declines have been related to loss of sagebrush habitats essential to sage-grouse (Connelly et al. 2000a). Although not irreversible in nature, conditions resulting in long-term declines are likely to persist. Within the long-term decline are short-term fluctuations in sage-grouse abundance due to variable climatic events, e.g., drought or severe winters.

Sage-grouse hunting is a recreational and culturally important tradition. Analysis of wings collected from hunters is the best source of information on annual productivity of sage-grouse and the influence of changing climatic conditions on productivity and population composition. Juvenile/adult ratios generated by wing analysis also can indicate approaching changes in male attendance on leks in subsequent years. Lek surveys determine the number of active leks while lek counts determine number of males/lek and are the best source of population trend information.

Sage-grouse exhibit relatively low productivity and high survival when compared with other upland birds. Nevertheless, sage-grouse have significantly declined in North Dakota. Loss of habitat and degradation of existing habitat is believed to be the most significant factors affecting sage grouse in North Dakota. An appropriate harvest rate has not been determined for greater sage-grouse populations but a harvest equal to 5-10% of the autumn population may be appropriate (Connelly et al. 2000b). If habitat becomes more restricted and population trends continue their decline, seasons may be suspended (see Conservation Action 1 below).

How can we maintain sage-grouse hunting without impacting the viability of sage-grouse populations and the public's sage-grouse hunting opportunity?		
Goal	**Issue**	**Conservation Actions**
Manage for harvests that respond to changes in sage-grouse populations and maintain or increase sage-grouse populations.	There is a single harvest structure for the entire sage-grouse range in North Dakota.	1) Close the sage-grouse season if the spring census indicates there are fewer than 100 males in the population which would indicate the breeding population is less than 300 individuals (Connelly et al. 2000b) 2) Establish sage-grouse seasons on an annual basis using the current year's lek data and other appropriate survey data. This would include the development of a statistically reliable trend monitoring protocol for inventorying lek attendance of male sage-grouse.

	There are strongly opposed viewpoints on the influence of hunting on sage-grouse populations.	1) Develop graduate level studies to evaluate the influence of hunting on sage-grouse and what would constitute a maximum harvest rate. 2) Continue standardized wing collection protocol to evaluate the influence of environmental conditions on sage-grouse productivity and population trends. 3) Expand public information efforts designed to increase public awareness of the role of sage-grouse hunting.

Livestock Grazing Management

Sagebrush communities provide critical habitat for sage-grouse, produce a diversity of tangible commodities and satisfy many societal values that are important to the U.S. economy and the well-being of U.S. citizens. Sagebrush-dominated rangeland that is occupied by sage-grouse includes private, state and federal lands.

Rangelands in the Northern Great Plains evolved with grazing and extreme climatic disturbances. However, many western rangelands were over-stocked with livestock in the late-1800s and early 1900s, thus altering the composition and productivity of some sagebrush and other vegetative communities. With development and implementation of proper range management practices, vegetation condition of many rangelands has improved (Montana Sage Grouse Work Group 2004).

Sagebrush communities typically have forage value for livestock as well as providing habitat for sage-grouse. Livestock effects on sage-grouse habitat, and on the birds, may be positive, negative, or neutral depending on the specific grazing prescription and on the ecological site. Livestock grazing has been responsible for retaining tracts of sagebrush-dominated rangeland from conversion to cropland. In terms of habitat quality, properly managed grazing can stimulate growth of grasses and forbs, and thus livestock can be used to manipulate the plant community toward a desired condition. For example, rest-rotation grazing systems designed after Hormay (1970) provide for long-term range health and, in comparison to other systems, was found to produce up to four times as many prairie grouse (i.e., sharp-tailed grouse and prairie chickens) compared with other grazing systems on the Fort Pierre National Grasslands (Rice and Carter 1982). Although that study didn't address sage-grouse directly, the effect of improved residual cover, in response to grazing management, would likely have positive implications for sage-grouse habitat. Management may not, however, restore all degraded range through grazing manipulation alone. Likewise, appropriate grazing practices may not totally compensate for other influences affecting sage-grouse abundance.

In response to environmental concerns, livestock operators and other land managers have developed stock water sources on uplands and have constructed fences to shift grazing from riparian to upland areas. Meeting objectives for riparian areas may increase removal of vegetation on upland sites. To minimize the potential impact of removing important understory vegetation, flexible grazing management programs need to be planned and implemented while considering needs of sage-grouse. Land managers also should consider potential effects, such as disturbance or mechanical damage to sagebrush, caused by livestock concentrations near leks during the breeding season or on key winter habitats.

Cooperative research is needed to identify and evaluate effects of various grazing management plans on the interaction of sage-grouse, commodity production, and societal values. Results should be used to develop grazing plans that eliminate or minimize potential conflicts.

Prescribed grazing standards and best management practices as described in *Best Management Practices for Grazing* (Montana Department of Natural Resources and Conservation 1999) are recommended as methods that can be used to implement many of the grazing actions in this section. In addition, the conservation actions in this section describe some considerations that may be specific to sage-grouse and sagebrush habitats.

How can we maintain and enhance sagebrush rangelands to provide productive sage-grouse habitat while providing for commodities and values desired by society?		
Goal	**Issue**	**Conservation Actions**
Manage grazing to maintain soil conditions and ecological processes necessary for a properly functioning sagebrush community that addresses the long-term needs of sage-grouse and other sagebrush associated species. [a] [a] Desired conditions for sage-grouse are covered in Section IV and Attachment I.	Conflicting priorities for land uses, species, and habitats	1) Use scientific data and historic information to establish baseline information when evaluating soil conditions and ecological processes and when monitoring seasonal sage-grouse habitats. 2) Set specific habitat objectives and implement appropriate grazing management to achieve those objectives and maintain or improve vegetation condition and trends. 3) Offer private landowners incentives when and where appropriate to achieve sage-grouse objectives. 4) Utilize techniques as outlined in "Interpreting Indicators of Rangeland Health", Technical Reference 1734-6.
	Some sagebrush communities may have been significantly altered by past grazing management practices	1) Implement appropriate grazing management strategies and range management practices where soil conditions and ecological processes will support sage-grouse and desired commodities and societal values. 2) Establish suitable goals for sagebrush communities that have deteriorated to such an extent that livestock management alone will not be sufficient to obtain habitat objectives. 3) Offer private landowners incentives when and where appropriate to achieve sage-grouse objectives.
	Drought may result in the degradation of native plant communities, reduces forage production, and thus reduces sage-grouse habitat	1) Livestock managers should have drought management strategies or plans (e.g. water facilities; forage sources) formulated for implementation during periods of drought. 2) Consider effects of livestock and wildlife distribution on sage-grouse prior to developing additional water sources. 3) Offer private landowners incentives when and where appropriate to achieve sage-grouse objectives.

	Improper grazing, or lack of grazing, can change the composition and/or structure of the native plant community and thereby reduce or eliminate food and cover for sage-grouse.	1) Monitor the response of forbs (kinds, vigor, and production) and the compositional diversity of native species with respect to livestock grazing, evaluate the data, and make necessary adjustments. 2) Identify reasons for lack of grass and forb cover in sagebrush communities and recommend/implement practices to increase the native herbaceous understory. 3) Identify critical sage-grouse areas, and adjust grazing to minimize conflict between production of commodities and protection of societal values. 4) Use monitoring methods that are best suited to the type of grazing management being incorporated at a site. Note: proper use will vary with the type of grazing system, e.g., rest rotation vs. deferred. 5) Adjust stocking levels (up or down) within the carrying capacity of the pasture or range. Adjustments should be based on a monitoring program evaluating plant and soil response with respect to actual livestock use, weather, wildlife use, insects, and other environmental factors.
	Riparian areas (wet meadows, seeps, streams) are important resources for sage-grouse and livestock.	1) Design and implement livestock grazing management practices (riparian pastures, seasonal grazing, development of off-stream water facilities, etc.) to achieve riparian management objectives. This may require additional water developments and/or fencing to achieve objectives. Additional two-track trails may be necessary. Decisions will be made on a case by case basis whether benefits from protection of riparian areas will be offset by additional developments. 2) Modify or adapt pipelines and natural springs, where practical, to create small wet meadows as brood habitat. 3) Ensure the sustainability of desired soil conditions and ecological processes within upland plant communities following implementation of strategies to protect riparian areas. This can be achieved by: a) protecting natural wet meadows and springs from over-use while developing water for livestock, b) planning the location, design, and construction of new fences to minimize impacts on sage-grouse. (See criteria for fencing under Grazing Management) c) avoid heavy utilization of grazed pastures to compensate for rested pastures (a year of rest cannot compensate for a year of excessive use).

	Potential for sage-grouse to be disturbed or displaced by concentrations of livestock near leks or winter habitat.	1) Discourage concentration of livestock on leks or other key sage-grouse habitats. a) Avoid placement of salt or mineral supplements near leks during the breeding season (Mar-Jun), b) Avoid supplemental winter feeding of livestock, where practical, on sage-grouse winter habitat and around leks. c) Offer private landowners incentives when and where appropriate to achieve sage-grouse objectives.
	Sage-grouse seasonal ranges encompass private, state, and federal land. Habitat values across the respective ownerships are important to sage-grouse.	1) Encourage land management practices that provide for maintaining or enhancing sage-grouse habitat on private, state, and federal land. 2) Encourage coordination of management activities on all properties to provide yearlong benefits to sage-grouse. This may require reasonable compromise in establishing management practices to achieve specific goals. 3) Offer private landowners incentives when and where appropriate to achieve sage-grouse objectives.
Assess impacts of fencing for livestock on sage-grouse and sage-grouse habitats.	Existing fences near breeding, brood-rearing, or winter habitats can increase the risk of collision mortalities and/or predation on sage-grouse by hawks, eagles, and ravens by providing perches.	1) If portions of existing fences are found to pose a significant threat to sage-grouse as strike sites or raptor perches, mitigate through moving or modifying posts, etc. 2) Increase visibility of those fences by flagging. 3) Offer private landowners incentives when and where appropriate to achieve sage-grouse objectives.
	Proposal of new fences near sage-grouse leks and winter ranges.	1) Avoid placing fences through or near leks and winter ranges on state and federal lands. 2) Similar practices should be considered on private lands where possible. 3) Offer private landowners incentives when and where appropriate to achieve sage-grouse objectives.
Minimize impacts of using pesticides and herbicides to control insects and herbaceous plants that provide a food source for grouse.	Pesticides and herbicides may adversely impact the kinds and number of foods available in the form of insects and forbs and can directly affect chick survival.	1) Evaluate ecological consequences of using pesticides to control grasshoppers or other insects. 2) Evaluate ecological consequences of broadcast herbicide use on forbs and other important sage-grouse foods. 3) Minimize use of pesticides and herbicides within 1 mile of known grouse nesting areas, leks, or brood-rearing areas. 4) Develop educational materials detailing effects of pesticides and herbicides on sage-grouse.

Mining and Energy Development

Many of the nation's oil and gas resources are located under sage-grouse habitats across the western U.S. Energy activity can negatively affect sage-grouse populations if habitats are lost, fragmented, or changed in ways unfavorable to grouse.

Effects of oil and gas development on sage-grouse are not extensively documented. While exploration and development may negatively affect sage-grouse habitat and populations, long-term impacts after reclamation are not clearly understood. Research suggests that energy development can displace sage-grouse and that displaced grouse may return in some cases to the site after energy-related activities have ceased, but populations may not attain pre-development levels. Declines are attributed to effects of human disturbance, roads and power lines that fragment habitat, placement of infrastructure in areas once free from structures, alteration of vegetation composition through introduction of noxious weeds and other non-native plants, and disruptive noise near leks. Initial site disturbance and remaining structures can potentially enhance habitat for avian and mammalian predators.

Current research in several western states is directed at identifying and quantifying impacts of energy development on sage-grouse.

How can we meet our energy demands and minimize impacts to sage-grouse and sagebrush habitats?		
Goal	**Issue**	**Conservation Actions**
Minimize impacts of oil and gas development on sage-grouse and sagebrush habitats.	Energy development may adversely affect sage-grouse.	1) Work cooperatively—agencies, utilities, and landowners—to identify and map important seasonal ranges for sage-grouse. 2) Complete a broad scale assessment to identify important areas for grouse (wintering, nesting etc.) that require additional protection or conservation during land use planning and leasing of energy reserves. 3) Prioritize areas relative to their need for protection—ranging from complete protection through moderate to high levels of energy development. 4) Encourage development in incremental stages to stagger disturbance (federal leases range from 3-10 years); design schedules that include long-term strategies to localize disturbance and recovery within established zones over a staggered time frame. 5) Provide technical assistance to private landowners who lease privately owned fee minerals. 6) Use off-site mitigation, e.g., creation of sagebrush habitat, or purchase conservation easements with industry dollars to offset habitat losses. 7) Remove facilities and infrastructure when use is completed. 8) Enhance our understanding of effects of energy development through pre-activity inventory,

		monitoring over the life of the development, and annual evaluations thereafter. 9) Encourage operators to utilize conservation efforts on all development projects regardless of surface ownership.
	Increased human disturbance.	1) Allow no surface occupancy within 0.25 miles of an active lek. If siting structures near important breeding, brood-rearing, and winter habitat is unavoidable, consider the following: a) size of the structure(s), b) life of the operation, c) extent to which impacts would be minimized by topography, and d) disturbance by noise and maintenance. 2) Allow no surface use in nesting habitat within 2 miles of an active lek during a period of breeding and nesting—1 March –15 June (this action applies to drilling, testing and new construction projects, but does not apply to operation and maintenance of production facilities). 3) Restrict maintenance and related activities in sage-grouse breeding/nesting complexes—1 March –15 June—between the hours of 8:00 pm and 8:00 am 4) Allow no surface use activities within crucial sage-grouse wintering areas during 15 November-14 March (this action applies to drilling, testing and new construction projects, but does not apply to operation and maintenance of production facilities). 5) Remove structures and associated infrastructure when project is completed.
	Increased roads, pipelines, and power lines can fragment sagebrush habitats.	1) Develop a comprehensive infrastructure plan prior to energy development activities to minimize road densities. 2) Avoid locating roads and power lines in crucial sage-grouse breeding, nesting, and wintering areas. 3) See conservation actions for siting and constructing power lines. 4) Use minimal surface disturbance to install roads and pipelines and reclaim site of abandoned wells to natural communities.

Minimize impacts of fossil fuel generation facilities on sage-grouse and sagebrush habitats.	Energy-related facilities located within 2 miles of a sage-grouse lek can degrade habitat quality.	1) Locate storage facilities, generators, and holding tanks outside the line of sight and sound of important breeding habitat. 2) Minimize ground disturbance in sagebrush stands with documented use by sage-grouse: a) breeding habitat—the lek and associated stands of sagebrush, b) nesting habitat—stands of sagebrush within 2 miles of a lek, and c) wintering habitat—sagebrush stands with documented winter use by sage-grouse with portions that would remain above the snow even during years of deep-snow conditions. 3) Concentrate energy-related facilities when practical.
	Energy-related activities can cause invasion of noxious weeds and other non-native plants.	1) See conservation actions related to preventing the spread of weeds and controlling infestations of noxious weeds. 2) Engage industry as a partner to develop and establish new sources of seed of native plant species for restoration of sites disturbed by development.
	Noise can disrupt breeding rituals and cause abandonment of leks.	1) Restrict noise levels from production facilities to 49 decibels (10 dba above background noise at the lek). 2) Restrict use of heavy equipment that exceeds 49 decibels within 2 miles of a lek from 8 p.m-8:a.m. during March 1-June 15. 3) If possible locate production facilities downwind (prevailing wind direction) of lek sites to further reduce disturbance.
	Water discharge and impoundments can degrade or inundate breeding, nesting, and winter habitat.	1) Design impoundments and manage discharge so as not to degrade or inundate leks, nesting sites, and wintering sites. 2) Protect natural springs from any source of disturbance or degradation from energy-related activities.
Provide for the least obtrusive regulation of oil and gas activities while providing for needs of sage-grouse.	Siting requirements need to be re-examined as technological advances make development more compatible with sage-grouse needs.	1) Provide for long-term monitoring of siting requirements to examine effects of current and future development on sage-grouse. 2) Set up a schedule for reviewing and revising siting and use criteria with industry.

Noxious Weed Management

Certain species of plants are currently designated as “noxious” in North Dakota as well as others that are termed “troublesome” (NDSU Ext. Service 2004). “Noxious” applies only to species so designated by the North Dakota Department of Agriculture. County weed boards may add species to local lists that have not been designated by the state, but at a minimum must include those species designated by the Department of Agriculture. Resource managers, both public and private, have a statutory responsibility to develop management plans for treatment of noxious weeds on the land they own and/or manage. The magnitude of weed infestations, however, often prevents appropriate and timely treatments.

Noxious weeds and other invasive plant species, such as annual grasses, displace more desirable native plant species and cause significant adverse biological and economic effects by reducing productivity of healthy rangeland. Noxious weeds impact all classes of wildlife and domestic livestock. Plant species designated as noxious weeds are classified as either established and spreading, newly introduced, or are recognized as potential invaders. Noxious weed species present in adjoining states and provinces are a threat in North Dakota.

Although introduction and subsequent spread of weeds can occur through several means, the most pervasive occurs along transportation and floodplain corridors. One of the primary concerns of resource managers is the spread of noxious weeds by vehicles. Disturbed ground typically serves as the initial point of establishment, with the amount of disturbed ground being directly proportional to the overall susceptibility of an area to weed invasion.

Disturbance can take many forms and causes—the most common being human-caused activities, such as road building. Often overlooked, but equally important, are climatological and biological influences. Recurrent flooding and wildfires, as well as prolonged drought, can disturb plants and topsoil over large areas. Biological forms of ground disturbance include burrowing activities by small mammals and localized over-use by livestock and/or wild ungulates. These large- and small-scale disturbances provide opportunity for invasive species to become established.

Herbicide treatment is the most widely employed method to control noxious weeds. For most noxious weeds, this method of treatment provides immediate, effective results. Problems occur when weed seeds have been allowed to build up in the soil and/or surrounding land areas and left untreated. Re-establishment in such cases occurs from seed banks and off-site reinvasion. This cycle of treatment/re-establishment is expensive and requires dedication and immediate action by resource managers when weeds reappear within treated areas. Prevention, which requires focused purposeful action in surrounding infested and uninfested areas, provides the most cost-effective control. Prevention works best when management strategies acknowledge a threat and prioritize efforts to eliminate potential sources of infestation and expansion.

Chemical control of noxious weeds is efficient but might pose some toxicological risk to sage-grouse and other wildlife during treatment. Pathways of exposure include absorption from treated plants, inhalation of chemical particles suspended in the atmosphere, and direct ingestion of treated plants (Montana Fish, Wildlife and Parks 1994). If properly applied, however, toxicological risks should be minimal. A reduction of forbs important to sage-grouse during brood-rearing could have more serious consequences to local populations, with the magnitude of effects dependent on the scale of treatment. However, resource managers must realize that untreated noxious weeds are ultimately more effective at competitively displacing desirable plant components than short-term, transient impacts from proper herbicide application.

How can we minimize impacts of noxious weeds and other invasive species and their control on sage-grouse?		
Goal	**Issue**	**Conservation Actions**
Identify current noxious weed infestations within and adjacent to occupied sage-grouse habitat or suspected ranges.	Current information on existing weed infestations is insufficient for successful weed management.	1) Inventory and map existing noxious weed populations within and adjacent to occupied sage-grouse habitat or suspected range.
Implement habitat-specific weed management plans for known sage-grouse ranges.	Appropriate weed management can't be performed without habitat-specific information.	1) Develop habitat-specific weed management plans for known sage-grouse ranges, using the inventory and map information developed in the action described above.
Maintain habitat quality for both wildlife and livestock interests through proactive weed management.	Weed infestations result in loss of native grass, forb, and sagebrush abundance and diversity.	1) Promote measures that prevent introduction and spread of weed seeds and other reproducing plant parts.
Prevent the initial establishment of weeds within or on lands surrounding sage-grouse habitat.	Noxious weeds spread quickly and without regard to ownership or management boundaries. Without immediate treatment, noxious weeds become a problem to all surrounding landowners. Effective weed management cannot occur in isolation or to the exclusion of any land managers within an area.	1) Develop and implement management techniques that minimize the risk of infestation. 2) Use weed seed-free livestock forage and mulch. 3) Where feasible, avoid vehicle movement through infested areas. 4) Use weed-free seed for re-establishment of vegetation. 5) Eliminate unnecessary soil disturbance and vehicle access/movement into occupied sage-grouse habitat. Limit vehicle use to established roads only. 6) Regularly monitor access points and roads for weed establishment.
Ensure that land managers and users (general public) are educated about the threat noxious weeds pose to native plant communities and work together to find appropriate management solutions.	Cooperative integrated weed management efforts are essential in order to have successful sage-grouse habitat.	1) Develop partnerships with regional public and private land management units. Solicit involvement of local weed management specialists, private landowners, wildlife biologists, and range ecologists to share knowledge and responsibilities on noxious weed issues. 2) Establish goals and set priorities that encompass the needs of both livestock and wildlife managers so all parties are working under a similar plan. 3) Provide training to appropriate staff on the proper selection and use of herbicides, including effects that climatic conditions and soils types have on applications of herbicides.

		4) Maintain proper operating herbicide application equipment as well as proper herbicide application records, according to pesticide laws. 5) Conduct monitoring and develop follow-up procedures for treated areas. 6) Participate in integrated weed management training conducted by state and federal agencies, local experiment stations, and local (county) weed districts. 7) Educate all field personnel on weed identification, manner in which weeds spread, and methods of treating weed infestations.
Minimize effects of weed control treatments on non-target organisms.	It is important to maintain viable sagebrush habitat and populations of sage-grouse while eradicating infestations of noxious weeds.	1) Employ integrated weed management treatment methods such as a combination of biological and cultural , e.g., grazing, mowing, or seeding, treatments in conjunction with herbicides to manage weeds in sage-grouse habitat. 2) Use the most selective herbicides where chemical treatment is appropriate, to minimize loss of non-target plant species. Develop cost-share guidelines for those instances when expensive selective herbicides are deemed necessary. 3) Restore plant communities with desired species adapted to the site, using proven management techniques where biologically feasible. A restoration program may be necessary if conditions prevent natural native plant reestablishment.
Provide necessary funding mechanisms and dedicated labor to act immediately when new infestations are identified within sage-grouse habitat.	New weed infestations are often undetected.	1) Establish a monitoring protocol to detect new infestations.
	Weed management may not be an identified budget item in sage-grouse management plans.	1) Weed management costs should be an identified budget item in sage-grouse management plans. Money should be dedicated for monitoring and education as well as direct treatment expenses.
	Funding and/or human resources may not be available when new infestations are discovered.	1) Establish partnerships or formal agreements with local (county) weed districts if appropriate to utilize their equipment and/or personnel.

Outreach, Education, and Implementation

Public education, outreach, and "inreach" (communication within agencies and groups to increase understanding) about sage-grouse conservation should be undertaken through a partnership between state and federal agencies, non-governmental organizations, and citizens. Effective conservation of sage-

grouse requires collaboration between public land managers, private landowners, wildlife professionals, extension service agents, and others to develop and implement appropriate regional protection strategies.

Implementation requires a sound biological foundation. Most information about shrub-steppe habitats and sage-grouse is contained in technical manuscripts. User-friendly information is needed to manage habitats to conserve sage-grouse and other sagebrush-associated species. Participating agencies, groups, and individuals will need to develop and provide educational material about sage-grouse and their needs and new research findings as they become available.

How can we inform the public and agencies about sage-grouse populations and habitat needs, and coordinate the implementation of the conservation plan on both public and private lands?		
Goal	**Issue**	**Conservation Action**
Improve public and agency understanding about conservation of sage-grouse and sagebrush communities.	The general public and agency staffs have not been exposed to current information on ecological needs and methods for conserving sage-grouse and sagebrush habitats. Materials are needed to present this information.	1) Develop educational materials (brochure, Power Point presentation, camera-ready ads, press releases, public service announcements, event invitations and surveys, websites, newsletters, and research information). 2) Present materials in a series of community meetings that bring statewide technical group participants and regional agency staff together with local people.
Gain agency and public understanding, input, and endorsement of the Sage-grouse Conservation Plan	The general public and agency staff may not initially understand, and therefore not support the plan.	1) Distribute the plan via hard copy and website. 2) Develop and implement a communications plan that identifies the audience and the message. 3) Prepare an executive summary of the plan. 4) Review and reconcile public concerns.
Implement a conservation strategy for sage-grouse using the Conservation Plan as a model.	Implementing a rangewide plan in light of diverse geographical, cultural, and socio-economic challenges poses a challenge.	1) Implement a local work group. A work group includes but is not limited to agency personnel (BLM, USFS, NRCS, NDG&F, USFWS), landowners, (ranchers, farmers, grazing association), sportsmen, legislators, businessmen, media, etc.
	Informational materials are needed for the sage-grouse conservation effort.	1) Develop a list of incentive programs presently offered that could be used to prevent the loss of sage-grouse habitat. 2) Develop and distribute information on best management practices and incentives for sage-grouse and sagebrush obligates.[1]

		3) Request counties and agencies to designate a sage-grouse contact person to interface with county planning authorities. 4) Provide sage-grouse habitat maps and recommendations to county planners, public land agencies, and other interest groups and land managers. 5) Encourage county governments to offer incentives to developers who protect and enhance sage-grouse habitat.
[1] Sagebrush obligates are species that depend on sagebrush during the breeding season or year round: these include sage sparrow, Brewer's sparrow, sage thrasher, sage-grouse, pygmy rabbit, sagebrush vole, sagebrush lizard and pronghorn antelope. Many other species depend on the sagebrush community to a lesser degree. We refer to all these species as sagebrush-associated species (Paige & Ritter 1999)		

Power Lines and Generation Facilities

Both investor-owned electric utilities and Rural Electric Co-ops deliver electricity through power lines throughout the state. The current density of lines in sage-grouse habitat is lower than in urban or other rural areas due to lower human population density. Increasingly popular rural subdivisions and increasing levels of energy development account for most new power lines in sage-grouse habitat.

Power lines can provide hunting perches for raptors in treeless areas. Sage-grouse also may be injured or killed by flying into these structures. Power lines most likely impact grouse near leks, in brood-rearing habitat, and in wintering areas that also support large numbers of wintering raptors. Construction of new power lines contributes to habitat degradation when accompanied by new roads or other infrastructure, e.g., pipelines, fences, etc.

The U.S. Fish and Wildlife Service strongly encourages electric utilities to address raptor electrocution problems on power lines nationwide by either preventing raptors from perching on poles or by making poles safe for raptors to perch on. Installation of perch prevention devices may protect raptors, but they will still try to land on such poles located near concentrations of prey. Utilities commonly make power poles safe for raptors to use as perches but this poses a dilemma in sage-grouse habitat. It is important that parties involved with power lines utilize appropriate guidelines (Avian Power Line Action Committee guidelines 1994) when designing raptor perch sites and perch guards.

Burying lines would reduce or eliminate both electrocution of raptors and perch sites. Burying high-voltage (Transmission) lines is very difficult both technically and economically. Burying lower voltage (Distribution) lines costs substantially more than equivalent overhead facilities and creates a potential for invasion of noxious weeds. Locating causes of outages on underground lines is difficult and greatly increases the time required for subsequent repair. Underground repairs also involve a greater disturbance of ground and vegetation.

Proposed generation facilities may include fossil fuel plants (coal and natural gas) and wind power. Such facilities also may include associated infrastructure (buildings, roads, railroads, power lines, pipelines etc). When sited in sagebrush habitats, these plants and associated infrastructure may contribute to

destruction, fragmentation, or degradation of sagebrush habitats. Wind turbines may also cause direct mortality to sage-grouse that fly into the rotating blades.

How can we continue to provide electric service to customers and minimize impacts to sage-grouse and sagebrush habitats?		
Goal	**Issue**	**Conservation Actions**
Minimize impacts of power lines on sage-grouse and sagebrush habitats.	Existing power lines near a lek, brood-rearing habitat, or winter habitat increases the risk of predation on sage-grouse by raptors.	1) Document the segment(s) of line causing problems. 2) Determine by cooperative action—agencies, utilities, and landowners—whether or not modification of poles to limit perching will prevent electrocution of raptors and decrease predation on sage-grouse. Inform involved parties of and utilize Avian Power Line Action Committee 1994 guidelines. 3) Emphasize the following if perch prevention modifications do not work to protect sage-grouse and sagebrush habitat: a) reroute the line using distance, topography, or vegetative cover; or b) bury the line. 4) Explore opportunities for technical assistance and funding. 5) Remove power line when use is completed.
	New power lines proposed in sage-grouse habitat can pose threats to sage-grouse.	1) Minimize the number of new lines in sage-grouse habitat. 2) Site new lines in existing corridors wherever practicable and site power lines and pipelines along existing roads. 3) Encourage use of off-grid systems such as solar, natural gas micro-turbines, and wind power where feasible in sage-grouse habitats. 4) If siting power lines on important breeding, brood-rearing, and winter habitat is unavoidable, use the best information available to minimize impacts. 5) If siting is required within 2 miles of important breeding, brood-rearing, and winter habitat (Connelly et al. 2000b), emphasize options for preventing raptor perch sites utilizing Avian Power Line Action Committee 1994 guidelines or bury a portion of the line. 6) Develop a route—with agencies, utilities, and landowners cooperating—that uses topography, vegetative cover, site distance, etc. to effectively protect identified sage-grouse habitat in a cost efficient manner.

		7) Restrict timing for construction to prevent disturbance during critical periods: a) breeding—1 March-15 June b) winter—1 December-31 March 8) Take appropriate measures to prevent introduction or dispersal of noxious weeds during construction and planned maintenance. 9) Remove power line when use is completed.
	Existing power line is causing consistent or significant collision mortality on sage-grouse.	1) Document the segment(s) of line causing consistent or biologically significant mortality—with agencies, utilities, and landowners cooperating in the effort. 2) Initiate collision prevention measures using guidelines (Avian Power Line Action Committee 1994) on identified segments. Measures are subject to restriction or modification for wind and ice loading or other engineering concerns, or updated collision prevention information. 3) Remove power lines that traverse important sage-grouse habitats when facilities being serviced are no longer in use or when projects are completed.
Minimize impacts of fossil fuel generation facilities on sage-grouse and sagebrush habitats.	Fossil fuel generation may impact sage-grouse and sage-grouse habitat.	1) Use the best available information to: a) identify important sage-grouse breeding, brood-rearing, and winter habitat in an appropriate vicinity of a proposed facility and associated infrastructure; and b) site fossil fuel generation facilities and associated infrastructure — with developers, agencies, utilities, and landowners cooperating—using topography, vegetative cover, site distance, etc. to effectively protect identified sage-grouse habitat. 2) Restrict timing of construction to minimize disturbance during critical periods: a) breeding—1 March-15 June b) winter—1 December-31 March 3) Take appropriate measures to prevent introduction or dispersal of noxious weeds during construction, maintenance, and operation as required by federal and state laws. 4) Develop offsite mitigation strategies in situations where fragmentation or degradation of sage-grouse habitat is unavoidable.

Predation

Predator populations, their effects on sage-grouse populations, and issues surrounding predator control concern landowners, wildlife managers, and the public. Some people believe that predator populations have increased due to lack of predator control and that predators are the primary factor limiting sage-grouse populations. Others contend that habitat fragmentation and degradation are the primary reasons for population declines, and that these land use changes contribute to increased rates of predation.

Predation does impact sage-grouse to varying degrees. The impact of predation can vary as changes occur in the predator/prey environment seasonally, from year to year, and geographically. Many native mammals, raptors, and other species prey upon sage-grouse eggs, juveniles, and adults. Bull snakes can be an effective nest predator. Invasive species like red fox and raccoon have expanded their range into sagebrush steppe communities and can impact success of ground nesting birds. Quality and quantity of the sagebrush habitat, composition of the predator community, and weather patterns such as drought or severe winters likely determine both annual and long-term carrying capacity for sage-grouse. Sage-grouse populations appear to cycle from low to high numbers under the current combination of habitat, predation, and weather influences.

Certain vital rates such as adult hen survival, nest success, and juvenile recruitment drive sage-grouse population dynamics. Attempting to modify these vital rates to increase populations through either direct predator control actions or by manipulating habitat to indirectly control predation rates should be evaluated in terms of cost effectiveness and efficiency. The influence of weather patterns on these same vital rates should likewise be integrated into these discussions.

How can predation be managed to enhance production and survival of sage-grouse?		
Goal	**Issue**	**Conservation Action**
Manage predation to enhance sage-grouse survival and production where appropriate.	Predator numbers and species composition have changed, and the predator-prey relationship for sage-grouse needs further investigation.	1) Initiate studies to better understand sage-grouse mortality rates, factors that influence these rates, and effectiveness of management actions to change them. 2) Assess population status and trends of important predator species (both native and invasive). 3) Expand public information efforts designed to increase public awareness on the role of habitat, predation, and weather on sage-grouse population trends.
	Habitat fragmentation and poor quality habitat may be affecting mortality rates by allowing increased predation.	1) Initiate studies to determine relationships between predation, habitat fragmentation, and habitat condition. 2) Implement actions to improve the structure and composition of sagebrush communities to meet desired conditions for sage-grouse seasonal habitats. 3) Maintain and restore sagebrush communities where appropriate for sage-grouse populations. 4) Protect existing habitats through conservation easements, incentives, or other practices such as long-term leases.

	Man-caused alterations on the landscape have modified conditions and may directly facilitate increased predation.	1) Reduce man-made perches in sage-grouse breeding, nesting, and wintering habitats. a) Placement of power poles should follow prescriptions detailed in the discussion of power lines and generation facilities, b) Placement of fences should follow prescriptions detailed in the discussion of grazing management. 2) Reduce the availability of predator "subsidies" such as human-made den sites (nonfunctioning culverts, old foundations, wood piles) and supplemental food sources (garbage dumps, spilled grain, etc.) that contribute to increased predator numbers. 3) If predation is shown to be depressing sage-grouse populations, consider predator management actions specific to the predator species, site, and situation. 4) Consider expanded opportunities to take non-protected, invasive species where appropriate.

Recreational Disturbance of Sage-grouse

Sage-grouse are sensitive to disturbance at leks, nest sites, and in critical winter habitats. Human activity in these habitats may intentionally focus on sage-grouse (lek viewing, monitoring, photography, etc.), or may be incidental to other recreational activities (OHV use, hiking, horseback riding, etc.). Disturbances can be diminished or minimized at critical times and on seasonal ranges by concentrating use at designated times of year or day, restricting activities within 1.5 miles of leks (Joslin and Youmans 1999), and/or allowing certain types of use only at designated sites, e.g. viewing and/or photography at leks.

Monitoring sage-grouse populations and habitats is essential at leks and other critical habitats. Other multiple use activities may disturb leks and other habitats. Recreational and monitoring activities should be considered cumulatively with other activities as part of assessing overall levels, effects, and approaches for managing human disturbance of sage-grouse. Hunting as a recreational activity does not concentrate human use on seasonal ranges.

How can we continue to provide sage-grouse viewing and other recreational opportunities[1] while minimizing impacts to sage-grouse and sagebrush habitats?		
Goal	**Issue**	**Conservation Actions**
Minimize impacts of recreational viewing of sage-grouse at leks.	Citizens should be able to view and photograph sage-grouse breeding displays. However, viewing may disturb breeding activities, displace leks, and reduce reproductive success.	1) Agencies should document leks where recreational viewing is occurring. 2) Working together, the agency(ies) and interested public should determine whether or not management of viewing is needed to reduce disturbance of leks. 3) Educational materials should be developed and provided to the public indicating the effects of concentrated recreational activities and the importance of seasonal ranges to sage-grouse.

	Management of lek viewing may be necessary.	1) Establish viewing guidelines, i.e., distance, timing, approach methods, signage, parking areas, and area closures. 2) Designate particular leks for public viewing, and where appropriate, restrict viewing and photography to designated sites. 3) Determine, through the agency(ies) and the public working together, whether or not other recreational activities disturb leks, nesting, or winter habitats.
Minimize impacts of recreational activities unrelated to sage-grouse viewing.	Types of recreation other than lek viewing may affect sage-grouse.	1) Reduce disturbance of sage-grouse and degradation of sagebrush habitats through use of site-specific monitoring, and where appropriate, develop seasonally restrictive public access to specific lek, nesting, and winter habitats. 2) Consider sage-grouse needs when developing roads and OHV management plans. 3) Develop and provide educational materials to the public describing effects of concentrated recreational activities and the importance of seasonal ranges to sage-grouse. 4) Encourage recreationists to avoid continuous or concentrated use within two miles of leks from 15 March to 15 June. 5) Issue special use permits for certain activities with distance and timing restrictions to maintain the integrity of breeding habitat.

[1] Recreational hunting is discussed elsewhere under separate conservation actions.

Roads and Motorized Vehicles

Roads have a variety of impacts on sage-grouse and their habitats. Vehicle use on federal and state lands, both on and off roads, has increased significantly over the past few years and is impacting habitat quality (Mattise 1995). As documented in Joslin and Youmans (1999), vehicles do impact wildlife. Severity of impacts may be directly related to the amount of vehicle travel occurring. For example, the impact from an interstate highway through sagebrush-grassland could have a particularly devastating effect on sage-grouse, whereas the impact from small amounts of motorized cross-country travel occurring in the same area could be of little consequence to sage-grouse during non-nesting or other non-critical time periods.

As human population growth continues, pressure to subdivide land may further conflict with sage-grouse. An increase in number of roads will cause continued habitat fragmentation and loss and a potential decline and/or shift in populations. In addition, oil and gas exploration and production will substantially increase the number of roads/2-track trails. Indirect impacts on wildlife and wildlife habitat from road development and use during exploration and production includes trails, 2-track, bladed, and graveled roads. These impacts have been well documented for a variety of development projects (Trombulak and Frissell 2000) and include habitat fragmentation and direct loss of birds due to vehicles,

stress, displacement, and increased hunting pressure. Roads also may affect an animal's reproductive success (Gutzwiller 1991). An increase in roads and other cross-country travel also contributes to the spread of noxious weeds and an overall decrease in wildlife habitat, including sage-grouse habitat.

How can existing and future roads be managed to minimize road-related disturbance, loss of habitat, degradation of habitat, and mortality of sage-grouse?		
Goal	**Issue**	**Conservation Actions**
Avoid further fragmentation and/or loss of critical sage-grouse habitats due to road-related disturbances and cumulative effects of roads.	Roads may increase sage-grouse mortality through collisions with vehicles, displacement because of human disturbance, or other factors**.**	1) Identify, map, quantify, and evaluate impacts of existing roads, including 2-tracks, in relation to known lek locations and sage-grouse winter ranges. 2) Consider impacts to sage-grouse when designing new roads and modifying existing roads. 3) Consider seasonal use restrictions or signing to avoid disturbance of critical sage-grouse habitats. 4) Manage on-road travel and OHV use in key grouse areas to avoid disturbance during critical times, e.g., breeding, winter and nesting periods. 5) Plan or control organized events to avoid increased traffic and impacts to sage-grouse. 6) Manage motorized and mechanized travel to minimize impacts to sage-grouse and their habitat by developing standards for future road construction. 7) Manage motorized and mechanized travel to minimize impacts to sage-grouse by increasing enforcement of existing OHV and travel management plans. 8) Provide educational opportunities for users of OHVs dealing with possible effects their activities may have on sage-grouse.
	Roads and their associated disturbances and cumulative effects contribute to the loss of habitat and declining sage-grouse populations.	1) Develop a transportation management plan across ownership boundaries in critical sage-grouse habitats. 2) Participate in travel planning efforts and educate the general public about the impacts of roads on sage-grouse and critical habitats. 3) Consider buffers, removal, realignment, or seasonal closures where appropriate to avoid degradation of habitat. 4) Re-vegetate closed roads with plant species beneficial to sage-grouse. 5) Close and re-vegetate travel ways in sage-grouse habitats where appropriate.

		6) Provide sage-grouse habitat information to all entities during planning phases of transportation development.

Vegetation

Sage-grouse require large expanses of sagebrush habitats with healthy, diverse understories of grasses and forbs. In some areas, past management of rangelands has altered the density, structure, and composition of sagebrush communities—sometimes creating a variety of conditions that do not meet the desired condition described for sage-grouse seasonal needs. Composition of grasses and forbs, condition and densities of sagebrush, and other habitat-related conditions vary and include extremes. Variation may result from environmental factors such as climate or land management practices as fire management, grazing, weeds, and recreation. Restoring or enhancing sage-grouse habitats requires diverse strategies. Disagreement among professionals often arises regarding the ecological role, or successional relationships, of "mature" or "decadent" stands of sagebrush, the need to manipulate sagebrush communities, method of control, and extent of treatment. Prior to sagebrush manipulation on public land, a thorough review by an interdisciplinary team should be conducted. To determine potential effects, the review should include an analysis of historic treatments on similar habitat nearest the area in question.

Sage-grouse habitats face the risk of sagebrush removal by prescribed burning, herbicide application, or by conversion to cropland. Conserving sagebrush habitats on private and public lands is by far the most effective approach to assuring long-term maintenance of sage-grouse abundance and distribution. Incentive-based, voluntary programs are available for protecting privately-owned sage-grouse habitats from detrimental habitat conversion. In some areas, there are opportunities for planting cropland back to sagebrush-grassland habitat but such sagebrush plantings are costly and can have a high failure rate.

How can we manage the density, structure, and composition of shrubs, forbs, and grasses to maintain the health of the community, enhance sage-grouse habitats, and meet the needs of other species and human uses?		
Goal	**Issue**	**Conservation actions**
Manage sagebrush communities in a manner that results in improved health and no net loss of sagebrush habitats.	Key privately owned sagebrush-grassland habitats may be at risk of manipulation.	1) Provide incentives for habitat conservation such as the state-administered Landowner Incentive Program, which provides an incentive payment to private landowners for protecting sagebrush habitats from plowing, herbicides, and burning (see Section V). 2) Promote sagebrush-grassland habitat conservation through USDA programs. 3) Protect habitat by purchase of conservation easements from interested landowners.
	Information regarding sagebrush distribution is incomplete.	1) Map and inventory existing sagebrush. 2) Improve the classification of sagebrush cover to distinguish density and species.
Provide for a density, composition, and diversity of sagebrush that meet seasonal needs of sage-grouse while	The age distribution of sagebrush may have been altered by management, e.g., a young stand recovering	1) Map and inventory areas. 2) Evaluate the site potential and desired condition, and develop specific objectives accordingly within specific landscapes.

contributing to overall community health.	from disturbance or a mature stand with poor regeneration.	3) If sagebrush is lacking: a) develop and implement grazing practices that support sagebrush establishment and growth, b) inter-seed historical breeding and winter habitats with the appropriate sagebrush species, c) identify and promote seed sources for habitat restoration efforts, d) encourage voluntary use of sagebrush in habitat incentive programs, e.g., Conservation Reserve Program, and work to develop additional funding sources for such programs, e) reclaim and/or re-seed areas where sagebrush has been lost or reduced by disturbance (fire, cropping, etc.), f) promote sagebrush plantings on project areas occurring within sage-grouse habitats. 4) If mature sagebrush dominates (based on sagebrush age sampling) with suppressed herbaceous understory: a) identify areas of dense mature cover that do not appear to be serving as quality habitat and analyze these areas within the context of a larger landscape, b) determine the reason for suppressed herbaceous understory (e.g., soil condition, historical grazing management, drought) and identify/implement methods for improving understory health (e.g. applying prescriptive grazing treatments, see Livestock Grazing Management), c) design sagebrush treatments to be compatible with sage-grouse needs, d) develop specific objectives for sage-grouse in breeding or winter habitats.
Within the context of improving seasonal habitats, maintain or improve vegetative quality and quantity of the understory in all breeding habitats of sage-grouse.	The plant community has been altered and lacks a diverse herbaceous understory.	1) Map and inventory areas believed to be important sage-grouse breeding habitats. 2) Evaluate the site potential and desired condition within the context of a larger landscape. 3) Develop and implement techniques to increase herbaceous diversity and density within ecological limits. 4) Ensure that grazing practices allow plants to grow to seed ripe on a rotational basis. 5) Adjust livestock grazing management when necessary to promote forb establishment and recruitment. 6) Identify large areas of introduced plant species as crested wheatgrass (*Agropyron cristatum*) and determine if restoration efforts are appropriate.

		7) Interseed appropriate breeding habitats with forbs where necessary. 8) If mature sagebrush dominates with suppressed herbaceous understory: a) identify areas of dense mature cover that do not appear to be serving as quality habitat and analyze these areas within the context of a larger landscape, b) design sagebrush treatments to be compatible with sage-grouse needs, c) develop specific objectives for sage-grouse in breeding or winter habitats, d) if treatment is deemed appropriate, interrupt seral stages within the appropriate patch size using a method (brush beating, chaining, chemical means, prescribed fire) compatible with local conditions. 9) Identify and promote seed sources for habitat restoration efforts. 10) Identify landowner incentives and additional funding sources to enhance existing programs (as CRP). 11) Protect/enhance riparian areas to encourage succulent vegetation and re-establishment of shrubs if they are lacking.
	Residual understory is lacking in sagebrush stands, mainly in breeding habitats.	1) Develop incentives to promote desired habitat conditions on private lands. 2) Manage grazing by domestic livestock and wild herbivores to retain and promote adequate residual cover in all breeding habitats with an emphasis on nesting areas. 3) Ensure that grazing allotment plans include objectives for sage-grouse in sage-grouse habitats. 4) Monitor USFS/BLM/State allotment plans and regulations, and promote changes where necessary. 5) Include native grasses in all reclamation and restoration activities.
Where opportunities allow, restore sage-grouse habitats lost to plowing.	Sagebrush-grassland habitats, important to sage-grouse, have been converted to cropland.	1) Work with landowners to re-establish sagebrush-grassland habitats through programs such as the Habitat Plots Program or CRP.
Where opportunities allow, acquire land in the sage grouse range.	Land may become available for acquisition, both from other public agencies or from the private sector.	1) Assume ownership and management of land now managed by the State Land Department (some of these lands are not profitable to the state). 2) Acquire private land tracts offered for sale by landowners. 3) Support acquisition by other public agencies (BLM, USFS) in their efforts to acquire land by purchase.

		4) Support land trades by BLM and USFS where trades are beneficial to sage grouse.

Managing Other Wildlife in Sage-grouse Habitats

Wild ungulates and other native herbivores, e.g., prairie dogs, may negatively affect habitats upon which grouse depend. Wild herbivores can contribute to the reduction of shrub canopy and/or herbaceous understory in nesting and brood-rearing habitats. Wild ungulates most often affect habitats of limited size within a landscape that includes streamsides and wet meadows that under most conditions provide an abundance of forbs and insects needed by sage-grouse broods. These areas become increasingly important as dry conditions typically progress through summer.

Other land uses can compound the effects on areas of concentration by wild ungulates and other native herbivores. These conditions are especially important to address during periods of drought. Any attempt to resolve potential conflicts from wildlife use in sage-grouse habitats depends on the knowledge and cooperation of local landowners and resource managers. Where evidence of adverse impacts by wild ungulates or other native herbivores is available, obtaining quantitative, site-specific measurements of vegetation conditions is paramount to assure that assessments are objective, and causes are accurately determined.

How can sage-grouse habitat be maintained where the effects of other wild herbivores (ungulates) are reducing the quality of the site for use by sage-grouse?		
Goal	**Issue**	**Conservation Action**
Man**a**ge for wild herbivore populations commensurate with the capability of sagebrush communities to sustain sage-grouse, other sagebrush dependent species, and other land use objectives.	High concentrations of wild herbivores in localized areas may reduce habitat effectiveness for sage-grouse.	1) Identify and map key sage-grouse habitats where other wild herbivores are having significant impacts. 2) Establish an inventory and vegetative monitoring schedule to quantitatively determine the extent of the effects in key areas. 3) Determine seasons of expected use and assess the potential impact to sage-grouse habitat. 4) Develop plans that keep ungulate population levels consistent with a site's capability to support them.
Provide for an adequate amount of functioning riparian[1] habitat during critical periods such as brood rearing.	Riparian habitats may be vulnerable to overuse by wild herbivores on some sites. This can sometimes be exacerbated seasonally, during droughts, and/or by other land use practices.	1) Identify levels of use by wild herbivores in affected riparian areas. 2) Identify other land use practices occurring in riparian habitats. 3) Assess current management practices in respect to findings. 4) Determine whether management changes are needed. 5) Have drought management plans in place to allow for the rapid implementation of alternate management strategies.

[1] Riparian habitat includes shoreline and drainages leading to small impoundments.

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SECTION V: IMPLEMENTATION:

Implementation of this plan will require both interagency cooperation and public input. Agencies will need to coordinate monitoring of populations and habitat and research projects related to conservation of sage-grouse. Agencies and organizations, private companies, work groups or individuals that become involved in conservation planning and projects will need to assess funding towards those projects. This section provides an initial insight into projects that are currently being funded, who is managing the project and what conservation actions they entail. It provides a brief summary of state and federal programs that can be used to implement projects by organizations and individuals. It also lists current and future research projects and sage-grouse population and habitat monitoring projects.

OBJECTIVES:

1. Use habitat programs that are in place to manage rangelands and improve sagebrush habitat in North Dakota. These programs can help to:
    a) improve and maintain existing sagebrush/steppe habitat;
    b) restore sagebrush/steppe habitat to areas that have been converted to cropland/tame grass;
    c) restore connectivity to existing habitat.

2. Provide for monitoring of:
    a) strutting grounds to determine the sage-grouse population status on an annual basis;
    b) the quality and trend of big sagebrush plant communities on a periodic basis.

3. Develop contracts with other agencies and universities that will cover needed research on sage-grouse in North Dakota.

AN ASSESSMENT OF SAGE-GROUSE/SAGEBRUSH CONSERVATION PROGRAMS:

North Dakota Game and Fish Department (NDGFD)

The North Dakota Game and Fish Department has several programs under the Private Lands Initiative (PLI) in place that have been adapted to work in the sagebrush/steppe area of southwestern North Dakota. These include: (1) the Landowner Incentive Program (LIP); (2) CRP Cost-sharing; (3) Working Lands; and (4) Habitat Plots.

Landowner Incentive Program (LIP)

LIP is a US Fish and Wildlife Service grant program to supplement North Dakota Game and Fish Department funds to protect and restore habitats on private lands to benefit at risk wildlife species. Landowners receive up front payments for 5, 10, 15 or 20 year agreements or other direct payments for habitat management, development and/or restoration of habitat. Examples of projects available in the sage-grouse sagebrush/steppe area of North Dakota include protecting existing sagebrush/steppe habitat, sage-grouse breeding, nesting and foraging sites (habitat); planting native vegetation such as grasses, forbs, shrubs (sagebrush); and promoting grazing systems beneficial to sage-grouse and livestock. The Department has approximately $250,000 available during this grant cycle (2005-2007) for individual landowners.

Conservation Reserve Program Cost Sharing

This program offers cost-share funds to landowners for establishing cover on acres enrolled in the USDA Conservation Reserve Program. It provides assistance in establishing grass and shrub (sagebrush) cover on lands enrolled in the program. Up to 50% cost-share on seed costs will be provided and can be applied to new, established, or renovation seedings.

Two options are offered to landowners. They have a choice of: limited haying and grazing; or no haying or grazing. For limited haying/grazing, the landowner must obtain a modified CRP conservation plan from their Farm Services Agency (FSA) office. Under this option, the landowner may hay or graze up to 50% of the acreage, either under his 50% option, or an emergency haying/grazing declaration. Under the latter option (no haying or grazing allowed) an extra incentive payment will compensate for this non-use.

Working Lands

The Working Lands Program recognizes and rewards landowners for activities and resources that have a positive impact on wildlife habitat without requiring land retirement. Points are awarded to landowners who are willing to undertake a habitat development project that will benefit wildlife and use cropland and rangeland management systems that favor conservation. Payments range from $.50 to $3.00 per acre and the contract period is two years.

Habitat Plots

This can be either a short term or multi-year agreement providing nesting, wintering or other key wildlife habitat. This plot program can be newly established cover, existing cover, or a combination of both. Agreements in the short term option for newly established habitat run for six years while existing habitat agreements run for three years. Long term options run from ten to twenty years. During the term of the contract, landowners agree to not hay or graze the tracts. Long-term options cover both new and existing habitats.

> New habitat: The Department will provide 50% cost-share (to $30/acre) to establish new permanent vegetative cover (including sagebrush) on cropland, with seed mix depending on soil classification.
>
> Existing habitat: Existing habitat can be enrolled along with converted cropland, and consists of habitat in place (grassland, sagebrush/steppe). Priority is given to areas greater than 80 acres in size. Payments are less than new habitat since no costs are involved in establishing new cover.

(Contact information for the NDGFD and these programs can be found in Attachment II)

United States Forest Service (USFS)

The High Plains Partnership (HPP)

The HPP mission is to establish and fully implement a public/private partnership, based on existing programs and organizations, to conserve and enrich the natural heritage of the High Plains region in cooperation with private landowners. The goals are to (1) improve the status of High Plains species-at-risk to reduce or remove their need for protection under authority of the ESA; and (2) improve the

economic viability of lands that are voluntarily managed for declining species in the High Plains by offering a diverse array of financial incentives.

The High Plains Partnership is a public/private initiative to proactively conserve declining habitats on private lands throughout the High Plains region. In keeping with the Secretary of the Interior's 4-C's philosophy of consultation, communication and cooperation in the service of conservation, the HPP is a joint effort between the USFWS Regions 2 and 6, 11 state wildlife agencies (AZ, CO, KS, MT, ND, NE, NM, OK, SD, TX, WY), USDA agencies, and numerous private conservation organizations (such as Wildlife Management Institute, National Wildlife Federation, The Nature Conservancy, Predator Conservation Alliance). The HPP initiative seeks to increase grassland project funding for all collaborators while providing on–the-ground technical support and financial assistance. (Contact information for the USFS and this program can be found in Attachment II)

Natural Resources Conservation Service (NRCS)

The NRCS can provide technical and financial assistance to landowners for development of conservation plans that include rangeland management practices. Various programs are available to provide financial assistance to apply these practices. Programs exist that are meant to facilitate grazing and range improvements as well as programs that will facilitate establishment of these practices.

Grazing and Range Improvement Programs

Conservation Practices (CP)

NRCS has various conservation practices that can be used to benefit sage-grouse habitat. Conservation practices can assist landowners in the development of a grazing system that is beneficial to sage-grouse, big sagebrush habitat and is economically viable.

Prescribed Grazing (528)

The 528 programs, or the Prescribed Grazing Program can be used to develop a grazing system to improve or maintain quantity and quality of food and/or cover available for wildlife while improving or maintaining quality forage for livestock health and productivity.

Restoration and Management of Declining Habitats (643)

This program is defined as projects for restoring and conserving rare or declining native vegetated communities and associated wildlife species. The purpose is to restore land degraded by human activity; provide habitat for rare and declining wildlife species by restoring and conserving native plant communities; increase native plant community diversity; and management of unique or declining native habitats. This practice will apply on any landscape which once supported or currently supports the habitat to be restored or managed, including the sagebrush/steppe in Bowman and Slope counties. This program will aid in revegetation by planting clumps of big sagebrush with revegetation programs involving native grass and forb species. Management of these lands will then be according to conservation practice standard – Prescribed Grazing (528).

Cost Sharing Programs to Facilitate Grazing and Range Improvements

Environmental Quality Incentive Program (EQIP)

This program is a voluntary conservation program that provides technical, financial, and educational assistance to farmers and ranchers who face threats to soil, water, air, and related natural resources on their land. It serves to address serious natural resource concerns by developing conservation systems for treatment of these problems. Through EQIP the agency can provide technical and financial assistance in installation of prescribed grazing systems to improve sagebrush habitat. Cost sharing is available for facilitating practices such as fencing and watering systems for better livestock distribution, grass seeding, and crop residue management. The objective is to optimize environmental benefits, achieved through a process that begins with the definition of National priorities, which includes promotion of at-risk species habitat conservation.

Conservation Innovation Grants (CIG)

Conservation Innovation Grants is a voluntary program intended to stimulate development and adoption of innovative conservation approaches and technologies while leveraging Federal investment in environmental enhancement and protection in conjunction with agricultural production.

Under CIG, funds from the EQIP program are used to award competitive grants to non-Federal governmental or private organizations, tribes or individuals. CIG enables NRCS to work with other public and private entities to educate and implement promising technologies and approaches that address pressing natural resource concerns. The program helps agricultural producers by providing more options for environmental enhancement projects and to help them comply with Federal, State and local regulations.

Grassland Reserve Program

This is a voluntary program that helps landowners and operators restore and conserve grassland, including rangeland, pastureland, and certain other lands, while maintaining the areas as grazing land. The program emphasizes support for grazing operations, plant and animal biodiversity, and grassland and land containing shrubs and forbs under the greatest threat of conversion.

Wildlife Habitat Incentives Program (WHIP)

This is a voluntary program that encourages creation of high quality wildlife habitat that supports wildlife populations of significance. It provides technical and financial assistance to landowners and others to develop upland habitat areas on their property. Most efforts to date have been to improve upland wildlife habitat on range land.

(Contact information for the NRCS and these programs can be found in Attachment II)

Farm Service Agency (FSA)

Conservation Reserve Program (CRP)

FSA has approved a Wildlife Priority Zone which incorporates the area of North Dakota that has sage brush habitat. This designation makes more cropland in the area eligible for CRP and provides general signup applications with additional scoring in the ranking process.

(Contact information for the FSA can be found in Attachment II)

MONITORING:

North Dakota Game and Fish Department

The NDGFD will continue in the lead roll of obtaining population data on sage-grouse. Data collected will be an annual spring census of sage-grouse on all known strutting ground sites (active and inactive), hunter success and harvest data, and population data from wing samples collected during fall hunting seasons. Monitoring of some big sagebrush plant communities will also be conducted to gauge success of state sponsored management practices that are beneficial to sage-grouse habitat.

NDGFD will work with the federal land managing agencies in the state to develop a monitoring program on sagebrush communities within sage-grouse habitat under federal management. The agency will also serve as a technical advisor to organizations, private corporations or individuals interested in implementing and monitoring habitat conservation practices on private property that will benefit sage-grouse.

RESEARCH NEEDS:

Contracts have been awarded to South Dakota State University to conduct research on sage-grouse in North Dakota. A Master's degree (Attachment III, Project Narrative I) began in March, 2005 and will continue through June, 2007. A PhD study has been developed, a student chosen, and work will begin in late summer or fall, 2005 (Attachment III, Project Narrative II). Additional research will be conducted as deemed necessary at the conclusion of these studies.

Attachment I: Guidelines to Manage Sage-grouse Populations and Their Habitat

http://sagemap.wr.usgs.gov/Docs/Sage_Grouse_Guidelines.pdf

Guidelines to manage sage grouse populations and their habitats

John W. Connelly, Michael A. Schroeder, Alan R. Sands, and Clait E. Braun

Abstract The status of sage grouse populations and habitats has been a concern to sportsmen and biologists for >80 years. Despite management and research efforts that date to the 1930s, breeding populations of this species have declined throughout much of its range. In May 1999, the western sage grouse (C. urophasianus phaios) in Washington was petitioned for listing under the Endangered Species Act because of population and habitat declines (C. Warren, United States Fish and Wildlife Service, personal communication). Sage grouse populations are allied closely with sagebrush (Artemisia spp.). Despite the well-known importance of this habitat to sage grouse and other sagebrush obligates, the quality and quantity of sagebrush habitats have declined for at least the last 50 years. Braun et al. (1977) provided guidelines for maintenance of sage grouse habitats. Since publication of those guidelines, much more information has been obtained on sage grouse. Because of continued concern about sage grouse and their habitats and a significant amount of new information, the Western States Sage and Columbian Sharp-tailed Grouse Technical Committee, under the direction of the Western Association of Fish and Wildlife Agencies, requested a revision and expansion of the guidelines originally published by Braun et al. (1977). This paper summarizes the current knowledge of the ecology of sage grouse and, based on this information, provides guidelines to manage sage grouse populations and their habitats.

Key words Artemisia, Centrocercus urophasianus, guidelines, habitat, management, populations, sage grouse, sagebrush

The status of sage grouse populations and habitats has been a concern to sportsmen and biologists for >80 years (Hornaday 1916, Patterson 1952, Autenrieth 1981). Despite management and research efforts that date to the 1930s (Girard 1937), breeding populations of this species have declined by at least 17–47% throughout much of its range (Connelly and Braun 1997). In May 1999, the western sage grouse (*C. urophasianus phaios*) in Washington was petitioned for listing under the Endangered Species Act because of population and habitat declines (C. Warren, United States Fish and Wildlife Service, personal communication).

Sage grouse populations are allied closely with sagebrush (*Artemisia* spp.) habitats (Patterson 1952, Braun et al. 1977, Braun 1987). The dependence of sage grouse on sagebrush for winter habitat has been well documented (Eng and Schladweiler 1972, Beck 1975, Beck 1977, Robertson 1991). Similarly, the relationship between sagebrush

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Sage grouse on a nest with good shrub and herbaceous cover. The nest was successful.

habitats and sage grouse nest success has been described thoroughly (Klebenow 1969, Wallestad and Pyrah 1974, Wakkinen 1990, Connelly et al. 1991, Gregg et al. 1994). Despite the well-known importance of this habitat to sage grouse and other sagebrush obligates (Braun et al. 1976, Saab and Rich 1997), the quality and quantity of sagebrush habitats have declined for at least the last 50 years (Braun et al. 1976, Braun 1987, Swenson et al. 1987, Connelly and Braun 1997).

Braun et al. (1977) provided guidelines for maintenance of sage grouse habitats. Since publication of those guidelines, much more information has been obtained on relative size of sagebrush habitats used by these grouse (Connelly 1982, Connelly et al. 1988, Wakkinen et al. 1992), seasonal use of sagebrush habitats (Benson et al. 1991, Connelly et al. 1991), effects of insecticides on sage grouse (Blus et al. 1989), importance of herbaceous cover in breeding habitat (Wakkinen 1990, Connelly et al. 1991, Gregg 1991, Barnett and Crawford 1994, Drut et al. 1994*a*, Gregg et al. 1994), and effects of fire on their habitat (Hulet 1983; Benson et al. 1991; Robertson 1991; Fischer 1994; Fischer et al. 1996*a*, 1997; Pyle and Crawford 1996; Connelly et al. 2000*b*). Because of continued concern about sage grouse and their habitats and a significant amount of new information, the Western States Sage and Columbian Sharp-tailed Grouse Technical Committee, under the direction of the Western Association of Fish and Wildlife Agencies, requested a revision and expansion of the guidelines originally published by Braun et al. (1977). This paper summarizes the current knowledge of the ecology of sage grouse and, based on this information, provides guidelines to manage sage grouse populations and their habitats.

Population biology

Seasonal movements and home range

Sage grouse display a variety of annual migratory patterns (Beck 1975, Wallestad 1975, Hulet 1983, Berry and Eng 1985, Connelly et al. 1988, Wakkinen 1990, Fischer 1994). Populations may have: 1) distinct winter, breeding, and summer areas; 2) distinct summer areas and integrated winter and breeding areas; 3) distinct winter areas and integrated breeding and summer areas; or 4) well-integrated seasonal habitats (nonmigratory populations). Seasonal movements between distinct seasonal ranges may exceed 75 km (Dalke et al. 1963, Connelly et al. 1988), which complicates attempts to define populations. Thus, Connelly et al. (1988) suggested that sage grouse populations be defined on a temporal and geographic basis. Because of differences in seasonal movements among populations (Dalke et al. 1963, Wallestad 1975, Connelly et al. 1988, Wakkinen 1990), 3 types of sage grouse populations can

Sage grouse on a nest with poor shrub and herbaceous cover. This nest was unsuccessful. Photo by Jena Hickey.

Sage grouse on winter range. Note the relatively sparse cover; without snow, the canopy cover of sagebrush in this area exceeds 20%.

be defined: 1) nonmigratory, grouse do not make long-distance movements (i.e., >10 km one way) between or among seasonal ranges; 2) one-stage migratory, grouse move between 2 distinct seasonal ranges; and 3) 2-stage migratory, grouse move among 3 distinct seasonal ranges. Within a given geographic area, especially summer range, there may be birds that belong to more than one of these types of populations.

On an annual basis, migratory sage grouse populations may occupy areas that exceed 2,700 km^2 (Hulet 1983, Leonard et al. 2000). During winter, Robertson (1991) reported that migratory sage grouse in southeastern Idaho made mean daily movements of 752 m and occupied an area $\geq$140 km^2. For a nonmigratory population in Montana, Wallestad (1975) reported that winter home range size ranged from 11 to 31 km^2. During summer, migratory sage grouse in Idaho occupied home ranges of 3 to 7 km^2 (Connelly and Markham 1983, Gates 1983).

Despite large annual movements, sage grouse have high fidelity to seasonal ranges (Keister and Willis 1986, Fischer et al. 1993). Females return to the same area to nest each year (Fischer et al. 1993) and may nest within 200 m of their previous year's nest (Gates 1983, Lyon 2000).

Survival

Wallestad (1975) reported that annual survival rates for yearling and adult female sage grouse were 35 and 40%, respectively, for poncho-tagged birds. However, Zablan (1993) reported that survival rates for banded yearling and adult females in Colorado were similar and averaged 55%; survival rates for yearling and adult males differed, averaging 52 and 38%, respectively. In Idaho, annual survival of male sage grouse ranged from 46 to 54% and female survival from 68 to 85% (Connelly et al. 1994). Lower survival rates for males may be related to physiological demands because of sexual dimorphism and greater predation rates (Swenson 1986).

Reproduction

Bergerud (1988) suggested that most female tetraonids nest as yearlings. Although essentially all female sage grouse nested in Washington (Schroeder 1997), Connelly et al. (1993) reported that in Idaho up to 45% of yearling and 22% of adult female sage grouse do not nest each year. Gregg (1991) indicated that, of 119 females monitored through the breeding season in eastern Oregon, 26 (22%) did not nest. However, Coggins (1998) reported a 99% nest initiation rate for 3 years for the same population in Oregon. The differences may be related to improved range condition that resulted in better nutritional status of pre-laying hens (Barnett and Crawford 1994).

Estimates of sage grouse nest success throughout the species' range vary from 12 to 86% (Trueblood 1954, Gregg 1991, Schroeder et al. 1999). Nest success also may vary on an annual basis (Schroeder 1997, Sveum et al. 1998*a*). Wallestad and Pyrah (1974) observed greater nest success by adults than yearlings. However, significant differences in nest success between age groups have not been reported in other studies (Connelly et al. 1993, Schroeder 1997).

Clutch size of sage grouse is extremely variable and relatively low compared to other species of gamebirds (Edminster 1954, Schroeder 1997). Average clutch size for first nests varies from 6.0 to

Sage grouse nest. Photo by Jena Hickey.

9.5 throughout the species' range (Sveum 1995, Schroeder 1997). Greatest and least average clutch sizes have been reported in Washington (Sveum 1995, Schroeder 1997).

Renesting by sage grouse varies regionally from <20% (Patterson 1952, Eng 1963, Hulet 1983, Connelly et al. 1993) to >80% (Schroeder 1997). Despite regional variation, differences in renesting rates due to age have not been documented (Connelly et al. 1993, Schroeder 1997). Because of variation in nest initiation, success, and renesting rates, the proportion of females successfully hatching a brood varies between 15 and 70% (Wallestad and Pyrah 1974, Gregg et al. 1994). Despite this variation, sage grouse generally have low reproductive rates and high annual survival compared to most gallinaceous species (Zablan 1993, Connelly et al. 1994, Connelly and Braun 1997, Schroeder 1997, Schroeder et al. 1999).

Little information has been published on mortality of juvenile sage grouse or the level of production necessary to maintain a stable population. Among western states, long-term ratios have varied from 1.40 to 2.96 juveniles/hen in the fall; since 1985 these ratios have ranged from 1.21 to 2.19 (Connelly and Braun 1997). Available data suggest that a ratio $\geq$2.25 juveniles/hen in the fall should result in stable to increasing sage grouse populations (Connelly and Braun 1997, Edelmann et al. 1998).

Habitat requirements

Breeding habitats

Leks, or breeding display sites, typically occur in open areas surrounded by sagebrush (Patterson 1952, Gill 1965); these sites include, but are not limited to, landing strips, old lakebeds, low sagebrush flats and ridge tops, roads, cropland, and burned areas (Connelly et al. 1981, Gates 1985). Sage grouse males appear to form leks opportunistically at sites within or adjacent to potential nesting habitat. Although the lek may be an approximate center of annual ranges for nonmigratory populations (Eng and Schladweiler 1972, Wallestad and Pyrah 1974, Wallestad and Schladweiler 1974), this may not be the case for migratory populations (Connelly et al. 1988, Wakkinen et al. 1992). Average distances between nests and nearest leks vary from 1.1 to 6.2 km, but distance from lek of female capture to nest may be >20 km (Autenrieth 1981, Wakkinen et al. 1992, Fischer 1994, Hanf et al. 1994, Lyon 2000). Nests are placed independent of lek location (Bradbury et al. 1989, Wakkinen et al. 1992).

Habitats used by pre-laying hens also are part of the breeding habitat. These areas should provide a diversity of forbs high in calcium, phosphorus, and protein; the condition of these areas may greatly affect nest initiation rate, clutch size, and subsequent reproductive success (Barnett and Crawford 1994, Coggins 1998).

Most sage grouse nests occur under sagebrush (Patterson 1952, Gill 1965, Gray 1967, Wallestad and Pyrah 1974), but sage grouse will nest under other plant species (Klebenow 1969, Connelly et al. 1991, Gregg 1991, Sveum et al. 1998*a*). However, grouse nesting under sagebrush experience greater nest success (53%) than those nesting under other plant species (22%, Connelly et al. 1991).

Table 1. Habitat characteristics associated with sage grouse nest sites.

	Sagebrush		Grass		
State	Height[a](cm)	Coverage (%)[b]	Height(cm)	Coverage(%)[c]	Reference
Colo.	52				Petersen 1980
Id.		15		4	Klebenow 1969
Id.	58–79	23–38			Autenrieth 1981
Id.	71	22	18	3–10	Wakkinen 1990
Id.			19–23	7–9	Connelly et al. 1991
Id.	61		22	30	Fischer 1994
Id.		15–32	15–30		Klott et al. 1993
Id.	69	19	34	15	Apa 1998
Mont.	40	27			Wallestad 1975
Oreg.	80	20			Keister and Willis 1986
Oreg.		24	14	9–32	Gregg 1991
Wash.		20		51	Schroeder 1995
Wash.		19		32	Sveum et al. 1998a
Wyo.	36				Patterson 1952
Wyo.	29	24	15	9	Heath et al. 1997
Wyo.	31	25	18	5	Holloran 1999
Wyo.	33	26	21	11	Lyon 2000

[a] Mean height of nest bush.
[b] Mean canopy coverage of the sagebrush surrounding the nest.
[c] Some coverage estimates may include both grasses and forbs.

Mean height of sagebrush most commonly used by nesting grouse ranges from 29 to 80 cm (Table 1), and nests tend to be under the tallest sagebrush within a stand (Keister and Willis 1986, Wakkinen 1990, Apa 1998). In general, sage grouse nests are placed under shrubs having larger canopies and more ground and lateral cover as well as in stands with more shrub canopy cover than at random sites (Wakkinen 1990, Fischer 1994, Heath et al. 1997, Sveum et al. 1998*a*, Holloran 1999). Sagebrush cover near the nest site was greater around successful nests than unsuccessful nests in Montana (Wallestad and Pyrah 1974) and Oregon (Gregg 1991). Wallestad and Pyrah (1974) also indicated that successful nests were in sagebrush stands with greater average canopy coverage (27%) than those of unsuccessful nests (20%). Gregg (1991) reported that sage grouse nest success varied by cover type. The greatest nest success occurred in a mountain big sagebrush (*A. t. tridentata vaseyana*) cover type where shrubs 40–80 cm in height had greater canopy cover at the site of successful nests than at unsuccessful nests (Gregg 1991). These observations were consistent with the results of an artificial nest study showing greater coverage of medium-height shrubs improved success of artificial nests (DeLong 1993, DeLong et al. 1995).

Grass height and cover also are important components of sage grouse nest sites (Table 1). Grass associated with nest sites and with the stand of vegetation containing the nest was taller and denser than grass at random sites (Wakkinen 1990, Gregg 1991, Sveum et al. 1998*a*). Grass height at nests under non-sagebrush plants was greater ($P < 0.01$) than that associated with nests under sagebrush, further suggesting that grass height is an important habitat component for nesting sage grouse (Connelly et al. 1991). Moreover, in Oregon, grass cover was greater at successful nests than at unsuccessful nests (Gregg 1991). Grass >18 cm in height occurring in stands of sagebrush 40–80 cm tall resulted in lesser nest predation rates than in stands with lesser grass heights (Gregg et al. 1994). Herbaceous cover associated with nest sites may provide scent, visual, and physical barriers to potential predators (DeLong et al. 1995).

Early brood-rearing areas occur in upland sagebrush habitats relatively close to nest sites, but movements of individual broods may vary (Connelly 1982, Gates 1983). Within 2 days of hatching, one brood moved 3.1 km (Gates 1983). Early brood-rearing habitats may be relatively open

Radiotelemetry and a pointing dog are used to capture sage grouse chicks for a research project in southeastern Idaho.

(about 14% canopy cover) stands of sagebrush (Martin 1970, Wallestad 1971) with ≥15% canopy cover of grasses and forbs (Sveum et al. 1998*b,* Lyon 2000). Great plant species richness with abundant forbs and insects characterize brood areas (Dunn and Braun 1986, Klott and Lindzey 1990, Drut et al. 1994*a*, Apa 1998). In Oregon, diets of sage grouse chicks included 34 genera of forbs and 41 families of invertebrates (Drut et al. 1994*b*). Insects, especially ants (Hymenoptera) and beetles (Coleoptera), are an important component of early brood-rearing habitat (Drut et al. 1994*b*, Fischer et al. 1996*a*). Ants and beetles occurred more frequently ($P = 0.02$) at brood-activity centers compared to nonbrood sites (Fischer et al. 1996*a*).

Summer–late brood-rearing habitats

As sagebrush habitats desiccate, grouse usually move to more mesic sites during June and July (Gill 1965, Klebenow 1969, Savage 1969, Connelly and Markham 1983, Gates 1983, Connelly et al. 1988, Fischer et al. 1996*b*). Sage grouse broods occupy a variety of habitats during summer, including sagebrush (Martin 1970), relatively small burned areas within sagebrush (Pyle and Crawford 1996), wet meadows (Savage 1969), farmland, and other irrigated areas adjacent to sagebrush habitats (Connelly and Markham 1983, Gates 1983, Connelly et al. 1988). Apa (1998) reported that sites used by grouse broods had twice as much forb cover as independent sites.

Fall habitats

Sage grouse use a variety of habitats during fall. Patterson (1952) reported that grouse move from summer to winter range in October, but during

mild weather in late fall, some birds may still use summer range. Similarly, Connelly and Markham (1983) observed that most sage grouse had abandoned summering areas by the first week of October. Fall movements to winter range are slow and meandering and occur from late August to December (Connelly et al. 1988). Wallestad (1975) documented a shift in feeding habits from September, when grouse were consuming a large amount of forbs, to December, when birds were feeding only on sagebrush.

Winter habitats

Characteristics of sage grouse winter habitats are relatively similar throughout most of the species' range (Table 2). Eng and Schladweiler (1972) and Wallestad (1975) indicated that most observations of radiomarked sage grouse during winter in Montana occurred in sagebrush habitats with >20% canopy cover. However, Robertson (1991) indicated that sage grouse used sagebrush habitats that had average canopy coverage of 15% and average height of 46 cm during 3 winters in southeastern Idaho. In Idaho, sage grouse selected areas with greater canopy cover of Wyoming big sagebrush (*A. t. wyomingensis*) in stands containing taller shrubs when compared to random sites (Robertson 1991).

Table 2. Characteristics of sagebrush at sage grouse winter-use sites.

	Canopy		
State	Coverage[a] (%)	Height[a] (cm)	Reference
Colo.		24–36[bd]	Beck 1977
Colo.		20–30[cd]	Beck 1977
Colo.	43[b]	34[b]	Schoenberg 1982
Colo.	37[c]	26[c]	Schoenberg 1982
Colo.	30–38[de]	41–54[de]	Hupp 1987
Id.	38[e]	56[e]	Autenrieth 1981
Id.	26[b]	29[b]	Connelly 1982
Id.	25[c]	26[c]	Connelly 1982
Id.	15	46	Robertson 1991
Mont.	27	25	Eng and Schladweiler 1972
Mont.	>20		Wallestad 1975
Oreg.	12–17[d]		Hanf et al. 1994

[a] Mean canopy coverage or height of sagebrush above snow.
[b] Males
[c] Females
[d] Ranges are given when data were provided for more than one year or area.
[e] No snow present when measurements were made or total height of plant was measured.

In Colorado, sage grouse may be restricted to <10% of the sagebrush habitat because of variation in topography and snow depth (Beck 1977, Hupp and Braun 1989). Such restricted areas of use may not occur throughout the species' range because in southeastern Idaho, severe winter weather did not result in the grouse population greatly reducing its seasonal range (Robertson 1991).

During winter, sage grouse feed almost exclusively on leaves of sagebrush (Patterson 1952, Wallestad et al. 1975). Although big sagebrush dominates the diet in most portions of the range (Patterson 1952; Wallested et al. 1975; Remington and Braun 1985; Welch et al. 1988, 1991), low sagebrush (*A. arbuscula*), black sagebrush (*A. nova,* Dalke et al. 1963, Beck 1977), fringed sagebrush (*A. frigida*, Wallestad et al. 1975), and silver sagebrush (*A. cana*, Aldridge 1998) are consumed in many areas depending on availability. Sage grouse in some areas apparently prefer Wyoming big sagebrush (Remington and Braun 1985, Myers 1992) and in other areas mountain big sagebrush (Welch et al. 1988, 1991). Some of the differences in selection may be due to preferences for greater levels of protein and the amount of volatile oils (Remington and Braun 1985, Welch et al. 1988).

Effects of habitat alteration

Range management treatments

Breeding habitat. Until the early 1980s, herbicide treatment (primarily with 2,4-D) was the most common method to reduce sagebrush on large tracts of rangeland (Braun 1987). Klebenow (1970) reported cessation of nesting in newly sprayed areas with < 5% live sagebrush canopy cover. Nesting also was nearly nonexistent in older sprayed areas containing about 5% live sagebrush cover (Klebenow 1970). In virtually all documented cases, herbicide application to blocks of sagebrush rangeland resulted in major declines in sage grouse breeding populations (Enyeart 1956, Higby 1969, Peterson 1970, Wallestad 1975). Effects of this treatment on sage grouse populations seemed more severe if the treated area was subsequently seeded to crested wheatgrass (*Agropyron cristatum*, Enyeart 1956).

Using fire to reduce sagebrush has become more common since most uses of 2,4-D on public lands were prohibited (Braun 1987). Klebenow (1972) and Sime (1991) suggested that fire may benefit sage grouse populations. Neither Gates (1983),

Martin (1990), nor Bensen et al. (1991) reported adverse effects of fire on breeding populations of sage grouse. In contrast, following a 9-year study, Connelly et al. (1994, 2000*b*) indicated that prescribed burning of Wyoming big sagebrush during a drought period resulted in a large decline (>80%) of a sage grouse breeding population in southeastern Idaho. Additionally, Hulet (1983) documented loss of leks from fire and Nelle et al. (2000) reported that burning mountain big sagebrush stands had long-term negative impacts on sage grouse nesting and brood-rearing habitats. Canopy cover in mountain big sagebrush did not provide appropriate nesting habitat 14 years after burning (Nelle et al. 2000). The impact of fire on sage grouse populations using habitats dominated by silver sagebrush (which may resprout following fire) is unknown.

Cheatgrass (*Bromus tectrorum*) will often occupy sites following disturbance, especially burning (Valentine 1989). Repeated burning or burning in late summer favors cheatgrass invasion and may be a major cause of the expansion of this species (Vallentine 1989). The ultimate result may be a loss of the sage grouse population because of long-term conversion of sagebrush habitat to rangeland dominated by an annual exotic grass. However, this situation largely appears confined to the western portion of the species' range and does not commonly occur in Wyoming (J. Lawson, Wyoming Department of Game and Fish, personal communication).

Mechanical methods of sagebrush control have often been applied to smaller areas than those treated by herbicides or fire, especially to convert rangeland to cropland. However, adverse effects of this type of treatment on sage grouse breeding populations also have been documented. In Montana, Swenson et al. (1987) indicated that the number of breeding males declined by 73% after 16% of their study area was plowed.

Brood-rearing habitats. Martin (1970) reported that sage grouse seldom used areas treated with herbicides to remove sagebrush in southwestern Montana. In Colorado, Rogers (1964) indicated that an entire population of sage grouse appeared to emigrate from an area that was subjected to several years of herbicide application to remove sagebrush. Similarly, Klebenow (1970) reported that herbicide spraying reduced the brood-carrying capacity of an area in southeastern Idaho. However, application of herbicides in early spring to reduce sagebrush cover may enhance some brood-rearing habitats by increasing the amount of herbaceous plants used for food (Autenrieth 1981).

Fire may improve sage grouse brood-rearing habitat (Klebenow 1972, Gates 1983, Sime 1991), but until recently, experimental evidence was not available to support or refute these contentions (Braun 1987). Pyle and Crawford (1996) suggested that fire may enhance brood-rearing habitat in montane settings but cautioned that its usefulness requires further investigation. A 9-year study of the effects of fire on sage grouse did not support that prescribed fire, conducted during late summer in a Wyoming big sagebrush habitat, improved brood-rearing habitat for sage grouse (Connelly et al. 1994, Fischer et al. 1996*a*). Prescribed burning of sage grouse habitat did not increase amount of forbs in burned areas compared to unburned areas (Fischer et al. 1996*a*, Nelle et al. 2000) and resulted in decreased insect populations in the treated area compared to the unburned area. Thus, fire may negatively affect sage grouse brood-rearing habitat rather than improve it in Wyoming big sagebrush habitats (Connelly and Braun 1997), but its effect on grouse habitats in mountain big sagebrush communities requires further investigation (Pyle and Crawford 1996, Nelle et al. 2000).

Sage grouse often use agricultural areas for brood-rearing habitat (Patterson 1952, Wallestad 1975, Gates 1983, Connelly et al. 1988, Blus et al. 1989). Grouse use of these areas may result in mortality because of exposure to insecticides. Blus et al. (1989) reported die-offs of sage grouse that were exposed to methamidiphos used in potato fields and dimethoate used in alfalfa fields. Dimethoate is used commonly for alfalfa, and 20 of 31 radiomarked grouse (65%) died following direct exposure to this insecticide (Blus et al. 1989).

Winter habitat. Reduction in sage grouse use of an area treated by herbicide was proportional to the severity (i.e., amount of damage to sagebrush) of the treatment (Pyrah 1972). In sage grouse winter range, strip partial kill, block partial kill, and total kill of sagebrush were increasingly detrimental to sage grouse in Montana (Pyrah 1972) and Wyoming (Higby 1969).

In Idaho, Robertson (1991) reported that a 2,000-ha prescribed burn that removed 57% of the sagebrush cover in sage grouse winter habitat minimally impacted the sage grouse population. Although sage grouse use of the burned area declined following the fire, grouse adapted to this disturbance by moving 1 to 10 km outside of the burn to areas

with greater sagebrush cover (Robertson 1991) than was available in the burned area.

Land use

Mining–energy development. Effects of mining, oil, and gas developments on sage grouse populations are not well known (Braun 1998). These activities negatively impact grouse habitat and populations over the short term (Braun 1998), but research suggests some recovery of populations following initial development and subsequent reclamation of the affected sites (Eng et al. 1979, Tate et al. 1979, Braun 1986). In Colorado, sage grouse were displaced by oil development and coal-mining activities, but numbers returned to pre-disturbance levels once the activities ceased (Braun 1987, Remington and Braun 1991). At least 6 leks in Alberta were disturbed by energy development and 4 were abandoned (Aldridge 1998). In Wyoming, female sage grouse captured on leks disturbed by natural gas development had lower nest-initiation rates, longer movements to nest sites, and different nesting habitats than hens captured on undisturbed leks (Lyon 2000). Sage grouse may repopulate an area following energy development but may not attain population levels that occurred prior to development (Braun 1998). Thus, short-term and long-term habitat loss appears to result from energy development and mining (Braun 1998).

Grazing. Domestic livestock have grazed over most areas used by sage grouse and this use is generally repetitive with annual or biennial grazing periods of varying timing and length (Braun 1998). Grazing patterns and use of habitats are often dependent on weather conditions (Valentine 1990). Historic and scientific evidence indicates that livestock grazing did not increase the distribution of sagebrush (Peterson 1995) but markedly reduced the herbaceous understory over relatively large areas and increased sagebrush density in some areas (Vale 1975, Tisdale and Hironaka 1981). Within the intermountain region, some vegetation changes from livestock grazing likely occurred because sagebrush steppe in this area did not evolve with intensive grazing by wild herbivores, as did the grassland prairies of central North America (Mack and Thompson 1982). Grazing by wild ungulates may reduce sagebrush cover (McArthur et al. 1988, Peterson 1995), and livestock grazing may result in high trampling mortality of sagebrush seedlings (Owens and Norton 1992). In Wyoming big sagebrush habitats, resting areas from livestock grazing may improve understory production as well as decrease sagebrush cover (Wambolt and Payne 1986).

There is little direct experimental evidence linking grazing practices to sage grouse population levels (Braun 1987, Connelly and Braun 1997). However, grass height and cover affect sage grouse nest site selection and success (Wakkinen 1990, Gregg 1991, Gregg et al. 1994, Delong et al. 1995, Sveum et al. 1998*a*). Thus, indirect evidence suggests grazing by livestock or wild herbivores that significantly reduces the herbaceous understory in breeding habitat may have negative impacts on sage grouse populations (Braun 1987, Dobkin 1995).

Miscellaneous activities. Construction of roads, powerlines, fences, reservoirs, ranches, farms, and housing developments has resulted in sage grouse habitat loss and fragmentation (Braun 1998). Between 1962 and 1997, >51,000 km of fence were constructed on land administered by the Bureau of Land Management in states supporting sage grouse populations (T. D. Rich, United States Bureau of Land Management, personal communication). Structures such as powerlines and fences pose hazards to sage grouse because they provide additional perch sites for raptors and because sage grouse may be injured or killed when they fly into these structures (Call and Maser 1985).

Weather

Prolonged drought during the 1930s and mid-1980s to early 1990s coincided with declining sage grouse populations throughout much of the species' range (Patterson 1952, Fischer 1994, Hanf et al. 1994). Drought may affect sage grouse populations by reducing herbaceous cover at nests and the quantity and quality of food available for hens and chicks during spring (Hanf et al. 1994, Fischer et al. 1996*a*).

Spring weather may influence sage grouse production. Relatively wet springs may result in increased production (Wallestad 1975, Autenrieth 1981). However, heavy rainfall during egg-laying or unseasonably cold temperatures with precipitation during hatching may decrease production (Wallestad 1975).

There is no evidence that severe winter weather affects sage grouse populations unless sagebrush cover has been greatly reduced or eliminated (Wallestad 1975, Beck 1977, Robertson 1991).

Predation

Over the last 25 years, numerous studies have used radiotelemetry to address sage grouse survival and nest success (Wallestad 1975; Hulet 1983; Gregg 1991; Robertson 1991; Connelly et al. 1993, 1994; Gregg et al. 1994; Schroeder 1997). Only Gregg (1991) and Gregg et al. (1994) indicated that predation was limiting sage grouse numbers, and their research suggested that low nest success from predation was related to poor nesting habitat. Most reported nest-success rates are >40%, suggesting that nest predation is not a widespread problem. Similarly, high survival rates of adult (Connelly et al. 1993, Zablan 1993) and older (>10 weeks of age) juvenile sage grouse indicate that population declines are not generally related to high levels of predation. Thus, except for an early study in Oregon (Batterson and Morse 1948), predation has not been identified as a major limiting factor for sage grouse (Connelly and Braun 1997).

Constructing ranches, farms, and housing developments has resulted in the addition of nonnative predators to sage grouse habitats, including dogs, cats, and red foxes (*Vulpes vulpes*; J. W. Connelly, Idaho Department of Fish and Game, unpublished data; B. L. Welch, United States Forest Service, personal communication) and may be responsible for increases in abundance of the common raven (*Corvus corax*, Sauer et al. 1997). Relatively high raven populations may decrease sage grouse nest success (Batterson and Morse 1948, Autenrieth 1981), but rigorous field studies using radiotelemetry do not support this hypothesis. Current work in Strawberry Valley, Utah, suggests that red foxes are taking a relatively high proportion of the population (Flinders 1999). This may become a greater problem if red foxes become well established throughout sage grouse breeding habitat.

Recommended guidelines

Sage grouse populations occupy relatively large areas on a year-round basis (Berry and Eng 1985, Connelly et al. 1988, Wakkinen 1990, Leonard et al. 2000), invariably involving a mix of ownership and jurisdictions. Thus, state and federal natural resource agencies and private landowners must coordinate efforts over at least an entire seasonal range to successfully implement these guidelines. Based on current knowledge of sage grouse population and habitat trends, these guidelines have been developed to help agencies and landowners effectively assess and manage populations, protect and manage remaining habitats, and restore damaged habitat. Because of gaps in our knowledge and regional variation in habitat characteristics (Tisdale and Hironaka 1981), the judgment of local biologists and quantitative data from population and habitat monitoring are necessary to implement the guidelines correctly. Further, we urge agencies to use an adaptive management approach (Macnab 1983, Gratson et al. 1993), using monitoring and evaluation to assess the success of implementing these guidelines to manage sage grouse populations.

Activities responsible for the loss or degradation of sagebrush habitats also may be used to restore these habitats. These activities include prescribed fire, grazing, herbicides, and mechanical treatments. Decisions on land treatments using these tools should be based on quantitative knowledge of vegetative conditions over an entire population's seasonal range. Generally, the treatment selected should be that which is least disruptive to the vegetation community and has the most rapid recovery time. This selection should not be based solely on economic cost.

Definitions

For the purpose of these guidelines, we define an occupied lek as a traditional display area in or adjacent to sagebrush-dominated habitats that has been attended by $\geq$2 male sage grouse in $\geq$2 of the previous 5 years. We define a breeding population as a group of birds associated with 1 or more occupied leks in the same geographic area separated from other leks by >20 km. This definition is somewhat arbitrary but generally based on maximum distances females move to nest.

Population management

1) Before making management decisions, agencies should cooperate to first identify lek locations and determine whether a population is migratory or nonmigratory. In the case of migratory populations, migration routes and seasonal habitats must be identified to allow for meaningful and correct management decisions.

2) Breeding populations should be assessed by either lek counts (census number of males attending leks) or lek surveys (classify known leks as active or inactive) each year (Autenrieth et al. 1982). Depending on number of counts each spring (Jenni and Hartzler 1978, Emmons and Braun

1984) and weather conditions when the counts were made, lek counts may not provide an accurate assessment of sage grouse populations (Beck and Braun 1980) and the data should be viewed with caution. Despite these shortcomings, lek counts provide the best index to breeding population levels and many long-term data sets are available for trend analysis (Connelly and Braun 1997).

3) Production or recruitment should be monitored by brood counts or wing surveys (Autenrieth et al. 1982). Brood counts are labor-intensive and usually result in inadequate sample size. Where adequate samples of wings can be obtained, we recommend using wing surveys to obtain estimates of sage grouse nesting success and juvenile:adult hen (including yearlings) ratios.

4) Routine population monitoring should be used to assess trends and identify problems for all hunted and nonhunted populations. Check stations, wing collections, and questionnaires can be used to obtain harvest information. Breeding population and production data (above) can be used to monitor nonhunted populations.

5) The genetic variation of relatively small, isolated populations should be documented to better understand threats to these populations and implement appropriate management actions (Young 1994, Oyler-McCance et al. 1999).

6) Hunting seasons for sage grouse should be based on careful assessments of population size and trends. Harvest should not be based on the observations of Allen (1954:43), who stated, "Our populations of small animals operate under a 1-year plan of decimation and replacement; and Nature habitually maintains a wide margin of overproduction. She kills off a huge surplus of animals whether we take our harvest or not." To the contrary, sage grouse tend to have relatively long lives with low annual turnover (Zablan 1993, Connelly et al. 1994) and a low reproductive rate (Gregg 1991, Connelly et al. 1993). Consequently, hunting may be additive to other causes of mortality for sage grouse (Johnson and Braun 1999, Connelly et al. 2000*a*). However, most populations appear able to sustain hunting if managed carefully (Connelly et al. 2000*a*).

7) If populations occur over relatively large geographic areas and are stable to increasing, seasons and bag limits can be relatively liberal (2- to 4-bird daily bag limit and a 2- to 5-week season) for hunting seasons allowing firearms (Braun and Beck 1985).

8) If populations are declining (for 3 or more consecutive years) or trends are unknown, seasons and bag limits should be generally conservative (1- or 2-bird daily bag limit and a 1-to 4-week season) for hunting seasons allowing firearms, or suspended (for all types of hunting, including falconry and Native American subsistence hunting) because of this species' population characteristics (Braun 1998, Connelly et al. 2000*a*).

9) Where populations are hunted, harvest rates should be 10% or less of the estimated fall population to minimize negative effects on the subsequent year's breeding population (Connelly et al. 2000*a*).

10) Populations should not be hunted where $\leq$300 birds comprise the breeding population (i.e., $\leq$100 males are counted on leks [C. E. Braun, Colorado Division of Wildlife, unpublished report]).

11) Spring hunting of sage grouse on leks should be discouraged or, if unavoidable, confined to males only during the early portion of the breeding season. Spring hunting is considered an important tradition for some Native American tribes. However, in Idaho, 80% of the leks hunted during spring in the early 1990s (n=5) had become inactive by 1994 (Connelly et al. 1994).

12) Viewing sage grouse on leks (and censusing leks) should be conducted so that disturbance to birds is minimized or preferably eliminated (Call and Maser 1986). Agencies should generally not provide all lek locations to individuals simply interested in viewing birds. Instead, 1 to 3 lek locations should be identified as public viewing leks, and if demand is great enough, agencies should consider erecting 2–3 seasonal blinds at these leks for public use. Camping in the center of or on active leks should be vigorously discouraged.

13) Discourage establishment of red fox and other nonnative predator populations in sage grouse habitats.

14) For small, isolated populations and declining populations, assess the impact of predation on survival and production. Predator control programs are expensive and often ineffective. In some cases, these programs may provide temporary help while habitat is recovering. Predator management programs also could be considered in areas where seasonal habitats are in good condition but their extent has been reduced greatly. However, predator management should be implemented only if the available data (e.g., nest success <25%, annual survival of adult hens <45%) support the action.

General habitat management

The following guidelines pertain to all seasonal habitats used by sage grouse:

1) Monitor habitat conditions and propose treatments only if warranted by range condition (i.e., the area no longer supports habitat conditions described in the following guidelines under habitat protection). Do not base land treatments on schedules, targets, or quotas.

2) Use appropriate vegetation treatment techniques (e.g., mechanical methods, fire) to remove junipers and other conifers that have invaded sage grouse habitat (Commons et al. 1999). Whenever possible, use vegetation control techniques that are least disruptive to the stand of sagebrush, if this stand meets the needs of sage grouse (Table 3).

Table 3. Characteristics of sagebrush rangeland needed for productive sage grouse habitat.

	Breeding		Brood-rearing		Winter[e]	
	Height (cm)	Canopy (%)	Height (cm)	Canopy (%)	Height (cm)	Canopy (%)
Mesic sites[a]						
Sagebrush	40–80	15–25	40–80	10–25	25–35	10–30
Grass–forb	>18[c]	≥25[d]	variable	>15	N/A	N/A
Arid sites[a]						
Sagebrush	30–80	15–25	40–80	10–25	25–35	10–30
Grass/forb	>18[c]	≥15	variable	>15	N/A	N/A
Area[b]	>80		>40		>80	

[a] Mesic and arid sites should be defined on a local basis; annual precipitation, herbaceous understory, and soils should be considered (Tisdale and Hironaka 1981, Hironaka et al. 1983).

[b] Percentage of seasonal habitat needed with indicated conditions.

[c] Measured as "droop height"; the highest naturally growing portion of the plant.

[d] Coverage should exceed 15% for perennial grasses and 10% for forbs; values should be substantially greater if most sagebrush has a growth form that provides little lateral cover (Schroeder 1995)

[e] Values for height and canopy coverage are for shrubs exposed above snow.1

3) Increase the visibility of fences and other structures occurring within 1 km of seasonal ranges by flagging or similar means if these structures appear hazardous to flying grouse (e.g., birds have been observed hitting or narrowly missing these structures or grouse remains have been found next to these structures).

4) Avoid building powerlines and other tall structures that provide perch sites for raptors within 3 km of seasonal habitats. If these structures must be built, or presently exist, the lines should be buried or poles modified to prevent their use as raptor perch sites.

Breeding habitat management

For migratory and nonmigratory populations, lek attendance, nesting, and early brood rearing occur in breeding habitats. These habitats are sagebrush-dominated rangelands with a healthy herbaceous understory and are critical for survival of sage grouse populations. Mechanical disturbance, prescribed fire, and herbicides can be used to restore sage grouse habitats to those conditions identified as appropriate in the following sections on habitat protection. Local biologists and range ecologists should select the appropriate technique on a case-by-case basis. Generally, fire should not be used in breeding habitats dominated by Wyoming big sagebrush if these areas support sage grouse. Fire can be difficult to control and tends to burn the best remaining nesting and early brood-rearing habitats (i.e., those areas with the best remaining understory), while leaving areas with poor understory. Further, we recommend against using fire in habitats dominated by xeric mountain big sagebrush (*A. t. xericensis*) because annual grasses commonly invade these habitats and much of the original habitat has been altered by fire (Bunting et al. 1987).

Although mining and energy development are common activities throughout the range of sage grouse, quantitative data on the long-term effects of these activities on sage grouse are limited. However, some negative impacts have been documented (Braun 1998, Lyon 2000). Thus, these activities should be discouraged in breeding habitats, but when they are unavoidable, restoration efforts should follow procedures outlined in these guidelines.

Habitat protection

1) Manage breeding habitats to support 15–25% canopy cover of sagebrush, perennial herbaceous cover averaging ≥18 cm in height with ≥15% canopy cover for grasses and ≥10% for forbs and a diversity of forbs (Barnett and Crawford 1994, Drut et al. 1994*a*, Apa 1998) during spring (Table 3). Habitats meeting these conditions should have a high priority for wildfire suppression and should

not be considered for sagebrush control programs. Sagebrush and herbaceous cover should provide overhead and lateral concealment from predators. If average sagebrush height is >75 cm, herbaceous cover may need to be substantially greater than 18 cm to provide this protection. There is much variability among sagebrush-dominated habitats (Tisdale and Hironaka 1981, Hironaka et al. 1983), and some Wyoming sagebrush and low sagebrush breeding habitats may not support 25% herbaceous cover. In these areas, total herbaceous cover should be ≥15 % (Table 3). Further, the herbaceous height requirement may not be possible in habitats dominated by grasses that are relatively short when mature. In all of these cases, local biologists and range ecologists should develop height and cover requirements that are reasonable and ecologically defensible. Leks tend to be relatively open, thus cover on leks should not meet these requirements.

2) For nonmigratory grouse occupying habitats that are distributed uniformly (i.e., habitats have the characteristics described in guideline 1 and are generally distributed around the leks), protect (i.e., do not manipulate) sagebrush and herbaceous understory within 3.2 km of all occupied leks. For nonmigratory populations, consider leks the center of year-round activity and use them as focal points for management efforts (Braun et al. 1977).

3) For nonmigratory populations where sagebrush is not distributed uniformly (i.e., habitats have the characteristics described in guideline 1 but distributed irregularly with respect to leks), protect suitable habitats for ≤5 km from all occupied leks. Use radiotelemetry, repeated surveys for grouse use, or habitat mapping to identify nesting and early brood-rearing habitats.

4) For migratory populations, identify and protect breeding habitats within 18 km of leks in a manner similar to that described for nonmigratory sage grouse. For migratory sage grouse, leks generally are associated with nesting habitats but migratory birds may move >18 km from leks to nest sites. Thus, protection of habitat within 3.2 km of leks may not protect most of the important nesting areas (Wakkinen et al. 1992, Lyon 2000).

5) In areas of large-scale habitat loss (≥40% of original breeding habitat), protect all remaining habitats from additional loss or degradation. If remaining habitats are degraded, follow guidelines for habitat restoration listed below.

6) During drought periods (≥2 consecutive years), reduce stocking rates or change management practices for livestock, wild horses, and wild ungulates if cover requirements during the nesting and brood-rearing periods are not met. Grazing pressure from domestic livestock and wild ungulates should be managed in a manner that at all times addresses the possibility of drought.

Sage grouse just leaving a nest in good-condition breeding habitat in southwestern Idaho. Note the height of grass and herbaceous cover.

7) Suppress wildfires in all breeding habitats. In the event of multiple fires, land management agencies should have all breeding habitats identified and prioritized for suppression, giving the greatest priority to those that have become fragmented or reduced by >40% in the last 30 years.

8) Adjust timing of energy exploration, development, and construction activity to minimize disturbance of sage grouse breeding activities. Energy-related facilities should be located >3.2 km from active leks whenever possible. Human activities within view of or <0.5 km from leks should be minimized during the early morning and late evening when birds are near or on leks.

Habitat restoration

1) Before initiating vegetation treatments, quantitatively evaluate the area proposed for treatment to ensure that it does not have sagebrush and herbaceous cover suitable for breeding habitat (Table 3). Treatments should not be undertaken within sage grouse habitats until the limiting vegetation factor(s) has been identified, the proposed treatment is known to provide the desired vegetation response, and land-use activities can be managed after treatment to ensure that vegetation objectives are met.

2) Restore degraded rangelands to a condition that again provides suitable breeding habitat for sage grouse by including sagebrush, native forbs

(especially legumes), and native grasses in reseeding efforts (Apa 1998). If native forbs and grasses are unavailable, use species that are functional equivalents and provide habitat characteristics similar to those of native species.

3) Where the sagebrush overstory is intact but the understory has been degraded severely and quality of nesting habitat has declined (Table 3), use appropriate techniques (e.g., brush beating in strips or patches and interseed with native grasses and forbs) that retain some sagebrush but open shrub canopy to encourage forb and grass growth.

4) Do not use fire in sage grouse habitats prone to invasion by cheatgrass and other invasive weed species unless adequate measures are included in restoration plans to replace the cheatgrass understory with perennial species using approved reseeding strategies. These strategies could include, but are not limited to, use of pre-emergent herbicides (e.g., Oust®, Plateau®) to retard cheatgrass germination until perennial herbaceous species become established.

5) When restoring habitats dominated by Wyoming big sagebrush, regardless of the techniques used (e.g., prescribed fire, herbicides), do not treat >20% of the breeding habitat (including areas burned by wildfire) within a 30-year period (Bunting et al. 1987). The 30-year period represents the approximate recovery time for a stand of Wyoming big sagebrush. Additional treatments should be deferred until the previously treated area again provides suitable breeding habitat (Table 3). In some cases, this may take <30 years and in other cases >30 years. If 2,4-D or similar herbicides are used, they should be applied in strips such that their effect on forbs is minimized. Because fire generally burns the best remaining sage grouse habitats (i.e., those with the best understory) and leaves areas with sparse understory, use fire for habitat restoration only when it can be convincingly demonstrated to be in the best interest of sage grouse.

Nest habitat is measured in Owyhee County, southwestern Idaho.

This breeding habitat is in poor condition because of a lack of understory.

6) When restoring habitats dominated by mountain big sagebrush, regardless of the techniques used (e.g., fire, herbicides), treat ≤20% of the breeding habitat (including areas burned by wildfire) within a 20-year period (Bunting et al. 1987). The 20-year period represents the approximate recovery time for a stand of mountain big sagebrush. Additional treatments should be deferred until the previously treated area again provides suitable breeding habitat (Table 3). In some cases, this may take <20 years and in other cases >20 years. If 2,4-D or similar herbicides are used, they should be applied in strips such that their effect on forbs is minimized.

7) All wildfires and prescribed burns should be evaluated as soon as possible to determine whether reseeding is necessary to achieve habitat management objectives. If needed, reseed with sagebrush, native bunchgrasses, and forbs whenever possible.

8) Until research unequivocally demonstrates that using tebuthiuron and similar-acting herbicides to control sagebrush has no long-lasting negative impacts on sage grouse habitat, use these herbicides only on an experimental basis and over a sufficiently small area that any long-term negative impacts are negligible. Because these herbicides have the potential of reducing but not eliminating sagebrush cover within grouse breeding habitats, thus stimulating herbaceous development, their use as sage grouse habitat management tools should be examined closely.

John Crawford explains Oregon's sage grouse research program to field-trip attendees during a meeting of the Western States Sage and Columbian sharp-tailed Grouse Technical Committee.

Summer–late brood-rearing habitat management

Sage grouse may use a variety of habitats, including meadows, farmland, dry lakebeds, sagebrush, and riparian zones from late June to early November (Patterson 1952, Wallestad 1975, Connelly 1982, Hanf et al. 1994). Generally, these habitats are characterized by relatively moist conditions and many succulent forbs in or adjacent to sagebrush cover.

Habitat protection

1) Avoid land-use practices that reduce soil moisture effectiveness, increase erosion, cause invasion of exotic plants, and reduce abundance and diversity of forbs.

2) Avoid removing sagebrush within 300 m of sage grouse foraging areas along riparian zones, meadows, lakebeds, and farmland, unless such removal is necessary to achieve habitat management objectives (e.g., meadow restoration, treatment of conifer encroachment).

3) Discourage use of very toxic organophosphorus and carbamate insecticides in sage grouse brood-rearing habitats. Sage grouse using agricultural areas may be adversely affected by pesticide applications (Blus et al. 1989). Less toxic agrichemicals or biological control may provide suitable alternatives in these areas.

4) Avoid developing springs for livestock water, but if water from a spring will be used in a pipeline or trough, design the project to maintain free water and wet meadows at the spring. Capturing water from springs using pipelines and troughs may adversely affect wet meadows used by grouse for foraging.

Habitat restoration

1) Use brush beating or other mechanical treatments in strips 4–8 m wide in areas with relatively high shrub-canopy cover (≥35% total shrub cover) to improve late brood-rearing habitats. Brush beating can be used to effectively create different age classes of sagebrush in large areas with little age diversity.

2) If brush beating is impractical, use fire or herbicides to create a mosaic of openings in mountain big sagebrush and mixed-shrub communities used as late brood-rearing habitats where total shrub cover is ≥35%. Generally, 10–20% canopy cover of sagebrush and ≤25% total shrub cover will provide adequate habitat for sage grouse during summer.

3) Construct water developments for sage grouse only in or adjacent to known summer-use areas and provide escape ramps suitable for all avian species and other small animals. Water developments and "guzzlers" may improve sage grouse summer habitats (Autenrieth et al. 1982, Hanf et al. 1994). However, sage grouse used these developments infrequently in southeastern Idaho because most were constructed in sage grouse winter and breeding habitat rather than summer range (Connelly and Doughty 1989).

4) Whenever possible, modify developed springs and other water sources to restore natural free-flowing water and wet meadow habitats.

Winter habitat management

Sagebrush is the essential component of winter habitat. Sage grouse select winter-use sites based on snow depth and topography, and snowfall can affect the amount and height of sagebrush available to grouse (Connelly 1982, Hupp and Braun 1989, Robertson 1991). Thus, on a landscape scale, sage grouse winter habitats should allow grouse access to sagebrush under all snow conditions (Table 3).

Habitat protection

1) Maintain sagebrush communities on a landscape scale, allowing sage grouse access to sagebrush stands with canopy cover of 10–30% and heights of at least 25–35 cm regardless of snow cover. These areas should be high priority for wildfire suppression and sagebrush control should be avoided.

2) Protect patches of sagebrush within burned areas from disturbance and manipulation. These areas may provide the only winter habitat for sage grouse and their loss could result in the extirpation of the grouse population. They also are important

seed sources for sagebrush re-establishment in the burned areas. During fire-suppression activities do not remove or burn any remaining patches of sagebrush within the fire perimeter.

3) In areas of large-scale habitat loss (≥40% of original winter habitat), protect all remaining sagebrush habitats.

Habitat restoration

1) Reseed former winter range with the appropriate subspecies of sagebrush and herbaceous species unless the species are recolonizing the area in a density that would allow recovery (Table 3) within 15 years.

2) Discourage prescribed burns >50 ha, and do not burn >20% of an area used by sage grouse during winter within any 20–30-year interval (depending on estimated recovery time for the sagebrush habitat).

Conservation strategies

We recommend that each state and province develop and implement conservation plans for sage grouse. These plans should use local working groups comprised of representatives of all interested agencies, organizations, and individuals to identify and solve regional issues (Anonymous 1997). Within the context of these plans, natural resource agencies should cooperate to document the amount and condition of sagebrush rangeland remaining in the state or province. Local and regional plans should summarize common problems to conserve sage grouse and general conditions (Table 3) needed to maintain healthy sage grouse populations. Local differences in conditions that affect sage grouse populations may occur and should be considered in conservation plans. Natural resource agencies should identify remaining breeding and winter ranges in Wyoming big sagebrush habitats and establish these areas as high priority for wildfire suppression. Prescribed burning in habitats that are in good ecological condition should be avoided. Protection and restoration of sage grouse habitats also will likely benefit many other sagebrush obligate species (Saab and Rich 1997) and enhance efforts to conserve and restore sagebrush steppe.

Although translocating sage grouse to historical range has been done on numerous occasions, few attempts have been successful (Musil et al. 1993, Reese and Connelly 1997). Thus, we agree with Reese and Connelly (1997) that translocation efforts should be viewed as only experimental at this time and not as a viable management strategy.

More information is needed on characteristics of healthy sagebrush ecosystems and the relationship of grazing to sage grouse production. Field experiments should be implemented to evaluate the relationship of grazing pressure (i.e., disturbance and removal of herbaceous cover) to sage grouse nest success and juvenile survival (Connelly and Braun 1997). The overall quality of existing sage grouse habitat will become increasingly important as quantity of these habitats decrease. Sage grouse populations appear relatively secure in some portions of their range and at risk in other portions. However, populations that have thus far survived extensive habitat loss may still face extinction because of a time lag between habitat loss and ultimate population collapse (Cowlishaw 1999).

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John W. (Jack) Connelly (left) is a wildlife research biologist with the Idaho Department of Fish and Game. He received his B.S. in fish and wildlife resources from the University of Idaho and M.S. in wildlife biology and Ph.D. in zoology from Washington State University. He has been a member of The Wildlife Society for 25 years and is past-president of the Idaho Chapter and current president of the Northwest Section. He has been involved with research on sage grouse since 1977. Michael A. (Mike) Schroeder (right) is the upland bird research biologist for the Washington Department of Fish and Wildlife. He received his B.S. in wildlife ecology from Texas A&M University, M.S. in zoology from the University of Alberta, and Ph.D. in wildlife biology from Colorado State University. He has been a member of The Wildlife Society for 21 years. He has been studying Washington populations of sage grouse, sharp-tailed grouse, and spruce grouse since 1992. Alan R. Sands retired after 21 years as a wildlife biologist for the Bureau of Land Management and is now employed by The Nature Conservancy as a field representative for southwestern Idaho. He received his B.A. in math and science from San Diego State University and M.S. in wildlife management from Humboldt State University. He has been a member of The Wildlife Society for 25 years and is past vice-president of the Idaho Chapter. Clait E. Braun (center) recently retired from the Colorado Division of Wildlife. He received his B.S. in soil science from Kansas State University, M.S. from the University of Montana in forest wildlife management, and Ph.D. from Colorado State University in wildlife biology. He has been a member of The Wildlife Society for 39 years and is past-editor of The Journal of Wildlife Management, past-president of the Central Mountain and Plains Section, past Council Member, and past-president of The Wildlife Society.

Attachment II: Contact Information for Cooperating Agencies and Personnel

North Dakota Game and Fish Department
www.discovernd.com/gnf

Kevin Kading, Private Lands Section Leader
100 North Bismarck Expressway
Bismarck, North Dakota 58501-5095
701-328-6371

Nate Harling, Private Lands Biologist
225 30th Avenue Southwest
Dickinson, North Dakota 58601
701-227-7431

Natural Resources Conservation Service
www.nrcs.usda.gov

Dave Dewald, Biologist
220 East Rosser Avenue
Bismarck, North Dakota 58502-1458
701-530-2083

Mike Sondeland, District Conservationist
111 2nd Avenue NW
Bowman, North Dakota 58623-0920
701-523-3871

United States Forest Service
www.fs.fed.us

Arden Warm, Biologist
161 West 21st Street
Dickinson, North Dakota 58601
701-225-5151

Dan Svingen, Grassland Biologist
240 West Century Avenue
Bismarck, North Dakota 58503
701-250-4463, Ext. 107

Attachment III: Project Narratives for Sage-grouse Research in North Dakota

Project Narrative I

State: North Dakota
Project Number:
Grant Amendment No.
Study No.:

Study Title: Nesting and Brood-rearing Habitat Selection of Greater Sage-grouse and Associated Survival of Hens and Broods in North Dakota.

Justification and Need:

Populations of greater sage-grouse (*Centrocercus urophasianus*) have substantially declined throughout a majority if the species range (Connelly and Braun 1997, Schroeder et al. 1999, 2004). There has also been a corresponding decline in sage habitat quantity and quality, and the sage-grouse populations have declined in response to a pattern of land use changes that have reduced and degraded sagebrush ecosystems (Hemstrom et al. 2002).

Sage-grouse are native to sagebrush steppe, and their distribution closely follows that of sagebrush. Approximately 10-20% of western sagebrush steppe has been converted, and most remaining habitat has been modified by grazing, development, or non-native plants. Sage-grouse populations have also declined throughout their range, prompting them to be listed as a Priority Level 1 Species of Special Concern in both North and South Dakota. This listing level recommends immediate research and conservation actions. Current levels of concern about the status and health of greater sage-grouse populations in North Dakota mirror those about the species across it's range of distribution, and are based on concerns for the long-term conservation of the species and the sagebrush habitats on which it depends (Wambolt et al. 2002, Schroeder et al. 2004). More importantly, concerns have led to petitioning the U.S. Fish and Wildlife Service to protect sage-grouse populations under the Endangered Species Act. Listing would have significant impacts on federal and private land management practices.

North Dakota is on the eastern edge of the range of distribution for both sage-grouse and sagebrush habitats. Recent research has shown that sagebrush-dependent species on the fringe of sagebrush distribution may not utilize habitats in as predictable a manner as those same species in the core of sagebrush steppe ecosystem (Smith 2003, Lewis 2004). Moreover, little is known about the specific habitat use patterns and seasonal movements/distribution of sage-grouse in North Dakota. Data on seasonal habitat use and needs and seasonal population shifts/movements are required for informed management decisions concerning sage-grouse in North Dakota.

Objectives:

1. Determine and quantify nesting and brood-rearing habitat selection of radio-marked greater sage-grouse in North Dakota.

Bureau of Land Management
www.blm.gov

Tim Zachmeier, Biologist
2933 3rd Avenue West
Dickinson, North Dakota 58601
701-227-7710

US Fish and Wildlife Service
www.fws.gov

Kevin Willis, PFW Coordinator
3425 Miriam Avenue
Bismarck, North Dakota 58501
701-250-4403

2. Estimate survival of radio-marked male and female sage-grouse in southwestern North Dakota. We will investigate the cause of mortalities.

3. Estimate nest success of radio-marked female sage-grouse on North Dakota study sites to evaluate the cause and timing of nest failures (e.g., predation, abandonment, etc.).

4. Estimate brood survival of radio-marked female sage-grouse that nest successfully in western North Dakota. The cause(s) of brood/chick mortality will be investigated.

Expected Results and Benefits:

We will develop findings of the study into management recommendations that benefit state and federal (e.g., BLM, USFS) wildlife and habitat management agencies charged with management of greater sage-grouse and their habitats. This research will provide information on sage-grouse natural history at the edge of its range; an area where the basic ecology of the species has not been studied

Information collected will improve knowledge about the patterns of use and habitat need of sage-grouse in western North Dakota, as well as population information (e.g. survival, reproductive success) critical for sound management of greater sage-grouse. These data will compliment Geographical Information System (GIS) data layers that will enable land and wildlife managers to develop site specific management recommendations concerning sage-grouse and sagebrush-steppe habitats in North Dakota.

If resource biologists are to effectively manage lands for sage-grouse, they must know what habitats are used for the various seasonal life-history needs (mating, nesting, brood-rearing, wintering). This information will enhance management efforts not only for greater sage-grouse, but for all sagebrush dependent wildlife.

Procedures and Methods:

Marking and Monitoring Birds

Rocket netting, night spotlighting, and drift fence traps on strutting grounds will be used to capture and radio-mark sage-grouse within study sites. Captured birds will be sexed, aged, weighed and fitted with aluminum, numbered leg bands. Males and females will be fitted with necklace-type, 2-stage radio transmitters (as those made by Advanced Telemetry Systems, Isanti, MN). Transmitters will be fitted with mortality switches and will have an expected life of 12-36 months. Transmitters will have a confirmed range of 1-2 miles on the ground and 5-6 miles from an aircraft. Field crews will locate marked birds twice a week in spring and summer from the trap date through August to: (1) obtain precise estimates of survival, nest success, and chick survival to 30 days of age and (2) characterize nesting, brood-rearing and summer habitats. Additionally, a smaller sample of radio-marked males (10-15 birds) will be monitored to determine habitat use and survival

We will locate birds bi-weekly using aerial flights and ground reconnaissance to characterize habitats used by grouse in fall and winter (Phase II Objective 1). Bird locations will be recorded using a GPS and mapped in a GIS. Chicks in broods will be counted after hatching and again every 5-7 days until the brood reaches 30 days of age (broods mix after 30 days and individual broods become too difficult to identify). We will monitor nests using temperature probes attached to camouflaged data loggers to minimize human nest disturbance.

Local habitat information (e.g., sagebrush canopy, grass and forb height/density, bare ground) will be collected at systematic-random points throughout the study sites and at sage-grouse nests, brood locations and wintering sites using standardized vegetation monitoring methods. Vegetation at random points and at sage-grouse locations will be used to characterize habitat use in all seasons. Vital rates (e.g., survival estimates and nest success) will be analyzed using established fate and Cormack-Jolly-Seber models (season-, sex- and age- specific). Chick survival will be estimated by observing brood size up to 30 days post-hatching that are associated with radio-collared hens.

Habitat Characterization and Sampling

Habitat sampling will be conducted at all nest sites of greater sage-grouse and from random points selected from the locations of male and female with brood radio-marked birds. Habitat analysis will determine which habitat types, plant associations, and structural/physiographic characteristics of the landscape are important for sage-grouse during nesting and brood rearing periods. A modified Robel pole will be used to measure horizontal density (visual obstruction) of vegetation (Robel et al. 1970; Higgins and Barker 1982). Additionally, Daubenmire cover class estimates will be used to quantify vertical cover characteristics

Effective leaf and maximum vegetation height will be measured within a 30-cm radius of the Robel pole to the nearest cm (Higgins and Barker 1982). Vegetative height measurements will be made at each station (n=10) along the transect. The maximum crown diameter will be measured on at least 10 sagebrush plants per transect. Percent bare ground and canopy cover will be estimated or measured by live intercept techniques.

Plant collections of unidentified species will be made for later identification in the herbarium at SDSU in Brookings. Data will be collected on soil type or associations, land use treatments, and topography characteristics. Dr. Gary Larson, plant collections curator at SDSU will assist with taxonomic identification procedures, etc.

This study will be conducted through a contract with the Department of Wildlife and Fisheries Sciences at South Dakota State University. All data will be summarized in annual progress reports. Final project survey data analyses will be made available in a completion report, which may be a thesis, and will be made available for use by the scientific community as well as the general public. Investigators will also present results at professional meetings as appropriate. All of the techniques and procedures to be used in this project are accepted by the scientific community.

Study Duration:

January 1, 2005 – December 31, 2007

Schedule of Work

Fiscal Year	Work to be conducted
FY 05	Capture, radio-mark, and locate sage-grouse; collect habitat use data; prepare progress report
FY 06	Capture, radio-mark, and locate sage-grouse; collect habitat use data; prepare progress report

FY 07 Complete data collection and analysis, construct management recommendations; prepare final report (MS thesis)
FY 08 Complete publication and dissemination of research findings

Estimated Costs:

Item	FY05	FY06	FY07	FY08	Total
Grad. Student Stipend	7,100.00	15,000.00	8,000.00	0	30,100.00
Technicians (1-2)	8,000.00	9,000.00	2,000.00	0	19,000.00
Principal Investigator	0	0	0	0	-
Travel and Per Diem	2,700.00	6,200.00	1,000.00	0	9,900.00
Telephone and Photocopying	300.00	500.00	1,000.00	200.00	2,000.00
Equipment and Miscellaneous (radios and tracking equip.)	5,000.00	4,000.00	0	0	9,000.00
Aircraft Time (radio-tracking)	2,500.00	5,000.00	2,500.00		10,000.00
Publication	0	0	0	2,000.00	2,000.00
Mileage	2,500.00	5,000.00	1,000.00	0	8,500.00
Subtotal	28,100.00	44,700.00	15,500.00	2,200.00	90,500.00
Indirect 26%	7,306.00	11,622.00	4,030.00	572.00	23,530.00
Tuition Remission	750.00	1,500.00	1,500.00	0	3,750.00
Total Cash	36,156.00	57,822.00	21,030.00	2,772.00	100,450.00
Project Totals	**36,156.00**	**57,822.00**	**21,030.00**	**2,772.00**	**117,780.00**

This study will be funded by a grant to South Dakota State University from the North Dakota Game and Fish Department. A portion of the cost will be funded through grants from the Bureau of Land Management and the United States Forest Service.

Location of Work:

This work will be conducted primarily in Bowman, Slope, and Golden Valley counties of southwestern North Dakota. Some additional field work may involve tracking North Dakota radioed birds that may move across state lines into adjacent areas of Montana and/or South Dakota.

Technical Personnel:

Project personnel will include Jerry Kobriger, Upland Game Management Supervisor, North Dakota Game and Fish Department, and Dr. Kent C. Jensen, Department of Wildlife and Fisheries Sciences, South Dakota State University. A graduate research assistant (M.S. Thesis student) and seasonal field technicians as needed will also be used to complete the study. Dr. Kent C. Jensen will act as Principle Investigator, SDSU, Box 2140B, Brookings, SD 57007, Phone: (605) 688-6121, Fax: (605) 688-4515.

Related Federal Projects:

The research will be contracted with South Dakota State University and will not involve the direct expenditure of other federal funds or in-kind contributions.

Floodplains and Wetlands:

The activities proposed in this study do not include construction in or alteration of any flood plain or wetland.

Endangered Species or Threatened Species:

Species considered: bald eagle, whooping crane, Topeka shiner, Eskimo curlew, piping plover, interior least tern, American burying beetle, gray wolf, pallid sturgeon, black-footed ferret, and Ute ladies-tresses.

This study only involves the collection and analysis of information that will not impact any of the species considered.

Environmental Assessment:

This study is a research project that is directly related to the conservation of wildlife resources in North Dakota that does not involve habitat destruction. This study is not expected to impact any threatened or endangered species. Animal capture and marking protocols and animal handling and disposal will meet all guidelines of the Animal Welfare Committee at South Dakota State University. This study also does not include the introduction of contaminants or introduction of organisms not indigenous to the affected ecosystem. Therefore, this study qualified as a categorical exclusion from the NEPA process as described in the Federal Register, Vol. 62, No. 11, Page 2375, Section 1.4(B)1, dated January 16, 1997. The exceptions to the application of this categorical exclusion were considered by this agency and were found to be not applicable to this study.

Prime and Unique Farmlands:

This research study will not involve any soil disturbing activities, therefore, this project will have no impact on any prime or unique farmlands.

Historical and Cultural Resources:

This is a wildlife research project that does not involve soil disturbance activities, and therefore has been exempted from review by the North Dakota State Historic Preservation Officer (SHPO) as described in Item 212 of the memorandum of Agreement with the SHPO dated 30 June 1987.

Environmental Justice (Executive Order 12898):

This project only involves the collection of wildlife population and habitat data and will have no impact whatsoever on environmental justice issues.

Invasive Species (Executive Order 13112):

This project only involves the collection of wildlife population and habitat data and will not promote the introduction or spread of invasive species.

Literature Cited:

Connelly, J.W., and C.E. Braun. 1997. Long-term changes in sage-grouse (*Centrocercus urophasianus*) populations in western North America. Wildlife Biology. 3:229-234.

Hemstrom, M.A., M.J. Wisdom, M.M. Rowland, B.C. Wales, W.J. Hann, and R.A. Gravenmier. 2002. Sagebrush-steppe vegetation dynamics and potential for restoration in the interior Columbia Basin, USA. Conservation Biology 16:1243-1255.

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Schroeder, M. A., C.L. Aldridge, A.D. Apa, J.R. Bohne, C.E. Braun, S.D. Bunnell, J.W. Connelly, P.A. Deibert, S.C. Gardner, M.A. Hilliard, G.D. Kobriger, S.M. Mcadam, C.W. McCarthy, J.J. McCarthy, D.L. Mitchell, E.V. Rickerson, and S.J. Stiver. 2004. Distribution of sage-grouse in North America. Condor 106:363-376.

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Wambolt, C.L., A.J. Harp, B.L. Welch, N. Shaw, J.W. Connelly, K.P. Reese, C.E. Braun, D.A. Klebenow, E.D. McArthur, J.G. Thompson, L.A. Torell, and J.A. Tanaka. 2002. Conservation of greater sage-grouse on public lands in the western U.S.: implications of recovery and management policies. Policy Analysis Center for Western Public Lands, Policy Paper SG-02-02, Caldwell, ID.

Project Narrative II

Study Title: Seasonal Movements and Autumn - Winter Habitat Selection of Greater Sage-grouse in North Dakota and South Dakota.

Justification and Need:

Populations of greater sage-grouse (*Centrocercus urophasianus*) have substantially declined throughout a majority if the species range (Connelly and Braun 1997, Schroeder et al. 1999, 2004). There has also been a corresponding decline in sage habitat quantity and quality, and the sage-grouse populations have declined in response to a pattern of land use changes that have reduced and degraded sagebrush ecosystems (Hemstrom et al. 2002). Sage-grouse are native to sagebrush steppe, and their distribution closely follows that of sagebrush. Approximately 10-20% of western sagebrush steppe has been converted, and most remaining habitat has been modified by grazing, development, or non-native plants. Sage-grouse populations have also declined throughout their range, prompting them to be listed as a Priority Level 1 Species of Special Concern in both North and South Dakota. This listing level recommends immediate research and conservation actions. Current levels of concern about the status and health of greater sage-grouse populations in North Dakota mirror those about the species across it's range of distribution, and are based on concerns for the long-term conservation of the species and the sagebrush habitats on which it depends (Wambolt et al. 2002, Schroeder et al. 2004). More importantly, concerns have led to petitioning the U.S. Fish and Wildlife Service to protect sage-grouse populations under the Endangered Species Act. Listing would have significant impacts on federal and private land management practices. Important mineral resources are located under sage-grouse habitats across the western U.S. Sagebrush steppe habitats of western North and South Dakota exemplify important sage-grouse habitats that overlay mineral resources that are currently being extracted, or have been targeted for development. There are many concerns involving the responses of sage-grouse and their use pf habitats that have been or potentially will be impacted by the infrastructure of roads, power lines, buildings, generators, and water outflows associated with mineral development. Direct effects may include habitat loss (or avoidance), disruption of breeding behaviors, and direct mortality due to vehicular and power line collisions. Indirect effects may involve shifts in habitat suitability related to altered vegetation structure and composition, food and water resources, and predator communities.

North Dakota and South Dakota are on the eastern edge of the range of distribution for both sage-grouse and sagebrush habitats. Recent research has shown that sagebrush-dependent species on the fringe of sagebrush distribution may not utilize habitats in as predictable a manner as those same species in the core of sagebrush steppe ecosystem (Smith 2003, Lewis 2004). Moreover, little is known about the specific habitat use patterns and seasonal movements/distribution of sage-grouse in the Dakotas. Data on seasonal habitat use and needs and seasonal population shifts/movements are required for informed management decisions concerning sage-grouse and their habitats in North and South Dakota.

Objectives:

5. Determine habitat use and habitat needs for wintering greater sage-grouse in North and South Dakota

6. Determine seasonal movements of greater sage-grouse in North and South Dakota and evaluate movements in terms of grouse habitat requirements for all portions of the annual life cycle.

7. Identify critical habitat use areas for nesting, brood-rearing, and wintering greater sage-grouse in North and South Dakota through the development of GIS models using data from this study and companion nesting & brood-rearing studies and available land cover and land-use GIS data layers.

Expected Results and Benefits:

We will develop findings of the study into management recommendations that benefit federal (e.g., BLM, USFS) and state land and wildlife management agencies charged with management of sage-steppe habitats critical to greater sage-grouse. This research will provide information on the habitat use and requirements of sage-grouse on the edge of their range of distribution; an area where the basic ecology of the species has not been studied

Information collected will improve knowledge about the patterns of use and habitat need of sage-grouse in the western Dakotas, as well as potential impacts from various land uses including mineral development, livestock grazing, and the infrastructures associated with these activities. This information is critical for sound management of greater sage-grouse habitats. These data also will compliment Geographical Information System (GIS) data layers that will enable land and wildlife managers to develop site specific management recommendations concerning sage-grouse and sagebrush-steppe habitats in North and South Dakota.

If resource biologists are to effectively manage lands for sage-grouse, they must know what habitats are used for the various seasonal life-history needs (mating, nesting, brood-rearing, wintering). This information will enhance management efforts not only for greater sage-grouse, but for all sagebrush dependent wildlife.

Procedures and Methods:

Marking and Monitoring Birds

Rocket netting, night spotlighting, and drift fence traps on strutting grounds will be used to capture and radio-mark sage-grouse within study sites. Captured birds will be sexed, aged, weighed and fitted with aluminum, numbered leg bands. Males and females will be fitted with necklace-type, 2-stage radio transmitters (as those made by Advanced Telemetry Systems, Isanti, MN). We plan on marking 25 birds in each of North and South Dakota, with 75% of the radios being placed on hens and 25% placed on cocks. Twenty additional transmitters will be deployed on broods during the late summer to monitor movements and habitat selection of brood members during the critical fall-winter transition period. Transmitters will be fitted with mortality switches and will have an expected life of 12-36 months. Transmitters will have a confirmed range of 1-2 miles on the ground and 5-6 miles from an aircraft. Field crews will locate marked birds twice a week from early fall (September 1st) through to spring mating season (March 31st) to: (1) assess seasonal movements of various age and sex classes of greater sage-grouse and (2) characterize the habitats used by sage-grouse in relation to season and life-cycle needs. Particular emphasis will be place on winter habitat selection and use by sage-grouse of all age and sex classes.

We will locate birds bi-weekly using aerial flights and ground reconnaissance to characterize habitats used by grouse in fall and winter. Bird locations will be recorded using a GPS and mapped in a GIS. Local habitat information (e.g., sagebrush canopy, grass and forb height/density, bare ground, snow depth, air/microsite temperature differential) will be collected at systematic-random points throughout

the study sites at sage-grouse wintering sites using standardized vegetation monitoring methods. Vegetation at random points and at sage-grouse locations will be used to characterize habitat use in all seasons.

Habitat Characterization and Sampling

Habitat sampling will be conducted by selecting from random locations of radio-marked birds. Habitat analysis will determine which habitat types, plant associations, and structural/physiographic characteristics of the landscape are important for sage-grouse during thee fall and winter seasons. A modified Robel pole will be used to measure horizontal density (visual obstruction) of vegetation (Robel et al. 1970; Higgins and Barker 1982). Additionally, Daubenmire cover class estimates will be used to quantify vertical cover characteristics

Effective leaf and maximum vegetation height will be measured within a 30-cm radius of the Robel pole to the nearest cm (Higgins and Barker 1982). Vegetative height measurements will be made at each station (n=10) along the transect. The maximum crown diameter will be measured on at least 10 sagebrush plants per transect. Percent bare ground and canopy cover will be estimated or measured by live intercept techniques. Snow depths will be measured at radio-location sites and at random points within the study area. Additionally, selected sites will be equipped with real-time weather recorders to measure temperature, wind speed, direction, etc. at microsites used by wintering sage-grouse and at random points within the study area.

Study Duration:

January 1, 2005 – December 31, 2008

Schedule of Work:

Fiscal Year	Work to be conducted
FY 05	Capture, radio-mark, and locate sage-grouse; collect habitat use data; prepare progress report
FY 06	Capture, radio-mark, and locate sage-grouse; collect habitat use data; prepare progress report
FY 07	Capture, radio-mark, and locate sage-grouse; collect habitat use data; prepare progress report
FY 08	Complete data collection and habitat analysis, construct GIS habitat use layer, develop management recommendations; prepare final report (PhD Dissertation)
FY 09	Complete publication and dissemination of research findings

Schedule of Deliverables:

We will provide written, annual updates on the project to BLM offices in North Dakota (Dickinson) and South Dakota (Bell Fourche) on 1 November each year. We will also provide copies of updates to state partners. A copy of the PhD student's dissertation will serve as the final project report (to be delivered by 31 December 2008). Digital GIS data layers (ARC-View Format) from sage-grouse study data will be provided to all interested partners. Copies of all published papers derived from the project also will be given to partners. We plan to publish the results of this study in peer-reviewed journals (e.g., Journal

of Wildlife Management, Wildlife Society Bulletin, Conservation Biology) as well as in popular outdoor magazines (e.g., South Dakota Conservation Digest, North Dakota Outdoors).

This study will be funded by a grant to South Dakota State University from the Bureau of Land Management and the United States Forest Service. Additional logistical support will be provided by the North Dakota Game and Fish Department and the South Dakota Department of Game, Fish, and Parks. This study will run in conjunction with companion studies investigating nesting and brood-rearing habitat selection, nesting success, hen survival, and brood survival/success in both North and South Dakota. These studies are funded by the North Dakota Game and Fish Department, and the South Dakota Department of Game, Fish, and Parks, respectively. The proposed study will dove-tail with these studies to stretch financial resources and utilize the same radioed birds to investigate both reproductive and wintering ecology/habitat use and seasonal movements.

Location of Work:

This work will be conducted primarily in Bowman, Slope, and Golden Valley counties of southwestern North Dakota and Butte and Harding counties of northwestern South Dakota. Some additional field work may involve tracking radioed birds that may move across state lines into adjacent areas of Montana and/or Wyoming.

Technical Personnel:

Principal Investigator (PI): **Dr. Kent C. Jensen,** Department of Wildlife and Fisheries Sciences, Northern Plains Biostress Lab 138D, Box 2140B, South Dakota State University, Brookings, SD 57007 (605)688-4781

Proposal sponsors from BLM in ND and SD: **Tim Zachmeier**, Wildlife Biologist, North Dakota Field Office, 2933 3rd Avenue West, Dickinson, ND 58601 (701)227-7749.
Charles A. Berdan*, Wildlife Biologist, South Dakota Field Office, 310 Roundup Street, Belle Fourche, SD 57717 (605)892-7007*

Tim and Chuck contribute to project vision and planning. Chuck provided lek location information for SD. Tom and Larry are primary proposal sponsors from their respective state offices.

Proposal sponsors from US Forest service in ND and SD: **Dan Svingen**, Grassland Biologist, Dakota Prairie Grasslands Headquarters, 240 West Century Avenue, Bismarck, ND 58501 (701) 250-4463 ext. 113

Dan contributes to project vision and planning, and is responsible for management of sage-grouse habitats within the Grand River National Grasslands.

State Partners: **Gerald D. Kobriger**, Upland Game Management Supervisor, North Dakota Game and Fish Department, 225 30th Avenue SW, Dickinson, ND 58601 (701)227-7431
John Wrede, Regional Wildlife Manager, South Dakota Department of Game, Fish, and Parks, 3305 West South Street, Rapid City, SD 57702-8160 (605)394-2394
Eileen Dowd-Stukel, Senior Wildlife Biologist, South Dakota Department of Game, Fish, and Parks, 523 E. Capitol, Pierre, SD 57501-3182) (605)773-4229
Jerry, John, and Eileen contributed to project planning and vision, and helped foster the state and federal partnerships necessary for completion of this project. Jerry provided lek locations historical population

and harvest data for North Dakota and logistical support from the North Dakota Game and Fish Department. The North Dakota Game and Fish Department is also providing financial support for one M.S. student and funds for field equipment and travel associated with population monitoring and nesting/brood-rearing ecology studies in North Dakota. John provided lek locations and available population trend and harvest data from South Dakota. South Dakota Game, Fish and Parks Department also are providing support for one M.S. student (to start in Fall 2005) and funds for field equipment and travel associated with the nesting/brood-rearing ecology studies in South Dakota.

Graduate Research Assistant: A PhD Student at South Dakota State University

Literature Cited:

Connelly, J.W., and C.E. Braun. 1997. Long-term changes in sage-grouse (*Centrocercus urophasianus*) populations in western North America. Wildlife Biology. 3:229-234.

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Total BLM Project Budget for FY 2005 – FY 2009 (broken out by year)

	2005	2006	2007	2008	2009
Salary/benefits					
Graduate student (PhD)	7,015	9,700	10,100	10,500	5,400
Field technicians	2,000	4,150	4,250	4,750	0
PI effort (5%)	1,315	1,350	1,400	1,450	900
Travel					
Field housing (7 mos @ $600/month)	2,100	2,100	2,100	2,100	0
Travel for PI and PhD student (includes research vehicle charges)	3,000	4,000	4,000	4,500	2,000
Supplies					
Radio-telemetry Transmitters	3,750	2,000	1,500	0	0
Trapping and banding equipment	500	375	375	250	0
Telemetry Receivers (2)	2,500	0	0	0	0
Aircraft Time – Radio tracking	1,000	1,000	1,000	750	
Refurbish radio collars		1,250	1,250	0	0
Field materials	1,000	1,000	500	500	0
Communication					
PI and PhD student phone/postage/FAX/mail/copying	500	375	375	500	750
Publication Costs & Page Charges	0	0	0	0	2,500
Direct Costs	**24,680.00**	**27,300.00**	**26,850.00**	**25,300.00**	**11,550.00**
Indirect Costs (26%)	**6,417.00**	**7,098.00**	**6,981.00**	**6,578.00**	**3003.00**
Graduate Tuition Remission	750.00	1,500.00	1,500.00	1,500.00	1,500.00
Yearly Project Costs	**31,847.00**	**35,898.00**	**35,331.00**	**33,378.00**	**16,053.00**