Greater Sage-Grouse Conservation Assessment and Strategy for Oregon:

A Plan to Maintain and Enhance Populations and Habitat

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EXECUTIVE SUMMARY

Greater sage-grouse (*Centrocercus urophasianus*) were once found in most grassland and sagebrush (*Artemisia* spp.) habitats east of the Cascades in Oregon. European settlement and conversion of sagebrush steppe into agricultural production led to extirpation of the species in the Columbia Basin by the early part of the 1900s, but sagebrush rangelands have persisted, particularly in southeast Oregon. Populations have fluctuated markedly since the mid 1900s with notable declines in populations from the 1950s to early 1970s. These patterns in populations and habitat loss are similar to those observed for greater sage-grouse throughout its range. Population declines during the latter part of the 1900s lead to considerable concern for the species and subsequent conservation planning in all western states where it occurs. This management strategy is a result of this larger conservation effort by the Western Association of Fish and Wildlife Agencies.

This updated and revised Plan describes Oregon Department of Fish and Wildlife's management of greater sage-grouse and provides guidance to public land management agencies and land managers for sage-grouse conservation. Conservation actions should be encouraged on private lands as these contain some of the more productive sites, but conservation on private land is voluntary.

Highlights of updates. Population goals have been revised based on statistically more robust methods for estimating population sizes. Accomplishments in conservation, research, and monitoring that have occurred since 2005 are discussed. The Core Area approach to strategically identifying important landscapes for sage-grouse is explained in detail from model development to implementation. Finally, there have been numerous publications on sage-grouse since 2005 and that literature has been updated to the document where appropriate.

This management strategy and the supporting background information is intended to promote the conservation of greater sage-grouse and intact functioning sagebrush communities in Oregon. The strategy is tied to the life history of greater sage-grouse and uses the best science available. Although this strategy focuses on conservation of greater sage-grouse, the intent is to benefit conservation needs of other sagebrush-steppe species. Oregon greater sage-grouse are important to the North American population and management actions in the state will have implications on a much larger scale.

This Plan recognizes that livestock ranching operations which manage for ecologically sustainable native rangelands is compatible with sage-grouse conservation, and necessary management activities to maintain a sustainable ranching operation are not considered "development actions" under the application of the Mitigation Policy to sage-grouse habitat.

This Plan provides biological recommendations for long-term conservation of sage-grouse in Oregon based on the best available science. However, ODFW recognizes that land use planners and managers may need to consider these recommendations within the context of social-economic issues and decisions that are the responsibility of the respective governmental bodies. Thus, the intent of this plan is to inform decision-makers regarding the biological consequences of various actions on sage-grouse, but not to dictate land management decision.

This document is divided into 6 sections. Section I explains the background and philosophy of conservation approaches in this strategy. Section II provides an overview of sage-grouse biology and ecology throughout the species range. Sections III and IV provide an assessment of populations and habitat, respectively, upon which management objectives are developed and their underlying assumptions and rationale are stated. In Section V, conservation guidelines are outlined, that describe actions needed and methods for achieving habitat objectives. Section VI outlines components for Plan implementation, includes a description of the structure and role of local implementation groups, and implications for public (state and federal) land management agencies. There are 6 appendices that provide supporting information, including a new appendix about socio-economics provided by the Association of Oregon Counties. Sections III to VI of the plan were expanded, because these sections are linked to the objectives and implementation of this Plan.

Populations and habitat were assessed by BLM district boundaries because; the availability of habitat measures by district, each district approximates an eco-region, and BLM is the primary land manager within most of the district boundaries. The 23 years 1980-2003 are the relevant time period to establish a benchmark for sage-grouse populations and their habitats, because the factors of predator control methods (and take levels), grazing schedules, survey protocols, habitat treatments and harvest levels of sage-grouse were similar through this period.

Sections I&II. Introduction and General Ecology

These sections provide the justification for this effort and supporting background information on sage-grouse biology.

Section III. Populations

Oregon sage-grouse numbers apparently have declined over the long-term (1957-2003; See Hagen 2005). Reasons for these losses likely are the cumulative effects of habitat loss and degradation, changes in predator control methods, and increases in human disturbance. Because productivity was correlated with spring population trends, it is probable that these factors had the greatest effect on population trends of sage-grouse. Statewide spring population trends were relatively stable for the assessment period (1980-2010) with population increases in most areas from the mid 1990s through 2006. There have been wide fluctuations in annual counts of males during this period, and such fluctuations make it difficult to assess the impacts of future conservation actions. It is important that planning and evaluations account for this variation. A 5-year moving average of males per lek to assess population trends might be a practical guideline to use. Population size and trend (1980-2003) provides a benchmark for maintaining and setting population objectives. Currently Oregon populations are below this benchmark but have not reached levels that are outside the range of natural variation.

It is important to note that the population objectives in this Plan are lower than in the 2005 Plan, but these objectives are based on the same population data. The population objectives for this Plan are based on a new method for estimating populations that provides a statistically more rigorous estimate and consistently provide a lower population estimate using the same data. Thus, population goals are ***not*** being lowered for management purposes but for use of a more appropriate and scientifically acceptable way of estimating population trends. Population management objectives for statewide and regional populations are as follows:

Population Management

In accordance with the Wildlife Policy (ORS 496.012), the primary goal is to restore, maintain and enhance populations of greater sage-grouse such that multiple uses of populations and their habitats can continue. The overall goal will be to maintain or enhance sage-grouse abundance and distribution at the 2003 spring breeding population level, approximately 30,000 birds over the next 50 years. Regional population goals were also established for the five implementation areas.

Section IV. Habitat

In the Columbia Basin the majority of habitat loss occurred during the late 1800s and early 1900s as a direct result of sagebrush steppe conversion to agricultural land. Within the sage-grouse range in Oregon, 2 million ha (5 million acres) in the last 20-30 years of the current range has been marginalized by fire, juniper encroachment, and other conversions. Currently, there are >6 million ha (15 million acres) of sagebrush habitat much of it in the Great Basin ecosystem. The connectivity mapping indicated that approximately 3.7 million ha (9.2 million acres) are largely connected blocks of habitat; however, the understory condition of most of these acres is unknown. Compared to other states within the range of sage-grouse, Oregon has large expanses of contiguous habitat with minimal threats of fossil fuel exploration or development. However, there is potential for renewable energy developments (i.e., geo-thermal, solar, and wind) in most sage-grouse regions in Oregon. The current status of sagebrush habitat is a landscape comprised of 70% sagebrush and 30% potential habitat that has supported sage-grouse populations over the last 30 years. Thus, to meet population objectives of this Plan, the current distribution of sagebrush communities should be maintained (minimum) or enhanced (optimum).

The overarching habitat goal is to maintain or enhance the current range and distribution of sagebrush habitats in Oregon. Attaining the population objectives is largely dependent upon achieving habitat objectives. To meet this goal, the conservation focus should be to retain ≥70% of sage-grouse range as sagebrush habitat in advanced structural stages, sagebrush class 3, 4 or 5, with an emphasis on classes 4 and 5. The remaining 30% could include areas of juniper encroachment, non-sagebrush shrubland, and grassland (either from natural or anthropogenic disturbance) that potentially can be enhanced. The "70/30" goal is based on a multi-scale habitat assessment developed by Karl and Sadowski (2004). Five regional habitat goals were also established.

Core Area Maps: A Conservation Biology Approach

Core Areas represent a proactive attempt to identify a set of conservation targets to maintain a viable and connected set of populations before the opportunity to do so is lost (Doherty et al 2011). If conservation recommendations are fully implemented in Core Areas they would protect approximately 90% of the breeding populations of sage-grouse in Oregon, but only 38% of the species' range. Thus, this approach identifies the most productive landscapes for sage-grouse that occupy only a fraction of the sagebrush biome in which they occur. The Core Area approach and associated maps provide guidance to land use planners, land managers and the public as to the areas of greatest biological importance to the persistence sage-grouse populations. These areas should be targeted for conservation actions or protections when large scale disturbances are proposed. Alternatively, the Low Density habitats may assist in identifying areas that impacts to sage-grouse populations may be less of a risk, or opportunities to mitigate for lost habitat. This section updates and replaces guidance provided by ODFWs 7 August 2009, whitepaper (hereafter; ODFW 2009).

Section V. Guidelines

These voluntary guidelines are designed to maintain (at a minimum) or enhance the quality (optimum) of current habitats, and will assist resource managers in achieving population and habitat objectives of this Plan. Because populations and habitats have been maintained over a relatively consistent set of conditions for 30 years, maintaining and enhancing the current conditions habitats through these guidelines should assist in providing sustainable populations into the future. The guidelines should be implemented as needed regionally, because not all issues identified in the guidelines (e.g., juniper encroachment) are relevant to all regions of the state.

Implementation of these conservation guidelines will be guided by local Implementation Teams comprised of land managers, county governments, and land owners. These groups include a mix of public and private entities, and because BLM is the primary land manager, local groups are based on BLM District boundaries. Part of the local Implementation Teams' responsibility is to identify the appropriate tools to meet the objectives in their region.

Section VI. Implementation and Monitoring

Community-based conservation has been evolving during a period when wildlife conservation and natural resource management have been in the midst of three conceptual shifts: from reductionism to a holistic or systems view, to include humans in the ecosystem, and from expert-based to participatory conservation and management (Berkes 2004). The implementation goal of this Plan is to use community-based conservation to achieve the population and habitat objectives herein (Berkes 2004, Peterson et al. 2004).

Implementation of conservation measures outlined in this Plan will be guided by local implementation groups comprised of land managers and land owners. Because these groups are not mutually exclusive and include a mix of public and private entities, local groups will be based on BLM District boundaries and in some cases Resource Areas (BLM is the primary land manager of sage-grouse habitat in Oregon). These technical groups will identify management priorities within a region and the actions to address them. These groups will also be responsible for establishing: appropriate timelines, overseeing treatments and monitoring, and facilitating the funding of projects.

Since 2005, there has been a gross decrease of nearly 3% in sagebrush due primarily to wildfire (Table 23). However, the net loss when offset by the acres juniper removal is approximately 1%

(Table 24), notwithstanding the total acres lost is noteworthy. Thus, statewide the habitat goal is being maintained or at least within a margin of measurement error. In 2009, ODFW and NRCS embarked on a strategic plan to effectively spend Farm Bill Program funding (Environmental Quality Incentives Program [EQIP], Wildlife Habitat Improvement Program [WHIP]). This effort was assimilated by the NRCS's National Sage-grouse Initiative

Synopsis

Sage-grouse are sagebrush obligates requiring large areas with a variety of sagebrush communities to meet life-history needs. The primary objective of this Plan is to maintain large expanses of intact sagebrush habitat for the benefit of sage-grouse and other sagebrush associated species. Based on our assessment of habitat and populations, several Core Areas of habitat that have sustained populations over the last 20+ years. Protecting large expanses of sagebrush communities from fragmentation and habitat degradation should ensure sustainable populations into the future. The conservation guidelines provided in this Plan will assist local implementation groups and land managers maintain and enhance sagebrush communities throughout Oregon; and ultimately enable Oregon to achieve population and habitat objectives provided.

Section I. INTRODUCTION

Greater sage-grouse (*Centrocercus urophasianus*) are the largest North American grouse species and currently occupy sagebrush (*Artemisia* spp.) habitats in Baker, Crook, Deschutes, Harney, Lake, Malheur, and Union counties of Oregon (see Appendix VI for details on social-economic status of these counties). Typically greater sage-grouse habitat occurs in sagebrush communities at elevations of 1,220 to 2,438 m (4,000 to 8,000 ft) with annual precipitation of 25 to 38 cm (10 to16 in) and rolling topography with slopes generally less than 30% (Call and Maser 1985). Greater sage-grouse were once found in most sagebrush habitats east of the Cascades. European settlement and conversion of sagebrush steppe into agricultural production led to extirpation of the species in the Columbia Basin by the early 1900s (Batterson and Morse 1948). Within the extant range of Oregon, spring population indices have demonstrated an overall decline since the 1940s. However, population indices over the last 30 years suggest a relatively stable statewide population.

Habitat loss and fragmentation are the primary cause for long-term changes in population abundance and distribution (USFWS 2010). This strategy for greater sage-grouse conservation seeks to proactively address the primary threats to the species through voluntary conservation actions.

The overarching framework for long-term conservation of Oregon's fish and wildlife seeks the cooperation and collaboration of citizens and natural resource agencies alike to ensure the sustainability of wildlife species and their habitats (ODFW 2006). In the spirit of the Oregon Conservation Strategy, this species plan for greater sage-grouse calls for the cooperation of private landowners and the collaboration of natural resource agencies to implement conservation projects to maintain intact habitats, ensure connectivity, and where appropriate enhance habitat quality.

Additionally, the Oregon Conservation Strategy identifies six key conservation issues that pose the greatest threats to fish and wildlife populations and their habitats throughout Oregon (ODFW 2006: 7). Conservation of greater sage-grouse populations now and in the foreseeable future may demand considerable efforts to address four of these six key conservation issues:

1) Land use changes,

2) Invasive species,

3) Disruption of disturbance regimes, and

4) Barriers to fish and wildlife movement.

This document (Plan) and supporting background information is intended to promote effective management of greater sage-grouse (hereafter sage-grouse) and intact functioning sagebrush (*Artemisia* spp.) communities in Oregon. The Plan is tied to the life history of sage-grouse and uses the best science available. Most of the current sagebrush habitat in Oregon occurs on public lands (>70%) and much of this document focuses on public land management. However, voluntary conservation actions on private lands should be encouraged as they can provide an important component to the life-history needs and conservation of sage-grouse in Oregon. Although this Plan focuses on conservation of sage-grouse and their habitat, it will also benefit conservation needs of other species associated with sagebrush-steppe (Wisdom et al. 2002, Hanser and Knick 2011). Oregon sage-grouse populations and sagebrush habitats likely comprise nearly 20% of the North American range wide distribution (Connelly et al. 2004). Thus, management actions in Oregon will have implications on a rangewide scale.

A multi-stakeholder effort to conserve sage-grouse and their habitats was initiated in 2001 and a conservation plan was in place by August 2005. However, the Plan was considered a living document and would need to be updated to ensure that new information and conservation efforts were recognized. Because Oregon Department of Fish and Wildlife (ODFW) has the legal authority and responsibility for most of Oregon's wildlife, ODFW has taken a lead role in crafting this Plan. This document is not exclusively an ODFW plan; it is a strategy representing multiple interests and users of sage-grouse and their habitats. The motive for development of this Plan was multifaceted ranging from national to local objectives and includes the following:

First, ODFW signed a Memorandum of Understanding (MOU) with the Western Association of Fish and Wildlife Agencies (WAFWA) that commits the ODFW to development of a sage-grouse conservation strategy (2000). Additionally, WAFWA has signed a similar MOU with the primary federal natural resource agencies (U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, U.S. Department of Agriculture, U.S. Geological Survey) in 2008, which in summary directs signatories to maintain or enhance sage-grouse populations and their habitats into the future.

Second, development of this Plan facilitated a statewide assessment of sage-grouse populations and their habitats. This has enabled us to identify knowledge gaps (Rowland and Wisdom 2002) and guide ODFW and other resource agencies to strive for the collection of needed data. Information and guidance in this Plan has become a part of a range-wide strategy for conservation of sage-grouse and their habitats developed by WAFWA (Stiver et al. 2006).

Third, this Plan provides a framework within which sage-grouse conservation efforts can occur into the future by establishing habitat and population goals. This Plan describes the habitat needs of sage-grouse, which informs the management actions that land managers or working groups should consider to ensure that healthy sage-grouse populations and sagebrush habitats persist into the future.

Nature of this Guidance

The goal of this Plan is to provide a conservation biology framework that focuses efforts to maintain or enhance sage-grouse and sagebrush habitats into the future. The Plan builds on management priorities and actions addressed in the BLM Resource Management Plans (RMPs). The management strategies listed herein, if followed, should increase the likelihood that the goals of the Plan are achieved. The Plan is meant to be a dynamic document so when new information becomes available it can be used in an adaptive management process to evaluate, maintain and enhance sage-grouse populations and sagebrush habitat.

The outcomes of each conservation action suggested in this document must be evaluated for their effectiveness. Effectiveness may be measured by numbers of sage-grouse (or increased use) and/or habitat quantity as defined by the objectives in this Plan or possibly at a local scale. As such, many of the proposed actions should be implemented in an experimental context, and evaluated under the framework of adaptive resource management (ARM). ARM is learning by doing (Macnab 1983, Nudds 1999), and it is an iterative process that enables managers to evaluate the effectiveness of their management decisions (e.g., harvest quotas, habitat projects), and researchers gain information on system response (e.g., nesting success, recruitment) to the treatment (Lancia et al. 1996). In this context, management actions are not "failures," but may be an ineffective management tool, because ineffective actions can be learned from as easily as actions that are effective. The critical point is to learn and understand why an action was ineffective so that it is not repeated. It is the spirit of learning by doing that an unsuccessful experiment has the same merit as a successful experiment, and each management action herein should be treated as an experiment with controls, treatments, appropriate replication (where possible), and measurable response variables.

This Plan provides biological recommendations for long-term conservation of sage-grouse in Oregon based on the best available science. However, ODFW recognizes that land use planners and managers may need to consider these recommendations within the context of social-economic issues and decisions that are the responsibility of the respective governmental bodies. Thus, the intent of this Plan is to inform decision-makers regarding the biological consequences of various actions on sage-grouse, but not to dictate land management decisions.

Single-species vs. Ecosystem Process Approaches

The sage-grouse is a wide ranging species that requires a variety of plant community types within sagebrush habitat to meet the needs of its annual life cycle: lekking habitat (areas used for communal breeding displays) often contains little to no shrub component, a strong perennial grass component is needed for nesting habitat, forb rich communities are needed for brood rearing, and relatively dense stands of sagebrush are required during winter months. This Plan, while it concentrates on the habitat needs of sage-grouse, is intended to focus on maintenance and enhancement of sagebrush habitats, which are important to a number of other species (Maser et al. 1984, Rowland et al. 2005, Hanser and Knick 2011). The overarching goal of this Plan is to promote intact and functioning sagebrush landscapes. These landscapes typically support more wildlife species than monotypic grasslands (Maser et al. 1984).

In addressing the conservation of sage-grouse, the Plan recognizes that its geographic range overlaps the ranges of many other species, some of which are federally listed as threatened or endangered, are candidates for listing, or are closely associated with sagebrush communities. Consequently, other species associated with sagebrush were considered in developing the conservation strategy for sage-grouse. Specifically, the Plan assessed the relative benefits to other species in developing the conservation plan for sage-grouse, because managers should take advantage of opportunities to benefit other species where possible and not impact them negatively. This framework was appropriate because the primary stated purpose of the Endangered Species Act is "…to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved…" (Endangered Species Act 1973: Section 2(b)).

Examples of species that could benefit from the suggested approach include mule deer (*Odocoileus hemionus hemionus*), pronghorn (*Antilocarpa americana*), pygmy rabbit (*Brachylagus idahoensis*), black-tailed jackrabbit (*Lepus californicus*), sagebrush vole (*Lemmiscus curtatus*), Brewers sparrow (*Spizella breweri*), black-throated sparrow (*Amphispiza bilineata*), sage thrasher (*Oreoscoptes motanus*), sage sparrow (*Amphispiza belli*), loggerhead shrike (*Lanius ludovicianus*), horned lark (*Chondestes grammacus*), western meadowlark (*Sturnella neglecta*), northern sagebrush lizard (*Sceloporus graciosus*), and short-horned lizard (*Phrynosoma douglassi*). Maintenance of connectivity and reduction of fragmentation of sagebrush habitats is key to the long-term welfare of all these sagebrush associated species (Connelly et al. 2004, Hanser and Knick 2011).

How the Document will be Updated

At the direction of the Oregon Fish and Wildlife Commission or the Oregon Sage-Grouse and Sagebrush Habitat Conservation Team, this document may be updated as new information is collected on the life-history of sage-grouse in Oregon or across the range of the species.

Relationship of Document to Federal Endangered Species Act Listing Criteria

The population and habitat assessments and management strategies provided in this Plan are intended to address the listing criteria used by the U.S. Fish and Wildlife Service (hereafter the Service). The following factors are used in the process of deciding whether or not a species warrants protection under the Act:

A. The present or threatened destruction, modification, or curtailment of the species' habitat or range;

B. Over-utilization for commercial, recreational, scientific, or educational purposes;

C. Diseases or predation;

D. The inadequacy of existing regulatory mechanisms; or

E. Other natural or manmade factors affecting the species' survival.

Current Federal ESA Listing Status/Petitions

On 12 January 2005, the Service determined that actions from three petitions to protect sage-grouse range-wide were not warranted under the Endangered Species Act. The Columbian Basin Distinct Population Segment (DPS) which is currently "warranted but precluded" from protection under ESA has a historic distribution in north-central Oregon. However, populations have been extirpated from this region since early in the 20th century. On 19 December 2007, Federal Judge Lynn Winmill, Idaho District Court, remanded the 2005 decision back to the Service because administrative procedures were not followed. As of March 2010, greater sage-grouse are listed range-wide as "warranted but precluded" from protection under the ESA.

Oregon Endangered Species Act

The Oregon Revised Statute (ORS) 496.012 (also known as the *Wildlife Policy*) includes the statement that, "[i]t is the policy of the State of Oregon that wildlife should be managed to prevent serious depletion of any indigenous species and to provide the optimum recreational and aesthetic benefits for present and future generations…" To this end, inherent in this Plan is the goal to manage sage-grouse populations, such that they are not listed as a Threatened or Endangered Species at the State or Federal level. Consistent with the *Wildlife Policy* and the Oregon Fish and Wildlife Commission's authority to adopt rules necessary to manage wildlife (ORS 496.138), this Plan provides a framework to maintain and enhance sage-grouse populations and their habitats.

Policy for Evaluating for Conservation Efforts (PECE), U.S. Fish Wildlife Service
The Policy for Evaluating for Conservation Efforts (PECE) provides criteria for evaluating species conservation plans in lieu of federal protection (U.S. Fish and Wildlife Service 2003). The policy establishes two basic criteria: 1) the certainty that the conservation efforts will be implemented, and 2) the certainty that the efforts will be effective. To determine the likelihood of *implementation*, the Service evaluates whether or not the parties have the authority, resources, and schedule to complete the proposed efforts. To determine the likelihood of *effectiveness*, the Service evaluates whether or not the Plan: describes the nature and extent of threats, establishes specific conservation objectives, identifies steps to reduce the threats, and provides quantifiable performance measures to monitor for both compliance and effectiveness. The intent of this Plan is to satisfy these criteria where possible, understanding that the greatest likelihood of meeting PECE will occur at the project level.

Section II. OVERVIEW OF GREATER SAGE-GROUSE ECOLOGY

Description
Sage-grouse are sexually dimorphic (i.e., males are larger and have more conspicuous plumage than females) gallinaceous birds and are the largest North American grouse species. Adult males are typically 66-76 cm in length (beak to tail) and 2-3.5 kg. Adult females are typically 48-58 cm in length and 1-2 kg. Sexual dimorphism is also expressed by plumage. Males have a black throat and bib, white feathers along the sides of the neck, a large white ruff on the breast, green cervical apteria, and yellow superciliary combs; both enlarge during breeding displays. Although females have white-tipped upper tail coverts, they are more cryptically colored (Schroeder et al. 1999).

Taxonomy/Genetics
Sage-grouse belong to the order Galliformes, family Phasianidae, and subfamily Tetraoninae. There are two species of sage-grouse: greater sage-grouse and Gunnison sage-grouse (*C. minimus*). The latter occurs only in Colorado and Utah and is not discussed further in this document. Two subspecies of greater sage-grouse were previously recognized: the eastern greater sage-grouse (*C. u. urophasianus*) and the western greater sage-grouse (*C. u. phaios*) (American Ornithological Union 1998) which occurs in Oregon. However, recent genetic analyses found little evidence to support this subspecies distinction (Benedict et al. 2003, USFWS 2010). This Plan refers to sage-grouse without reference to subspecies delineation. Benedict et al. (2003) also described genetics for Beatys, Steens, Wagontire, Warner, and Whitehorse (ODFW wildlife management units) and found reasonable levels of genetic diversity.

Nesting Rates
The proportion of females nesting varies annually and regionally between 63–100% of populations (Bergerud 1988, Gregg 1991, Connelly et al. 1993, Schroeder 1997, Coggins 1998). This variation is possibly a result of available nutrition quality and the general health of pre-laying females (Barnett and Crawford 1994). Adult females tend to be more likely to nest (85–100%) than yearlings (55–79%) (Gregg et al. 2006, Connelly et al. 2011). Renesting rates by females, which have lost their first clutch, are 10-40% and varies with age and condition of female (Patterson 1952, Eng 1963, Petersen 1980, Bergerud 1988, Dunbar et al. 2005, Gregg et al. 2006, Connelly et al. 2011). The effect of renesting on overall population numbers can be highly variable and may be critical during some years (Schroeder 1997).

Nest Success
Nest success averages 40% but ranges from 15–86%; Trueblood 1954, Gregg 1991, Connelly et al. 1993, Schroeder et al. 1997, Connelly et al *in press*). Adult females may have higher success rates than yearling females, but this pattern is not consistent across studies (Schroeder et al. 1999, Connelly et al. 2011).

Clutch Size
Clutch size is variable and relatively low compared to other species of gallinaceous birds (Edminster 1954, Schroeder 1997) and within the grouse sub-family. Clutch size normally ranges from 7-10 (Schroeder et al. 1999). These differences may be related to habitat quality and overall

condition of pre-laying females (Coggins 1998). Females that renest usually have slightly smaller clutches.

Survival

Annual survival for yearling and adult female sage-grouse vary from 35–85%; male survival varies from 38 – 54% (Wallestad 1975, Connelly et al. 1994, Zablan et al. 2003, Sedinger et al. 2010). Lower survival for males may be related to higher predation rates on males during the lekking season (Swenson 1986). Generally winter survival is high (>70%) but years of extreme weather may reduce this rate (Moynahan et al. 2006, Battazzo 2007, Anthony and Willis 2009).

A stable sage-grouse population is largely dependent on the level of production of young (note: clutch size, nest success, and chick survival are subsets of production) and adult survival. Among harvested populations, the number of juveniles (i.e., hatch year birds) in the fall population varies from 1.40–2.96 juveniles per female. In recent years, this ratio has declined to 1.21–2.19 juveniles per female (Connelly and Braun 1997). More recently, estimates of chick survival have become available through the use of miniature radiotransmitters. Estimates from these studies suggest that 30-50% chicks survive to approximately 30 days post-hatch, with only 10-15% recruiting into the spring breeding population (Crawford et al. 2004, Herman-Brunson 2007, Gregg and Crawford 2009, Connelly et al. 2011).

Historic and Current Range-Wide Distribution

Historically, an estimated 89 million ha (220 million acres) of sagebrush-steppe vegetation existed in North America (McArthur and Ott 1996) making it one of the most widespread habitats. Nearly half of this habitat, however, has been lost or degraded over the last 100 years (Miller et al. 2011). In Oregon, approximately 65% of historic sagebrush-steppe is currently occupied by sagebrush.

Sage-grouse populations have exhibited long-term declines throughout North America, declining by an estimated 33% over the past 30–40 years (Connelly and Braun 1997, Braun 1998, Connelly et al. 2004). The species has been extirpated in five states--Arizona, New Mexico, Oklahoma, Kansas, Nebraska, and in the Canadian province of British Columbia (Schroeder et al. 2004). It is considered "at risk" in Washington, California, Utah, Colorado, North Dakota, South Dakota and in the Canadian provinces of Alberta and Saskatchewan. Even in Oregon, Nevada, Idaho, Wyoming, and Montana, where the species is considered to be "secure," long-term population declines have averaged 30% (Connelly and Braun 1997, Garton et al. 2011). Many factors affect sage-grouse populations and occur at different temporal and spatial scales. Those factors that result in habitat loss and fragmentation have been linked to declines in populations.

GENERAL HABITAT CHARACTERISTICS

In 1977, WAFWA's Sage-grouse Technical Committee published guidelines for the maintenance of sage-grouse habitats (Braun et al. 1977). Those guidelines were updated (Connelly et al. 2000b) and provide a baseline of information for sage-grouse habitat and its management that should be adapted as local ecological conditions and knowledge dictates.

Sage-grouse are sagebrush obligate species and without sagebrush the species cannot persist (Patterson 1952). Sagebrush is important for cover and it is an important component in their diet throughout the year (Schroeder et al. 1999). Within the sagebrush landscape there are key habitat elements that sage-grouse require for reproduction and survival.

Breeding Habitat

Sage-grouse breed on sites called leks (strutting grounds). Typically, the same lek sites are used annually. Leks are established in open areas surrounded by sagebrush, which is used for escape and protection from predators (Patterson 1952, Gill 1965). Examples of lek sites include; landing strips; old lake beds or playas; low sagebrush flats; openings on ridges, roads, crop land; and burned areas (Connelly et al. 1981, Gates 1985). As grouse populations decline, the number of males attending leks may decline and the use of some leks may be discontinued. Likewise, as populations increase, male attendance on leks increases, new leks may be established, or old leks may be reoccupied. Consequently, annual counts of males on leks are used to assess population trends (Connelly et al. 2003a).

The lek is considered to be the center of year-round activity for resident grouse populations (Eng and Schladweiler 1972, Wallestad and Pyrah 1974, Wallestad and Schladweiler 1974). However, habitats that are located substantial distances from leks are used by migratory populations of sage-grouse and are essential to their survival (Connelly et al. 1988, Wakkinen et al. 1992). On average, 80% of nests are within 6.2 km (4 mi) of the lek; however, some females may nest more than 20 km (12 mi) from the lek on which they were captured (Autenrieth 1981, Wakkinen et al. 1992, Fischer 1994, Doherty et al. 2011).

Females exhibit strong fidelity to breeding areas (Fischer et al. 1993), and habitats used by females prior to nesting are also part of the general breeding habitat. These areas provide forbs that are high in calcium, phosphorus, and protein, all of which are necessary for egg production. The condition and availability of breeding areas may have a significant effect on reproductive success (Barnett and Crawford 1994, Gregg et al. 2007, Atamian et al. 2010).

Optimum sage-grouse nesting habitat consists of a healthy sagebrush ecosystem complete with sagebrush (primarily *A. tridentata* ssp. *tridentata, A. t.* ssp. *vaseyana, A. t.* ssp. *wyomingensis*, *A. arbuscula* in Oregon) plants and a strong native herbaceous understory composed of grasses and forbs (Hagen et al. 2007). Nesting and early brood-rearing periods are a critical time period for sage-grouse.

Most sage-grouse nests are under sagebrush plants (Patterson 1952, Gill 1965, Gray 1967, Wallestad and Pyrah 1974, Schroeder et al. 1999, Hagen et al. 2007); however, nests have been found under other plant species (Connelly et al. 1991, Gregg 1991, Kolada et al 2009a). Sage-grouse that nest under sagebrush experience higher nest success (53%) than those nesting under other plant species (22%) (Connelly et al.1991). Research on nesting habitat has documented that sage-grouse tend to select nest sites under sagebrush plants that have large canopies (Hagen et al. 2007). The canopies provide overhead cover and often correlate with a herbaceous (primarily grasses) understory, which provides lateral cover and assists birds in hiding from predators (Patterson 1952, Gray 1967, Klebenow 1969, Wallestad and Pyrah 1974, Wakkinen 1990, Gregg 1991, Fischer 1994, Gregg et al. 1994, Holloran et al. 2005).

Recently, geographic variation in optimal nesting cover has been documented from eastern and western extremes of the species range. Sage-grouse females selected nest areas with >25% grass cover and <10% sagebrush cover in North Dakota and conversely <3% grass cover and >30% shrub cover in Mono, California (Herman-Brunson et al. 2009, Kolada et al. 2009b). Females that select regionally optimal nest cover conditions experience higher nest success rates than those nesting under inferior cover conditions (Wallestad and Pyrah 1974, Delong et al. 1995, Holloran et al. 2005, Herman-Brunson et al. 2009, Kolada et al. 2009b).

Brood Rearing Habitat

Early brood-rearing generally occurs relatively close to nest sites; however, movements of individual broods may be highly variable (Connelly 1982, Gates 1983, Hagen et al. 2007, Atamian et al. 2010). Females with broods may use sagebrush habitats that have less canopy cover (about 14%) than that provided in optimum nesting habitat (Martin 1970, Wallestad 1971, Aldridge and Boyce 2007), but need a canopy cover of at least 15% of grasses and forbs (Sveum et al. 1998). Low sagebrush community types (e.g., *A. longiloba*, *A. nova* and *A. arbuscula*) are drier sites with shallow clay soils that green-up early and can provide a rich forb component during early-brood rearing (Savage 1968, Martin 1970, Connelly and Markham 1983, Gates 1983, Connelly et al. 1988, Atamian et al. 2010). Chick diets include forbs and invertebrates (Drut et al. 1994). Insects, especially ants, beetles, and caterpillars are an important component of early brood-rearing habitat (Johnson and Boyce 1990, Drut et al. 1994, Fischer et al. 1996b, Gregg and Crawford 2009). Brood-rearing habitats having a wide diversity of plant species tend to provide an equivalent diversity of insects that are important chick foods.

In June and July, as sagebrush habitats become dry and herbaceous plants mature, females usually move their broods to more moist sites where succulent vegetation is available (Gill 1965, Klebenow 1969, Savage 1968, Gates 1983, Connelly and Markham 1983, Connelly et al. 1988, Fischer et al. 1996a, Atamian et al. 2010). Where available, alfalfa fields and other farmlands or irrigated areas adjacent to sagebrush habitats are sometimes used by sage-grouse (Patterson 1952, Aldridge and Boyce 2007). These anthropogenic habitat types are not uniformly distributed throughout the range of sage-grouse in Oregon, nor do they provide forage during fall and winter months. In addition, pesticides, which are frequently applied to such fields, have had negative impacts on sage-grouse survival (Blus et al. 1989). Additionally, flood irrigated alfalfa and hay fields may expose sage-grouse to mosquitoes carrying West Nile virus (WNv).

Winter Habitat

As fall progresses toward winter, sage-grouse move toward their winter ranges, at which time their diet shifts primarily to sagebrush leaves and buds (Patterson 1952, Wallestad 1975, Connelly and Markham 1983, Connelly et al. 1988). Exact timing of this movement varies depending on the sage-grouse population, geographic area, overall weather conditions, and snow depth.

Winter habitats for sage-grouse are relatively similar throughout most of their range. Because winter diet consists almost exclusively of sagebrush, winter habitats must provide adequate amounts of sagebrush. Sagebrush canopy can be highly variable (Patterson 1952, Eng and Schladweiler 1972, Wallestad et al. 1975, Beck 1977, Robertson 1991). Sage-grouse tend to select areas with both high canopy and taller stature sagebrush plants (e.g.,Wyoming big sagebrush (*A. t.* ssp. *wyomingensis*), and they will feed on plants which are highest in protein content (Remington and Braun 1985, Robertson 1991). It is critical that sagebrush be exposed at least 25– 30 cm (10–12 in) above snow level because this provides both food and cover for wintering sage-grouse (Hupp and Braun 1989). Sage-grouse are known to burrow in snow for thermoregulation and predator avoidance (Back et al. 1987). If snow covers the sagebrush, sage-grouse may move to areas where sagebrush is exposed. Alternatively, low sagebrush may provide adequate winter habitat where snow depths are low or windswept slopes keep the sagebrush clear of snow (Hanf et al. 1994, Bruce 2008).

Movement Patterns

Sage-grouse populations can be migratory or non-migratory (resident) (Beck 1975, Wallestad 1975, Berry and Eng 1985, Connelly et al. 1988, Wakkinen 1990, Fischer 1994), depending on location and associated land form. Where topographic relief allows, sage-grouse will generally move upwards in elevation from spring through fall as snow melt and plant growth advances so that forbs are maintained in the diet as long a duration as possible. Resident populations may spend the entire year within an area of 100 km^2 (38.61 $mi.^2$) or less in size. In migratory populations, seasonal movements may exceed 75 km (46.5 mi.), and home ranges may exceed 1,500 km^2 (579 $mi.^2$) (Dalke et al. 1963, Connelly et al. 1988) . There may be two or more seasonal ranges in such cases. For example, a migratory population may have a breeding range, a brood-rearing range, and a winter range, indicating a dependence on large expanses of habitat.

To accommodate these habitat needs, it is important to identify sage-grouse movement patterns and seasonal ranges before management actions, such as vegetation treatment projects, are planned. Suitable habitat is needed to allow for connectivity between different resident populations. Connectivity promotes genetic exchange and reduces complications that may arise from inbreeding.

MORTALITY FACTORS

Weather

Weather can influence nesting success and survival of young chicks (Bergerud 1988) and survival of adult females during autumn and winter (Anthony and Willis 2009). However, Wallestad and Watts (1972) found no correlation between sage-grouse productivity and rainfall or temperature in Montana. Similarly, Patterson (1952) found no nest failure resulting from low temperatures or snow but chick survival was compromised by several consecutive days of precipitation accompanied by cold temperatures in Wyoming. The impacts of weather on brood survival depended on the availability of forbs and insects immediately following hatch in Idaho (Dalke et al. 1963, Autenrieth 1981). Sage-grouse production was reasonable when mean average temperature in spring was > 7° C (45° F) and total precipitation was <5 cm (2 in) in Colorado (Gill 1966). Adult sage-grouse endure winter reasonably well, and can gain body mass during this period provided adequate wintering habitat is available (Patterson 1952). However, extreme low temperatures and accumulation of snow can influence survival in different parts of their range (Moynahan et al. 2006, Anthony and Willis 2009)

Predation

Survival of sage-grouse is typically high with more than approximately 60% of a cohort surviving from year to year. Of the 40% of a grouse population that succumbs to mortality during a year predation accounts for approximately 85% of reported non-hunting mortalities and 79% of nest failures (Bergerud 1988). Specifically, predation on nests and young chicks can be high and affect populations (Gregg et al. 1994, Aldridge and Brigham 2001, Schroeder and Baydack 2001, Coates 2007). However, few studies have indicated that predation is a major limiting factor to sage-grouse. In Idaho, predation was the most common cause of death for radio-marked sage-grouse (83% of males and 52% of females) in a hunted population (Connelly et al. 2000a) where apparent survival was 71 and 68% for male and female sage-grouse, respectively.

Coyotes (*Canis latrans*), badgers, (*Taxidea taxus*), bobcats (*Felis rufus*), and several species of raptors are common predators of juvenile and adult sage-grouse throughout most of sage-grouse range (Hagen 2011). Additionally, coyotes, badgers, common ravens (*Corvus corax*), and black-billed magpies (*Pica pica*) commonly prey on sage-grouse eggs (Hagen 2011). Predators that can kill and consume younger birds include the common raven, raptors, ground squirrels (*Spermophillus* spp.), and weasel (*Mustella* spp.) (Schroeder et al. 1999, Michener 2005). The abundance of red fox (*Vulpes vulpes*) and raccoon (*Procyon lotor*) may have substantially increased in sage-grouse habitats because of landscape changes (Fichter and Williams 1967, Bunnell 2000, Connelly et al. 2000a, Baxter et al. 2007).

Predation is probably most frequent on adult males during or shortly after the breeding season and on females during incubation and brood rearing (Schroeder et al. 1999, Hagen 2011). Predation rates may depend in part on the availability of alternative prey for predators, such as cottontail rabbits (*Silvlagus* spp.), jackrabbits (*Lepus* spp.) or other small mammals (Willis et al. 1993). Additionally, habitat quality may influence the rates of predation on sage-grouse (Schroeder and Baydack 2001). However, relatively high rates of nest success and adult survival suggests that predation is not a limiting factor range-wide, but might be an issue with isolated or fragmented populations (Hagen 2011).

Hunting

The impacts of recreational hunting on sage-grouse populations are unclear, but current harvest management is not considered a significant threat to sage-grouse populations (USFWS 2010). There are few experimental studies demonstrating an effect of harvest on populations the following year. However, Connelly et al. (2003b) demonstrated that rates of population growth were less in hunted than unhunted populations in Idaho. Twenty years of harvest data from Oregon did not indicate a correlation between harvest level and spring breeding population (Crawford 1982). Braun and Beck (1985) analyzed banded birds, harvest levels, and lek counts and concluded that the harvest rate of 7-11% in Colorado had no measurable effect on sage-grouse densities in spring. Because sage-grouse do not fit the 'high productivity-short life span' life history model common to other game bird species, the assumption that harvest mortality replaces birds that would have died of other causes during the year (i.e., compensatory mortality) have been questioned (Johnson and Braun 1999). Connelly et al. (2000a, 2003b) suggested that hunting losses are likely in addition to winter mortality for adult females (i.e., additive mortality). Johnson and Braun (1999) modeled population dynamics for sage-grouse in North Park, Colorado, and concluded that hunting mortality can be additive to other sources of mortality, especially in years of poor recruitment. However, recent work from Colorado and Nevada indicates that harvest rates <11% appear to be compensatory in nature (Sedinger et al. 2010).

This conclusion is similar to the range-wide sage-grouse management guidelines that recommend a harvest rate of 10% or less (Connelly et al. 2000). Oregon's policy has been for harvest not to exceed 5% of the fall population and in practice harvest has been estimated at <3% of the fall population in the hunted areas. Sage-grouse are not hunted range-wide in Oregon; regulated hunting is permitted in 12 of 21 wildlife management units where sage-grouse occur. At some level of harvest, hunting mortality is likely to become additive, requiring the implementation of a conservative and controlled recreational harvest management strategy that is adaptive.

Parasites & Diseases

Local populations may occasionally be affected by parasites or disease. However, there is no evidence to suggest that annual fluctuations in sage-grouse numbers are linked to such pathogens. Batterson and Morse (1948) reported a sage-grouse population crash in Oregon in 1919-1920 when dead and dying grouse were common throughout the preferred portions of their range. Schroeder et al. (1999) list the various parasites that infect sage-grouse and coccidiosis is the most commonly reported disease (i.e., diarrhea is the clinical sign) caused by protozoan organisms (*Eimeria* spp.). One such observation was recorded in Baker County, Oregon, in February 2006 (Hagen and Bildfell 2007).

In 2003, West Nile Virus (WNv) caused mortalities of sage-grouse in Wyoming (n = 16), Montana (n = 2), and Alberta (n = 5) with at least 23 sage-grouse found dead (Naugle et al. 2004). This included 9 of 15 radio-marked birds and 7 other sage-grouse in northeastern Wyoming that died of the virus. Currently, sage-grouse show low-no resistance to WNv, and mortality is assumed to be 100% (Naugle et al. 2004). Total mortality from WNv has been markedly reduced since 2003. In addition to Wyoming and Montana, the disease has been confirmed in dead sage-grouse from Colorado, California, Nevada, Idaho, Alberta, North and South Dakota, and Oregon.

In 2006, a die-off of at least 60 sage-grouse was documented near Burns Junction, and two other sage-grouse deaths were confirmed from WNv near Crane and Jordan Valley. Of the birds found dead, 3 provided suitable tissue samples and all were confirmed to be infected with WNv. No other significant mortalities have been documented in Oregon since 2006. ODFW has collaborated with the National Wildlife Health Center to monitor live sage-grouse for the presence of the disease or its antibodies since 2004, and from more than 1,000 blood samples (using Nobuto strips) from hunter harvested birds. Currently, one bird has tested positive for anti-bodies in the Nobuto strip samples but none have been detected in live sage-grouse blood samples. The one positive came from a juvenile male harvested in the Beulah Unit, which is in northern Malheur County.

Human Influences

Insecticides. Organophosphorus insecticides (dimethoate or methamidophos) have been found to be directly responsible for death of sage-grouse in proximity of sprayed alfalfa or potato fields in southeastern Idaho (Blus et al. 1989). Recently USDA has been spraying Dimilin® on public and private rangelands outside of Baker City to suppress grasshopper populations. The direct impact of this insecticide on sage-grouse is unknown, but there are no known direct effects on the domestic chicken. However, indirect effects might be reduced arthropod availability to juvenile sage-grouse at a time when invertebrates are selected food item.

Roads. Sage-grouse, particularly juveniles, are susceptible to being killed by vehicles (Wallestad 1975, Aldridge and Boyce 2007). Mortalities from vehicle collisions were more frequent than collisions with wires and fences in Montana (Wallestad 1975), and in Idaho vehicles accounted for 4% of mortalities of 77 radio-marked females (Connelly et al. 2000a). Road density nor distance to nearest roads were significant factors in the long-term persistence of sage-grouse across the range (Aldridge et al. 2008). However, localized effects of high volume roads appears to negatively affect habitat use and productivity (Lyon and Anderson 2003, Aldridge and Boyce 2007).

Wires and fences. Utility wires are known to cause mortality (Borell 1939), and collisions with power lines accounted for 2% of male and 0.9% of overall mortalities of radio-marked sage-grouse in Idaho (Connelly et al. 2000b). A barbed wire fence in winter habitat killed at least 36 sage-grouse the first winter after installation (Call and Maser 1985), and 21 mortalities were reported along a similar fence in Wyoming (Connelly et al. 2004). Recent work in Wyoming and Idaho has begun to quantify the effect of "problem" fences and methods to reduce collision risks. In Wyoming, 11.36 sage-grouse strikes/mile were detected along an unmarked fence in a 1.5 year time period (T. Christiansen, WGFD, 2009 unpubl. rep.). An average of 4.55 sage-grouse strikes/mile of marked fence was observed during the same time period. In Idaho, 5.3 and 0.9 sage-grouse strikes/mile were documented along unmarked and marked fences, respectively (B. Stevens, Univ Idaho. 2010 unpublished report)

ECOLOGY SUMMARY

Sage-grouse are a sagebrush obligate species, and alterations of sagebrush habitats are the primary cause of sage-grouse population declines. Sage-grouse are relatively long-lived (3-6 years), have lower productivity (seven eggs in a clutch and 1.6 chicks per female in fall populations) than most upland game birds, which generally have a 1-2 year lifespan and clutch sizes of >10 eggs. Sage-grouse exhibit strong fidelity to their seasonal ranges and especially to their breeding areas, which includes display sites (leks), nesting, and early-brood rearing habitats. The life-history pattern of sage-grouse yields populations with slow recovery rates after disturbance to their habitats.

Section III. SAGE-GROUSE POPULATIONS IN OREGON

The Decline of Oregon Sage-Grouse Populations
Sage-grouse were once found in most sagebrush habitats east of the Cascades (Figure 1). European settlement and conversion of sagebrush steppe into agricultural production led to extirpation of the species in the Columbia Basin by the early 1900s (Batterson and Morse 1948). Population monitoring did not begin until after this range contraction, thus estimating population size or density at the time of European settlement is difficult. Within the extant range of Oregon, spring population indices have demonstrated an overall decline since the 1940s (Hagen 2005). However, population indices over the past 30 years suggest relatively stable populations. Crawford and Lutz (1985) estimated substantial declines in spring populations during the period from 1941-1983, and attributed these declines to an "unmeasured" habitat factor. Willis et al. (1993) summarized population information through 1992 and indicated a similar decline from the 1940s but a fluctuating and stable trend since the late 1950s. Connelly and Braun (1997) summarized the data of the previous studies and implicated poor production and cumulative effects of land use as contributing factors to declining population trends, but classified Oregon as a state with "secure" sage-grouse populations. More recent assessments reported a ~4% annual decline for Oregon populations from 1965-2007 (Connelly et al. 2004, Anonymous 2008, Garton et al. 2011). However, the early data, prior to 1980s, should be viewed with caution due to small sample sizes and the absence of survey protocols.

POPULATION MONITORING PROGRAM IN OREGON

This section provides definitions to population measures and monitoring that are discussed in depth in the Population Assessment section below. Monitoring efforts and standards for sage-grouse have increased since about 1980 with a resulting increase in sample sizes. In addition, ODFW has been following a population monitoring protocol since approximately 1996, so data quality is consistent and comparable across the state (Appendix I). More than one type of data was used to assess population trend and status as described below.

Lek counts. Lek counts are based on the number of sage-grouse (primarily males) attending designated leks ("trend leks") each spring. Each trend lek or lek complex is counted at least three times at 7-10 day intervals during the breeding season. This survey provides a measure of population trend over time and serves as the basis for making annual minimum population estimates.

Lek searches. Since the early 1990's, ODFW has cooperated with BLM to systematically search all potentially suitable habitats for active sage-grouse leks. Since that time, 250 previously unknown leks have been discovered, leading to better information about the number and distribution of leks in the state for the purposes of monitoring population trends.

Brood routes. Brood production surveys are conducted to provide a measure of annual reproductive success and trend in sage-grouse productivity. Routes are conducted by vehicle between 15 July and 10 August, depending on spring plant growth and timing of the hatch. Routes are conducted in the same manner (time of day, method of transportation) each year. All

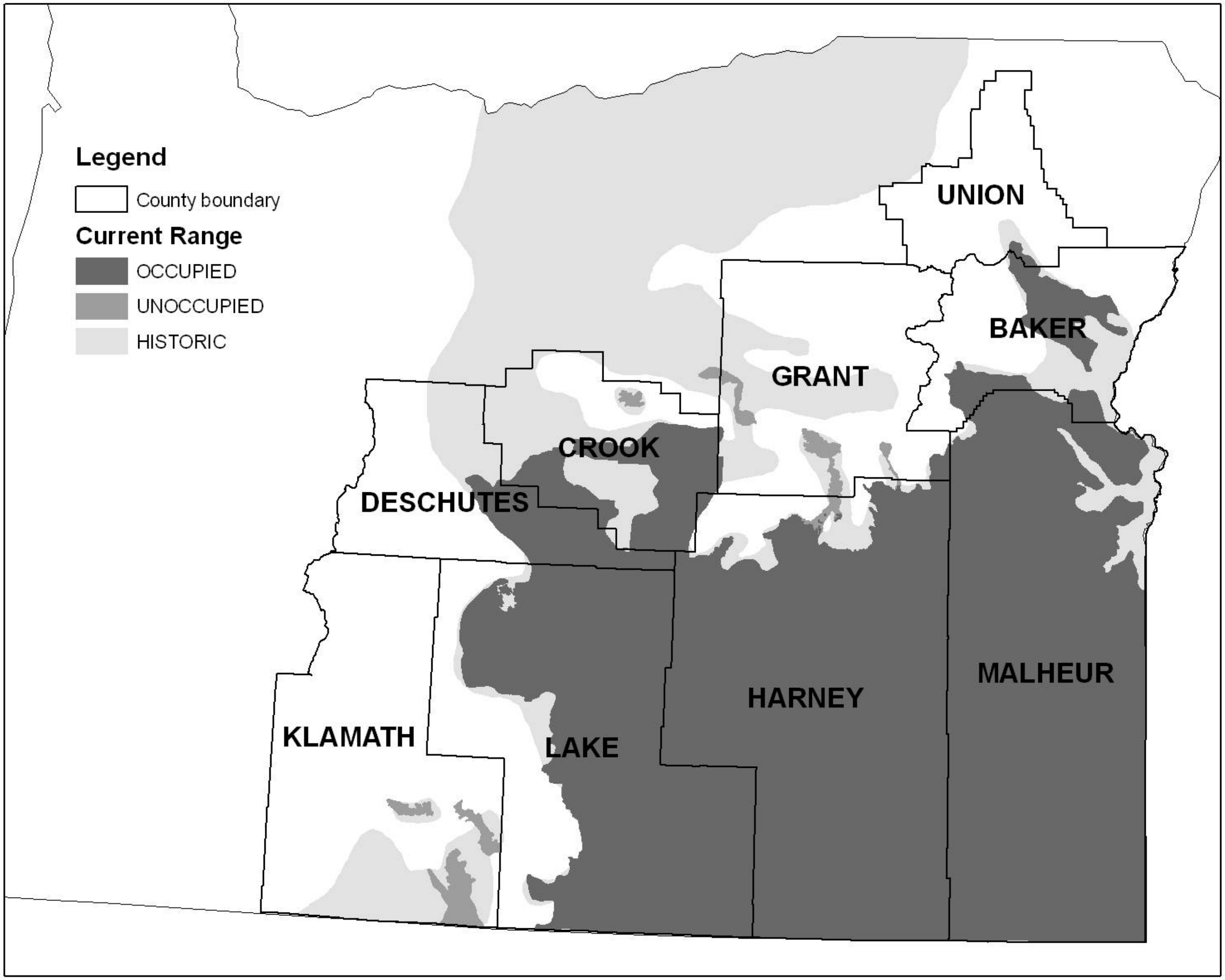

Figure 1. Historic and current range of greater sage-grouse in Oregon. The historic range is derived from Schroeder et al. (2004) and current occupied and unoccupied ranges based on habitat map developed by Oregon BLM and Oregon Department of Fish and Wildlife.

birds observed are counted, and classified as male, female, juvenile, and unknown.

Wing collections. Wings from hunter harvested sage-grouse provide information on the proportion of adults/yearlings/juveniles, chicks/females, and the sex ratio in the population prior to winter. Sage-grouse seasons in Oregon are tightly regulated through limited entry hunting and harvest restrictions and are used to collect additional information on population composition.

Population trends. Trend is measured by the change in the average number of males per active lek, the number of active leks, and the annual rate of change (percent change) in total numbers of males counted on leks between consecutive years.

POPULATION ASSESSMENT

Historical Conditions

There is evidence that Oregon sage-grouse populations have diminished since the early part of the twentieth century (Crawford and Lutz 1985, Willis et al. 1993, Connelly and Braun 1997, Connelly et al. 2004); however, the exact magnitude of that decline is difficult to measure accurately. Moreover, one must consider the conditions that may have contributed to the apparent large populations of the early 20^{th} Century. Before the assumption is made that population sizes of the 1940s and 1950s were "natural" and perhaps relevant to setting population or habitat objectives there are four important factors to consider.

First, the intensive predator control programs of that era in Oregon were removing an estimated 10,000 coyotes annually from the state and ~60% of the annual take was from sage-grouse counties (Animal Damage Control Records 1941-2003; Figure 2). Several other predator species were culled as well both directly and indirectly from predator control methods such as the use of Compound 1080. Thus, these numbers likely represent a minimum number of predators culled during this period.

Second, this level of predator control may have artificially elevated sage-grouse population sizes of sage-grouse despite the fact that grazing (Authorized AUMs) on public land was nearly two times that of current levels (Public Land Statistics, Figure 2).

Third, there were several years in which estimated harvest was >10,000 sage-grouse during regulated fall hunting seasons and may have had an additive effect on mortality despite larger population sizes (Figure 3).

Fourth, it was not until the 1980s that a reasonable sample (>20) of leks was monitored statewide (Figure 4), and monitoring protocols become more standardized. Thus, the precision and accuracy of the data and ability to monitor trends in the early period make inferences from this period questionable.

Based on sage-grouse life-history it likely that broad-scale sagebrush eradication programs of the 1960s impacted available habitat and populations (e.g., Vale Project; Willis et al. 1993). However, the cumulative effects of changes in predator control techniques, harvest levels, and habitat loss possibly contributed to these declines. The question remains, "Are the pre-decline -

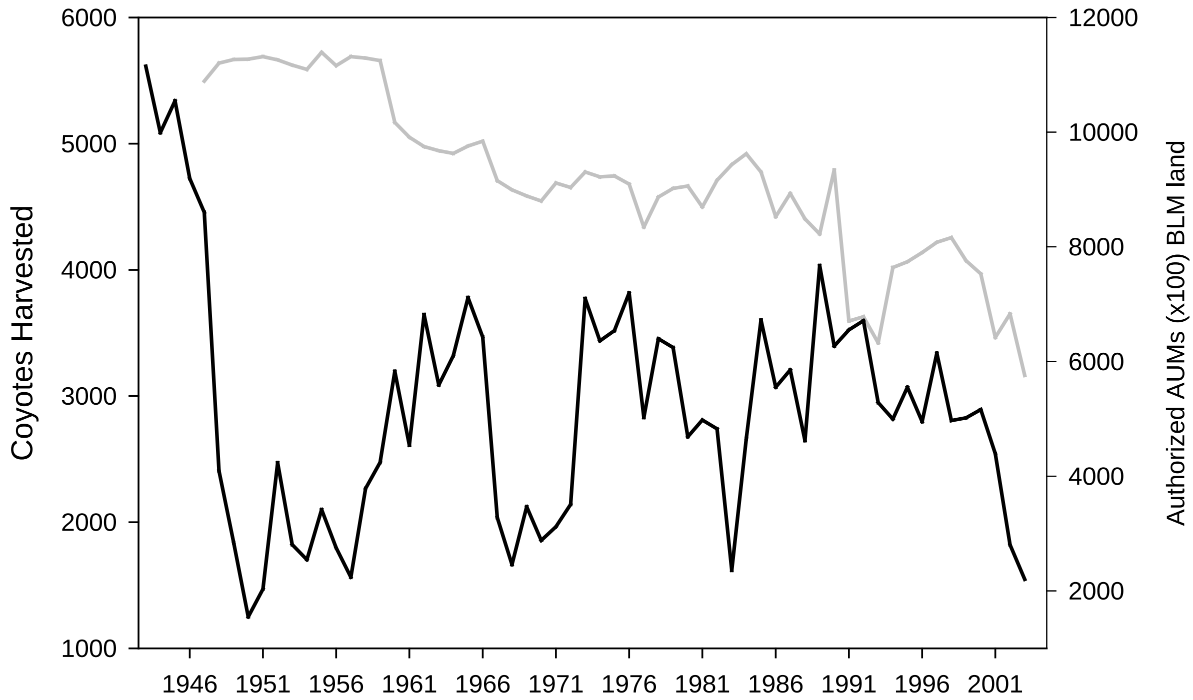

Figure 2. Authorized AUMs (gray line) on BLM lands and coyotes harvested and reported by Animal Damage Control for sage-grouse counties (black line) in Oregon 1943-2003.

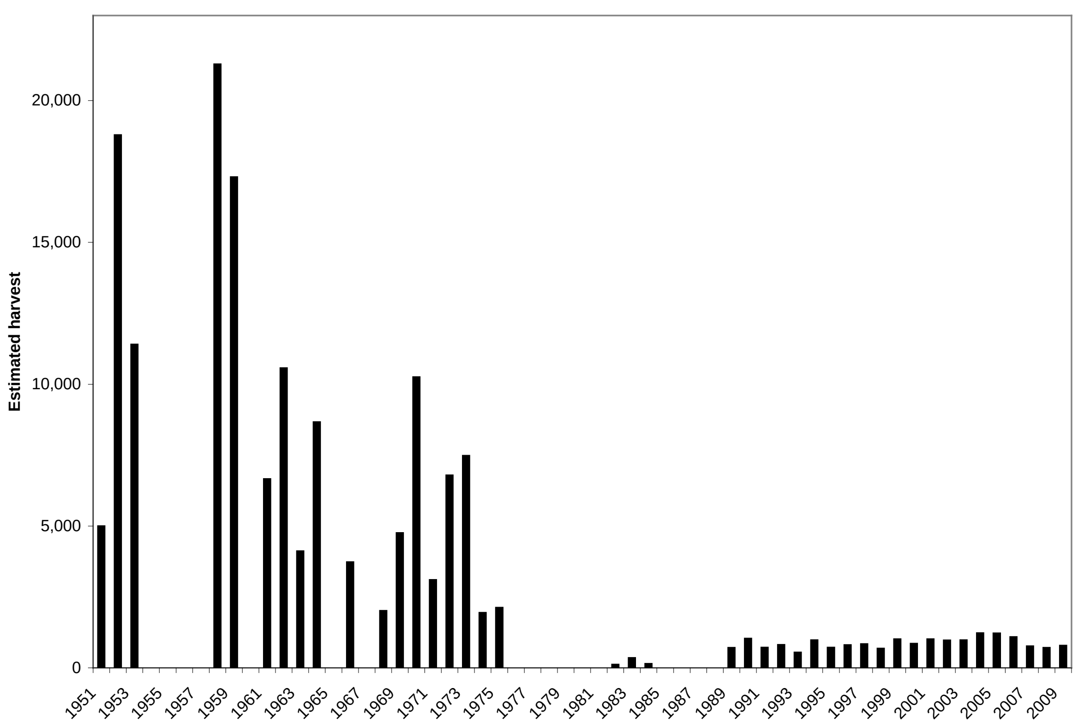

Figure 3. Total number of sage-grouse harvested in Oregon 1950-2009.

conditions attainable?" If so, "Is it financially or socially realistic to achieve such conditions?"

Considering the level and method of predator control, grazing schedules, survey protocols, habitat treatments, and harvest levels which occurred in the 1940-50's, it is questionable if sage-grouse population estimates and habitat conditions of that period should be used to base population or habitat goals in Oregon. Because of these factors, this Plan considered from 1980–2010 as the relevant time period in which to assess sage-grouse populations and their habitats in Oregon. Data from 1980–2003 were used to set population and habitat objectives, and data from 2004 and after will be used to evaluate effectiveness in meeting those objectives.

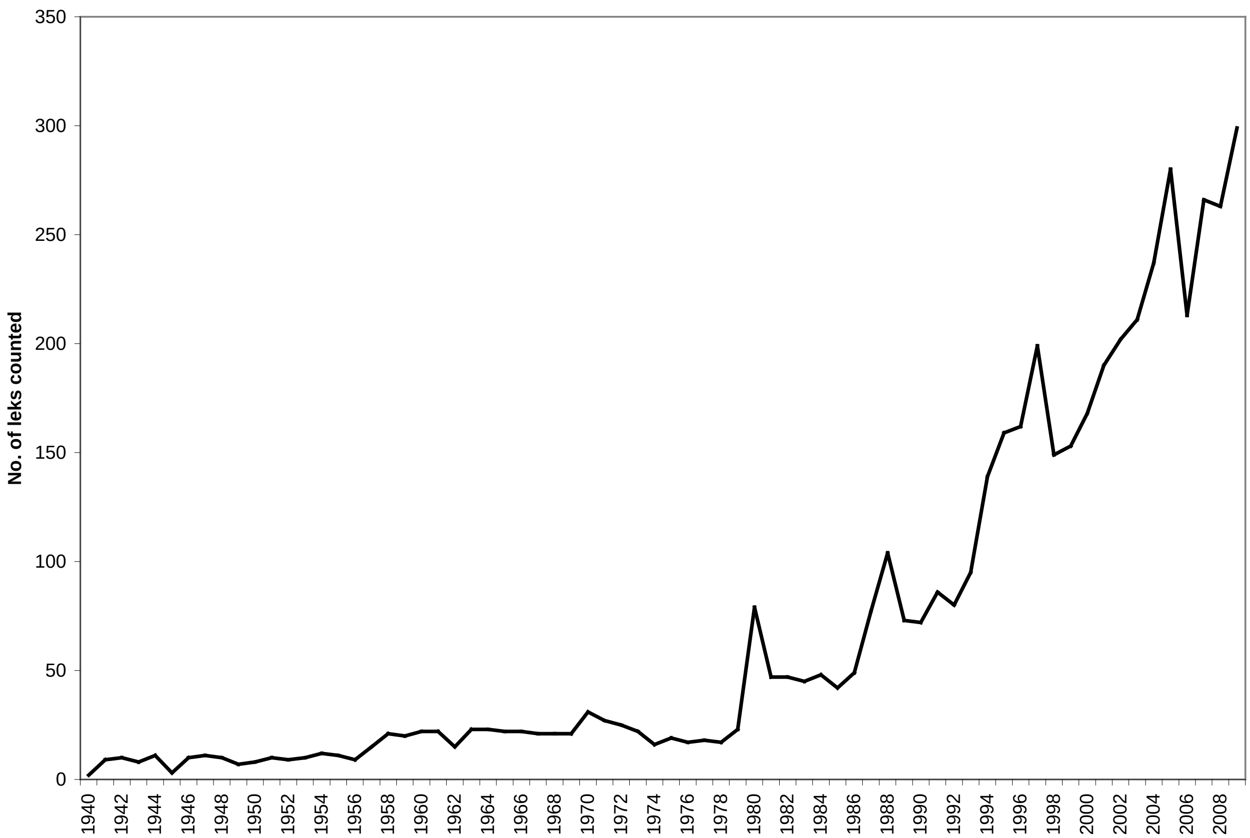

Figure 4. Total number of leks monitored by ODFW, USFWS, and BLM staff from 1941-2009.

Meta-populations and Geographic Sub-divisions

Garton et al. (2011) examined spatial information on sage-grouse populations both within and among states and identified potential meta-population structuring (a meta-population is one large population comprised of numerous smaller but usually interconnected sub-populations). Five populations have been identified in Oregon (Figure 5) and two of these are managed by at least three states. Currently, this Plan assumes these sub-populations are not continuous, because of natural and human-caused habitat fragmentation.

CURRENT DISTRIBUTION, TRENDS, AND STATUS OF SPRING POPULATIONS

The number of strutting males was obtained from counts of birds attending leks during March and April. Historically, the number of times a lek was counted in a year was variable. As of 1996, ODFW, USFWS, and BLM field staff adopted and implemented protocols to attempt to count each trend lek at least three times during the breeding season between 0.5 before and 1.5 hours after sunrise. Trend leks are breeding sites that have been counted consistently over a number of years and generally are a sub-sample of all leks in a region. This Plan provides three measures of population trends for sage-grouse populations in Oregon, changes in average males per lek, annual rate of change (Schroeder et al. 2000), and changes in lek size or total number of male sage-grouse using the lek. The indices chosen and methods for data analyses are similar to those used in the previous population assessments (Connelly et al. 2004, Anonymous 2008, Garton et al. 2011) and have been implemented for continuity and comparison.

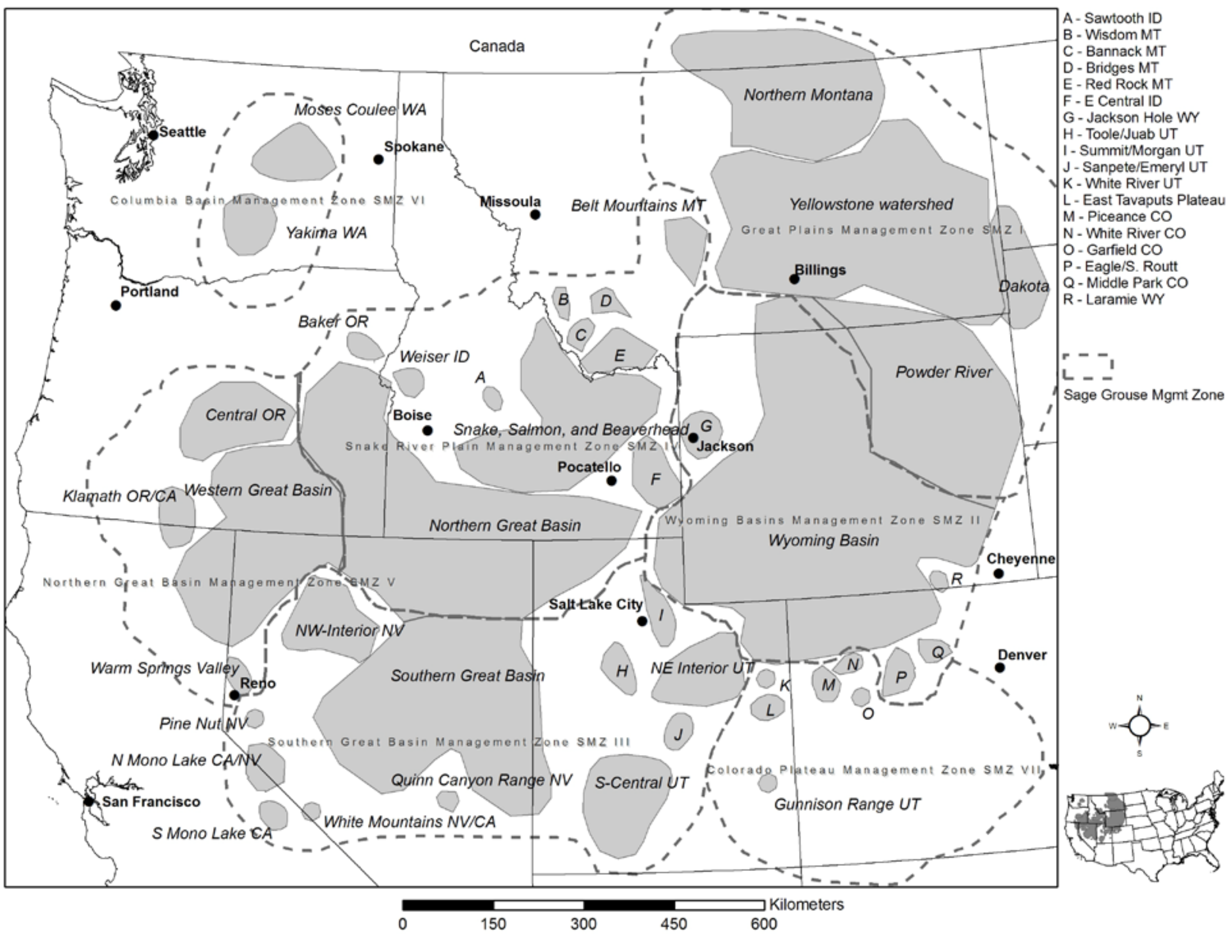

Figure 5. Geographic sub-division of five sage-grouse populations in Oregon and shared populations among adjacent states as defined in Garton et al. (*in press*): Klamath OR/CA, Central OR, Western Great Basin, Northern Great Basin, and Baker.

A lek site is defined as an area with 1 or more males observed displaying in two or more of the seven previous years. Generally sites with small numbers of males are associated with a larger lek site in the vicinity (≤ 1 mile) and are collectively referred to as a lek complex. A count of a lek complex generally includes counting all displaying males in a series of leks where no two lek sites are more than one mile apart. This rule was flexible in some cases, based on field knowledge of district biologists. Thus, all summaries that refer to males per lek, are accounting for lek complexes. These data were collected by ODFW, USFWS, and BLM biologists for nearly 65 years, and recently, additional lek data collected by Adopt-a-lek volunteers. Because this document serves as an update to the 2005 Plan, the following analyses focus only on those data from the established baseline year of 1980 for examining trends.

The annual rate of change (upward or downward) in the sage-grouse population was calculated based on the method described by Schroeder et al. (2000). Briefly, annual rates of change were estimated by comparing the numbers of birds counted at leks in consecutive years. Thus, a lek must be counted at least two years consecutively to be included an annual estimate of population change. A technical description of these techniques is in Appendix I.

DISTRIBUTION

Systematic helicopter surveys have continued since 2004, locating approximately 40 new lek sites. However, all of these breeding areas occur within the existing distribution of sage-grouse. Thus, there has not been a range contraction or expansion since 2004. Anecdotal reports of sage-grouse from Bear Valley and South Fork of the John Day River suggest that there may be seasonal ranges outside of the current range of the species but these observations have yet to be verified. Hence, these areas and Klamath County sagebrush habitats are referred to as "unoccupied" habitat (Figure 1).

Table 1. Average distance (km) between sage-grouse seasonal ranges from five study areas where radio-equipped birds were monitored.

Study area	Breeding to Summer	Summer to winter	Winter to breeding
Baker	15.9	4.9	3.3
Beatys	11.4	10.4	14.8
Central	9.6	14.7	10.2
Hart	5.7	12.1	9.5
Steens	9.6	ND	ND
Average	10.4	10.5	9.4

The migratory status of sage-grouse populations in Oregon has not been well documented. Recent studies have provided some insight to the seasonal movements of various populations enabling some classification of populations as migratory and non-migratory. A total of 420 seasonal ranges derived from 687 radiomarked sage-grouse across five study sites provided some delineation of populations using the Connelly et al. (2000) definition of migratory (moving >10 km between seasonal use areas) and non-migratory. Generally, sage-grouse exhibit one-stage migratory behavior with the largest movements occurring between breeding and summer habitats (Table 1), which corresponds with elevational movements in mountains of Oregon's Basin and Range ecoregion. Movements between summer and winter habitats were generally directed towards breeding areas with two exceptions. A few sage-grouse from the GI Ranch moved distances of >30 km in the "severe" winter of 2008. Sage-grouse from the Beatys Butte and Sheldon Refuge regions moved considerable distances to winter habitats. Additionally, the

Beatys Butte region was an exception as a two-stage migratory population with flocks of birds moving into distinct breeding, summer and winter ranges.

TRENDS

Statewide

Monitoring effort. In Oregon, 1,054 lek sites have been identified and many of these have been found in the last 15-20 years with the use of helicopter surveys. These lek sites comprise 756 lek complexes, and it is these sites on which the following analyses are based. On average, 38% of known lek complexes have been surveyed annually in recent years, and monitoring effort has increased five fold since 1980. The proportion of all leks monitored that were active fluctuated between 54–80% and averaged 71% over 5-year periods (Table 2).

Table 2. Monitoring effort and spring population trends summarized over 5-year periods for range-wide in Oregon, 1980–2010.

	1980-84		1985-89		1990-94		1995-99		2000-04		2005-10	
Variable	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Leks counted	52.2	6	68.0	11	93.4	12	163	9	201	11	260	14.3
Leks active	28.2	4	48.4	7	73.6	13	131	3	149	6	180	7.3
Males / lek	13.5	3	19.5	2	19.3	2	12.5	1	17.3	1	13.0	1.7
Males / active lek	22.8	2	27.0	2	25.1	2	15.5	1	23.5	2	18.6	2.2
Median / lek	7.0	2	10.1	2	11.3	1	9.1	1	9.8	1	7	1.1
Proportion change	0.01	0.10	0.11	0.09	–0.07	0.06	–0.05	0.07	0.09	0.02	-0.06	0.12

Population trends. The annual average numbers of males per active lek has not changed significantly since 1980 (Figure 6A), and this pattern was similar when summarized over 5-year periods (Table 2). All measures of lek activity were relatively unchanged over this time period. Annual rates of change based on lek data suggested two large increases and two subsequent declines in populations, and a fluctuating but slightly increasing trend (0.004%) from 1980–2010 (Figure 6B). These data also suggest that populations in Oregon were on average 3% larger prior to and 22% less, since the 2003 benchmark, respectively.

Two important limitations to these analyses are important to note. First, because leks monitored earlier in the assessment were few and generally the larger breeding areas, it tends to negatively bias the males per lek averages over time. Also, as the inventory of leks has increased through increased sampling effort it has provided a more complete description of the distribution of leks in the state. Without methods to document "creation" of new leks, most methods for estimating trends are prone to negative bias.

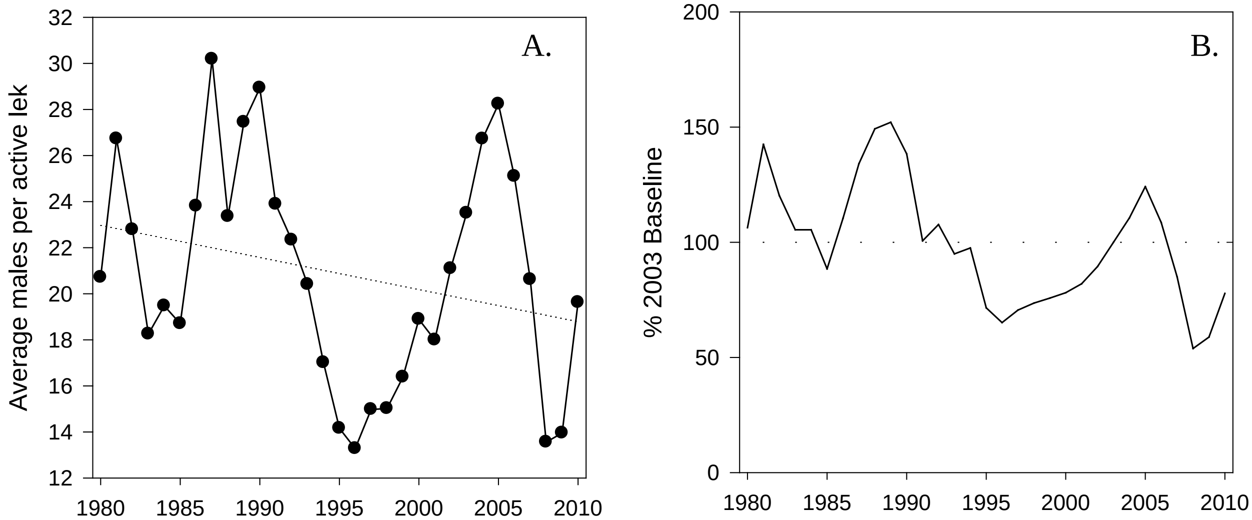

Figure 6. Statewide changes in lek size (males per active lek) (A), and annual rates of change in spring population index (B) reported as a percentage of the 2003 sage-grouse population (dashed line) for Oregon, 1980-2010.

Baker Resource Area

Monitoring efforts.—Baker County was the location of the first sage-grouse field study in Oregon (Batterson and Morse 1948) and where eight leks were monitored intensively from 1941–1948. However, systematic lek surveys were not initiated until 1993, and only four leks were counted until 1996 (Table 3). Helicopter surveys were flown in 2006 and 2009. Fifty-two lek sites have been identified in this region, 42% of which have been monitored annually in recent years, and 77–93% of leks monitored were active.

Table 3. Monitoring effort and spring population trends summarized over 5-year periods for Baker Resource Area, 1990–2010.

	1990-94		1995-99		2000-04		2005-10	
Variable	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Leks counted	4.5	0.9	16.2	2.3	19.2	2.7	22.4	3.8
Leks active	4.5	0.9	13.6	2.7	17.6	2.6	18.0	1.5
Males / lek	11.8	3	13.3	0.8	16.2	2.2	12.7	1.9
Males / active lek	11.8	3	16.5	1.0	17.6	2.3	14.7	1.4
Median / lek	7.5	1	12.7	0.9	12.8	2.3	8.5	2.3
Prop change	–0.12	0.47	0.13	0.09	0.06	0.11	-0.05	0.08

Population trends.—This Plan used the period from 1996–2010 as the assessment period, although it was difficult to draw many conclusions from this relatively short time period. The data suggested a non-significant negative trend in average number of males per lek (Figure 7A). Average annual rates of change (1.0%) also indicated a population increase over much of this period but with the recent decline starting in 2006 (Table 3). The population size was on average 26% less than prior to and since the 2003 benchmark (Figure 7B).

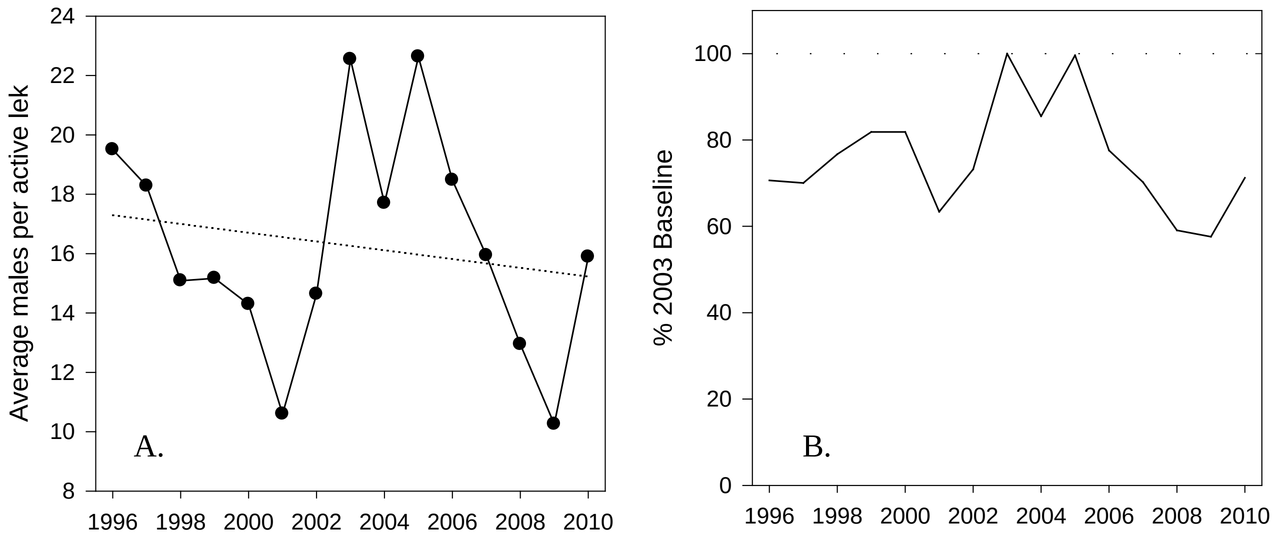

Figure 7. Changes in lek size (males per active lek) (A), and annual rates of change in spring population index (B) reported as a percentage of the 2003 sage-grouse population (dashed line) for Baker County Oregon, 1996-2010.

Vale District

Monitoring effort.—Population monitoring of sage-grouse has been sporadic in Vale District since the 1960s. Extensive helicopter surveys began in the late 1980s, was intermittent in the 1990s and again in 2005 and 2006, and have identified 279 lek complexes. Because systematic ground surveys began in 1993, this Plan used this year as the beginning of the assessment period (Table 4). Until 2006, 15 leks were used to measure trend and 13 were active. An additional 50-60 leks have been monitored by volunteers since 2006 to improve precision of trend estimates. Thus, 26% of known leks have been surveyed in recent years with 72% being active.

Table 4. Monitoring effort and spring population trends summarized over 5-year periods for Vale BLM District, 1995–2010.

	1995-99		2000-04		2005-10	
Variable	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Leks counted	56.8	8	15.6	0	76.4	9
Leks active	44.6	5	14.2	0	54	5
Males / lek	10.9	1	24.9	2	11.1	1
Males / active lek	13.5	1	27.4	3	15.3	2
Median / lek	6.7	0	16.4	1	8.3	1
Prop change	–0.07	0.07	0.11	0.07	-0.04	0.14

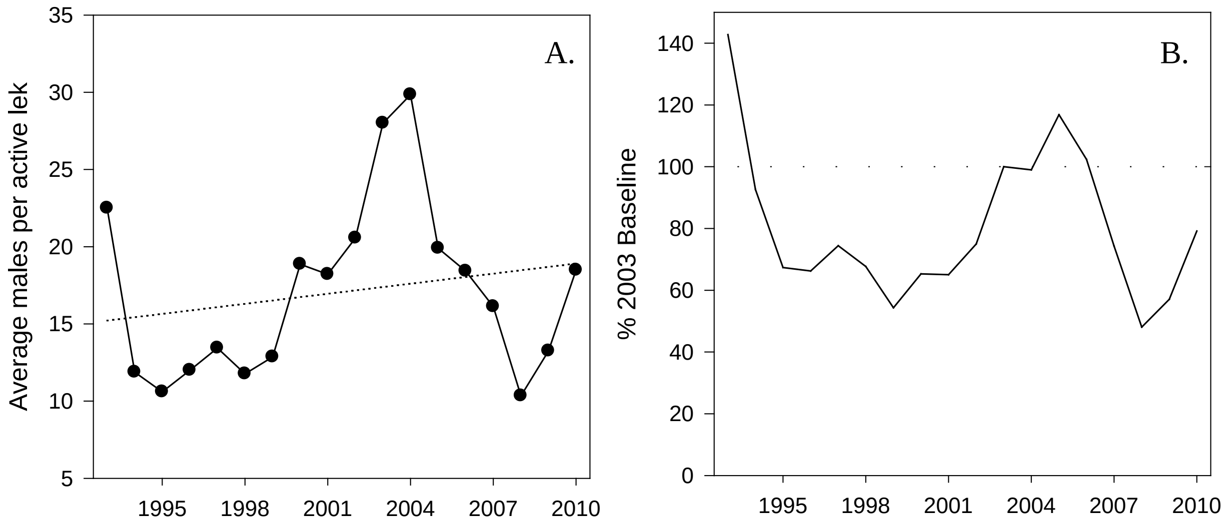

Figure 8. Changes in lek size (males per active lek) (A), and annual rates of change in spring population index (B) reported as a percentage of the 2003 sage-grouse population (gray line) for Vale BLM District (Malheur County Oregon), 1993-2010.

Population trends.—Average number of males observed per lek declined from 1993-1999 and 2004-2007 but has returned to pre-decline levels. The overall positive trend in lek size was not significant during the assessment period (Figure 8A). Average annual rate of change (–0.007%) indicated the 2 declining periods were greater than the increase from 1996–2005 (Figure 8B).

Burns District

Monitoring effort.— In the Burns District, ODFW has one of the longest running monitoring programs of sage-grouse leks. Recent helicopter surveys have assisted in determining status of many remote leks as well as identifying new leks in sub-optimal habitats. These efforts have resulted in locating 126 lek complexes in the District. Beginning in 1981, ≥10 leks were monitored consistently, with 70% or more of the leks active from 1981-2010 (Table 5). Recently 32% of all leks have been monitored annually and 77% of those have been active.

Table 5. Monitoring effort and spring population trends summarized over 5-year periods from 1981 to 2010 for Burns BLM District.

	1981-84		1985-89		1990-94		1995-99		2000-04		2005-10	
Variable	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Leks counted	13.0	2	20.6	4	17.8	1	24.4	4	29	3	39.6	7
Leks active	9.2	3	13.6	0	15.8	1	19.6	2	24.4	3	29.6	4
Males / lek	18.4	5	26.5	5	33.1	2	13.4	2	19.9	2	15.0	3
Males / active lek	24.2	6	36.7	6	37.4	3	15.6	1	23.1	1	19.4	3
Median / lek	11.1	4	16.3	5	22	2	10.2	2	12	2	9.8	1
Prop change	–0.07	0.02	0.12	0.12	–0.04	0.07	–0.06	0.12	0.12	0.10	-0.10	0.13

Population trends.—The number of males observed per lek fluctuated dramatically from 1981-2010 (Figure 9A). The peak of the population trend in the late 1980s and the decline of the mid 1990s were similar with Lakeview (below) and statewide trends. Populations in the Burns District recovered from the low in the mid-1990s, but returned to similar levels in 2007. Annual rates of change based on lek data suggested two large increases and two subsequent declines in populations, and a fluctuating but slightly increasing trend (0.009%) from 1980 to 2010 (Figure 9B). These data also suggest that populations were on average 1% and 22% less prior to and since the 2003 benchmark, respectively.

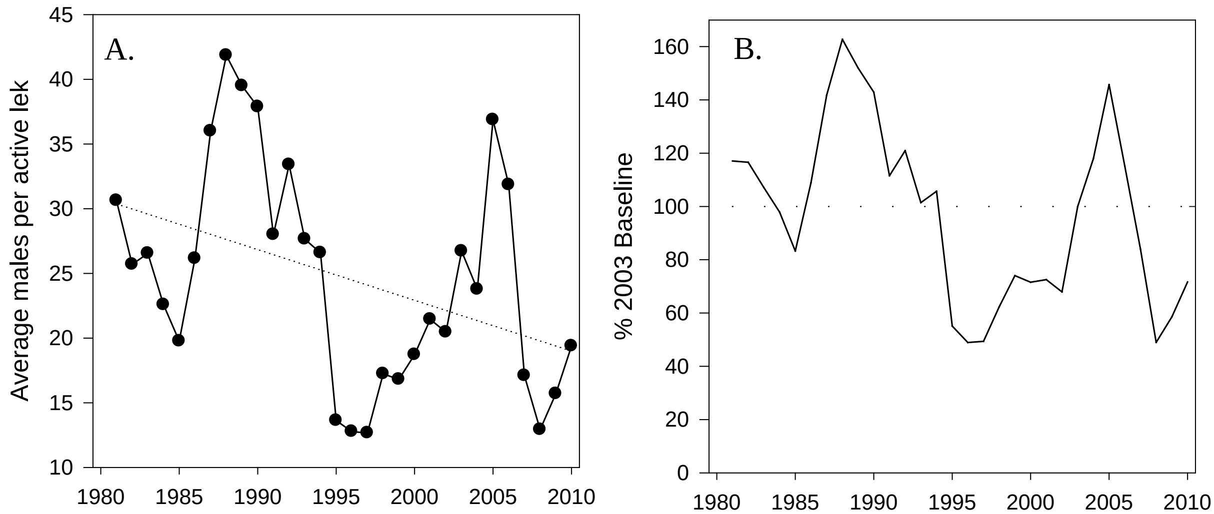

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Figure 9. Changes in lek size (males per active lek) (A) and annual rates of change in spring population index (B) reported as a percentage of the 2003 sage-grouse population (dashed line) for Burns BLM District, 1981-2010.

Lakeview District
Monitoring effort.— Hart Mountain National Antelope Refuge is within the Lakeview District and has had long term but inconsistent monitoring of sage-grouse leks. One hundred and eighty-eight leks have been identified in this region with most occurring in the southeastern portion of the Lakeview District. On average 42% of known lek complexes have been surveyed annually in recent years, and monitoring effort has increased two fold since 1980. The proportion of all leks monitored that were active fluctuated between 50–78% and averaged 60% over 5-year periods (Table 6).

Population trends.—As with Burns District, population trends have fluctuated markedly during the assessment period, with peaks in 1989 and 2006 and lows in 1996 and 2007 (Figure 10A). As of 2010, the average number of males observed per lek (15.8) has returned to near the 1996 low (14.0). The 2006 peak (58.0 males per active lek) exceeded the 1988 pre-peak level (44.4 males per lek). Annual rates of change fluctuated but had a slightly increasing trend (2.9%) from 1980 to 2010 (Figure 10B). These data also suggest that the population earlier in the assessment period was on average 6% and 22% less prior to and since the 2003 benchmark, respectively.

The Klamath Falls population had few birds at leks into the early 1990s, and no sightings have been confirmed since 1993 despite periodic survey efforts (Figure 1).

Table 6. Monitoring effort and spring population trends summarized over 5-year periods for Lakeview BLM District, 1980–2010.

	1980-84		1985-89		1990-94		1995-99		2000-04		2005-10	
Variable	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Leks counted	23.4	8	21.4	4	24.2	2	28.8	2	80.6	11	74.2	3.1
Leks active	11.4	2	14.0	2	16.6	2	22.4	2	51.6	6	46.4	2.1
Males / lek	15.3	4	24.0	4	20.8	3	15.8	2	20.3	1	16.5	2.6
Males / active lek	21.3	2	34.9	4	30.3	2	20.1	2	31.9	3	26.2	3.6
Median / lek	9.6	4	11.6	3	11.2	3	11.1	2	8.0	3	7.2	1.4
Prop change	0.17	0.18	0.07	0.09	–0.10	0.12	–0.01	0.13	0.17	0.04	-0.08	0.12

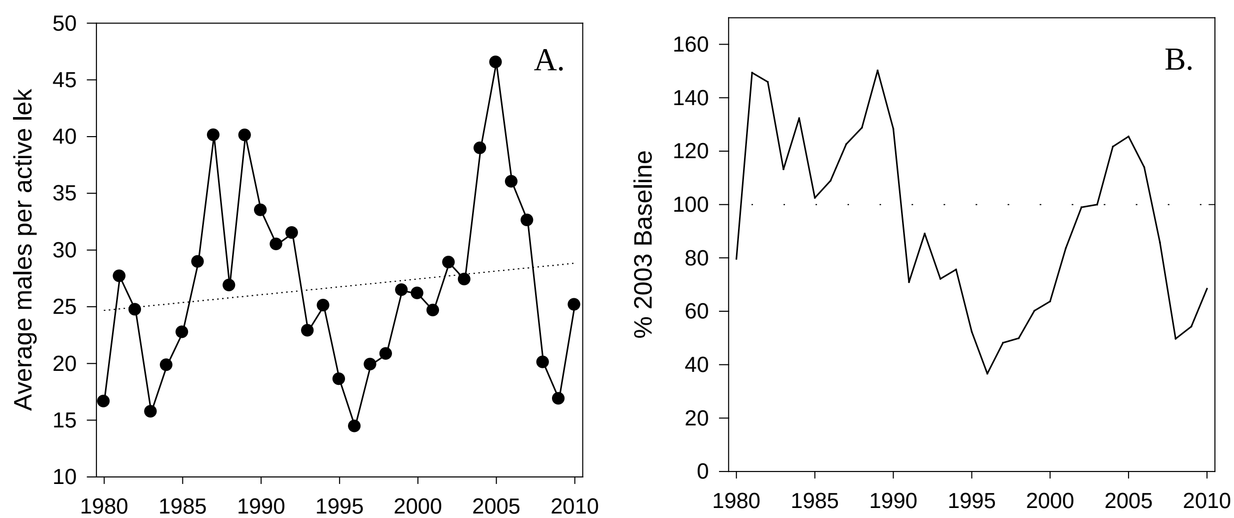


Figure 10. Changes in lek size (males per active lek) (A), and annual rates of change in spring population index (B) reported as a percentage of the 2003 sage-grouse population (dashed line) for Lakeview BLM District, 1980-2010.

Prineville District

Monitoring effort.—Leks were first counted in 1949 in Prineville; however, <10 were monitored consistently during the 1950s and 1970s. Fifty-eight lek complexes have been located in this region with approximately 67% of those active during the 2005–10 period (Table 7). On average 87% of known lek complexes have been surveyed annually in recent years, and monitoring effort has increased 4 fold since 1980. The proportion of all leks monitored that were active fluctuated between 61–86% (Table 7).

Table 7. Monitoring effort and spring population trends summarized over 5-year periods for Prineville BLM District, 1980–2010.

	1980-84		1985-89		1990-94		1995-99		2000-04		2005-10	
Variable	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Leks counted	11.4	2	17.6	5	26.8	3	39.4	1	54	1	46.8	4.0
Leks active	7	1	15.4	5	21.8	2	33.8	1	39.6	1	31	2.5
Males / lek	9.99	1	13.5	1	13.2	1	12.7	0	10.9	0	9.7	1.0
Males / active lek	16.5	3	15.7	1	16	1	14.8	0	14.8	0	14.6	1.5
Median / lek	5.7	1	9.4	1	10.5	1	10.6	1	7.1	1	5.7	0.8
Prop change	–0.14	0.10	0.19	0.16	–0.04	0.08	–0.04	0.01	–0.03	0.03	0.002	0.15

Population trends.—There has been a negative but non-significant trend in males per lek during the assessment period (Figure 11A). The declining trend for the Prineville District is the most sustained of all districts. Annual rate of change (Figure 11B) analysis indicated a population in decline (–0.004), and the population rate of change has remained fairly consistent since 2001. These data also suggest that the population earlier in the assessment period was on average 39% larger and 5% less prior to and since the 2003 benchmark, respectively.

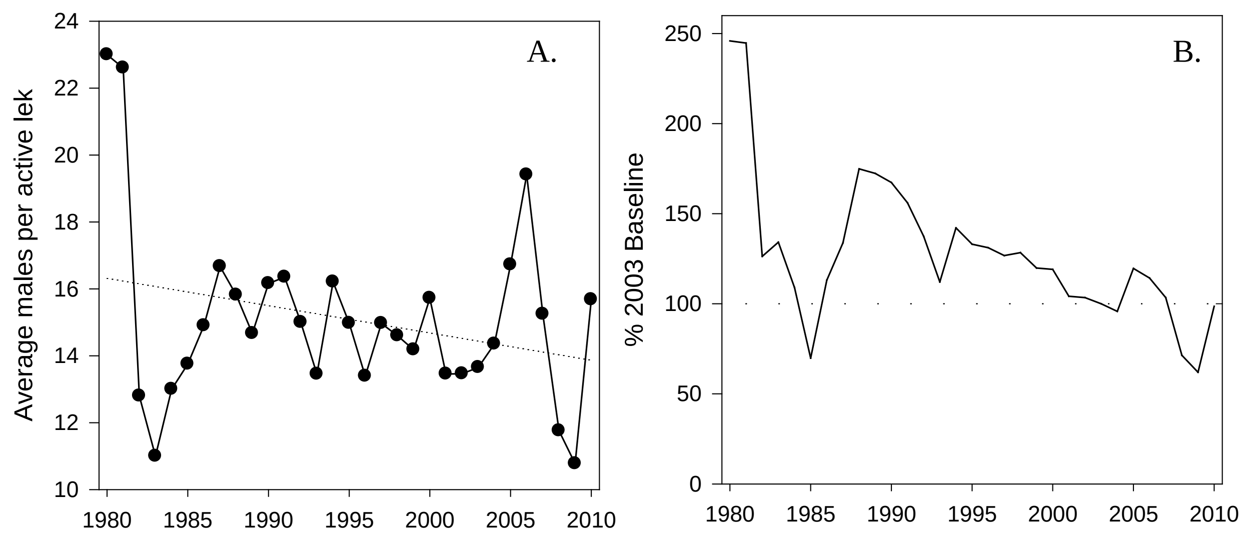


Figure 11. Changes in lek size (males per active lek) (A) and annual rates of change in spring population index (B) reported as a percentage of the 2003 sage-grouse population (dashed line) for Prineville BLM District, 1980-2010.

2010 Estimated Population Size

Since adoption of the 2005 Plan, a new approach has been developed to provide a minimum estimate of sage-grouse populations in Oregon. Thus, a revised estimate of 2003 population and a 2010 estimate have been computed (Table 8). The revised population estimate for Oregon sage-grouse was calculated using a stratified random estimator (Krebs 1994) for each management unit. Five strata were delineated based on lek size within each unit. Leks were assigned to the following strata: 0, 1-10, 11-25, 26-50, and >50 males per lek based on the average maximum number of males counted during years 2003–2010. For those leks not counted in past eight years, lek size was estimated by taking the number of males at last count and adjusting that number by the average proportional change from that year to 2010.

Implementing the stratified random estimator assumes that surveys are drawn from a random sample. Lek surveys are not randomly selected at this time, thus the bias associated with these counts are unknown, and not all leks in Oregon are known. As a result the range of values presented must be viewed as minimums, because the variation around these estimates is likely larger than the estimates generated. However, making these assumptions and developing strata are more reasonable than the estimates provided in 2005. At that time population size was generated by extrapolating the average number of males per active lek to an estimated number of active leks, which was likely biased high because of several large (>50 males) leks in each unit weighted those averages. The revised stratified approach helped to control the influence of large leks on estimating population size and included the number of inactive leks in the estimate.

Based on the best available information, there was a minimum spring population estimate of 24,000 (range = 21,000 to 27,000) sage-grouse in Oregon in spring of 2010 (Table 8; see Appendix III for calculations). A revised estimate for 2003 suggests a minimum statewide breeding population of 29,000 (range = 24,500 to 34,000) sage-grouse. This is approximately 11,000 less than previously estimated in 2003 (34,000 to 45,000; Table 8).

Previous estimates of sage-grouse population size support these results (Willis et al. 1993, Braun 1998). Using 24,000 birds as baseline and reconstructing backwards from annual rates of change data (Figure 6A), the 2010 population estimate was compared with prior estimates. As of spring 1992, Willis et al. (1993) calculated 27,505 birds in Oregon; by back projecting the annual rates of change and lek stratification the new method estimates that 1992 was 38% larger than the 2010 baseline at 33,300 birds. Willis et al.'s estimate was slightly lower than the rates of change estimate, but >150 new leks have been identified since then, and would have resulted in a larger population estimate. Additionally, Braun (1998) estimated that Oregon had >20,000 sage-grouse in spring of 1998; the annual rates of change indicated the 1998 population was 5% less than 2010, and within the measurement error of this estimate (22,800). More recently Broms et al. (2010) proposed using sex-and-age kill ratio models from hunter harvested data and surveys to estimate sage-grouse (and other small game) populations. Although confidence intervals for their technique were large, the point estimate for 2003, 18,055 (2,974–35,526) was more closely aligned with the revised estimate for 2003, than the previous estimate of 40,000 birds.

Caution should be used when making inference from minimum population estimates derived from leks counts, because it is largely based on indices of population size, and the actual relationship between the index and population size is unknown (Walsh et al. 2004).

Table 8. Minimum estimated spring population size for greater sage-grouse administrative units in Oregon, 2010. Estimated population size for 2003 from Hagen (2005) and a revised estimate for the same year based on stratification of lek size.

Management unit	2003	2003 revised	2010
Baker	2,706–3,503	1,566–2,546	872–1,650
Burns	4,934–8,164	3,722–4,941	3,877–5,195
Lakeview	9,852–14,947	8,613–10,134	5,523–6,445
Prineville	1,842–2,291	2,072–2,440	1,775–2,084
Vale	15,059–16,364	8,474–13,921	9,016–11,740
Statewide	34,393–45,268	24,447–33,982	21,064–27,115

CURRENT TREND AND STATUS IN PRODUCTION

Production is a critical stage in the life history of grouse and is one of the population variables upon which harvest levels are established. Previous assessments of sage-grouse in Oregon indicated long-term declines in production (Crawford and Lutz 1985, Connelly and Braun 1997). Brood production surveys (brood routes) provide a measure of annual reproductive success and trend in sage-grouse productivity. However, Oregon is the only state that uses brood routes to estimate production and assists in setting harvest levels. Since 1951, brood counts were conducted yearly although continuity between regions within the state has varied. Generally, counts were conducted between mid-July and mid-August, depending on plant phenology and timing of the hatch. All birds observed were counted and data were summarized as birds per 16 km (10 miles). Birds were classified as male, female, juvenile, and unknown. Classification information was used to calculate the number of chicks seen per female as well as other indices of population trend. Production routes were conducted in most BLM districts. However, there are no routes in Baker Resource Area, and estimates for the Vale District represent productivity primarily in Malheur County.

Wing-data from the harvest also provided estimates of productivity through classification of hatch-year and adult birds. Oregon has used wing-data as an additional tool to assess productivity since 1982; however, without hunting seasons from 1985-1988 no wing data were collected during these years. Moreover, improved methods classifying age for wings were implemented in 1993 making direct comparisons or trend analyses from the earlier period (1982-1992) problematic. Thus, all years (1982-2010) of wing-data were used qualitatively (Figure 12 A&B), and only 1993-2010 were used in formal analyses. Management units do not follow BLM District boundaries thus some pooling and use of units more than once were necessary to characterize productivity in each assessment area (Table 9).

Table 9. Summary of wildlife management units (WMUs) incorporated into each assessment area for the purpose of analyzing sage-grouse productivity from wing-data in the harvests.

	BLM District Boundary			
Baker	Burns	Lakeview	Prineville	Vale
Beulah	Juniper	Beatys Butte	Silvies	Beulah
Lookout Mountain	Malheur River	Wagontire	Wagontire	Owyhee
Sumpter	Silvies	Warner		Sumpter
	Steens			Whitehorse

Trends in productivity
An average of 1,254 km (780 miles) was traveled annually while conducting brood counts from 1980–2010. There was a slight increase in number of chicks observed per female over the long-term (~3% per year) (Figure 12A). Wing-data from 1982–2003 also suggest an increasing trend (Figure 12B). Wing-data and brood route data were highly correlated from 1993–2010, but no measurable trend was detected from wing-data (Appendix III: Table A-2).

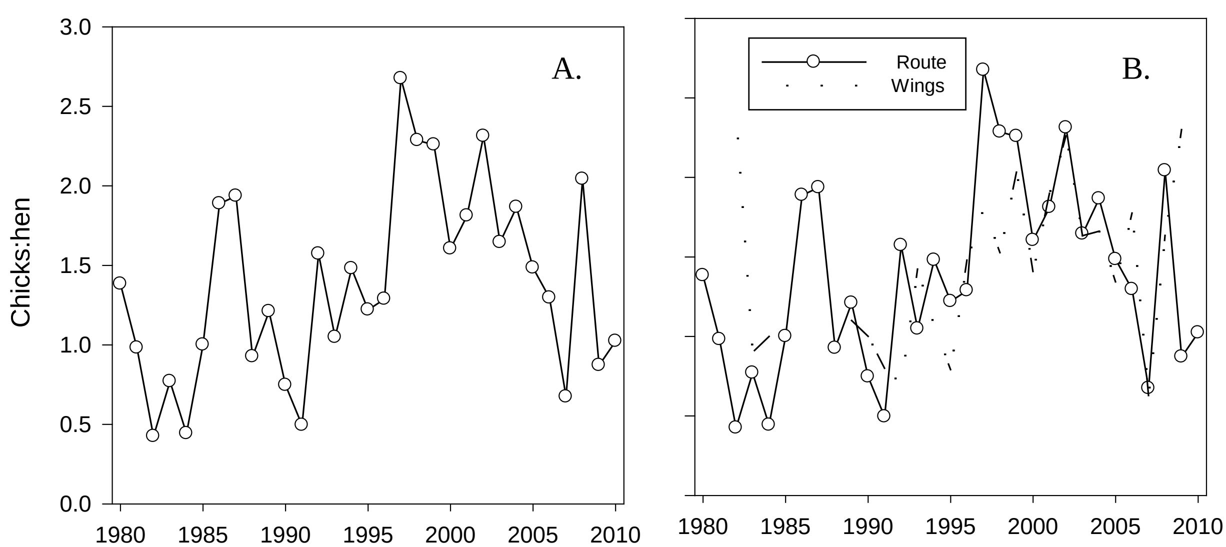


Figure 12. Changes in productivity from brood routes from 1980-2009 (A). Chicks:female ratios from brood routes (line with open circles) and wing-data (dashed black line) for 1980-2009 (B).

PRODUCTIVITY AND SPRING POPULATION SIZE

Monitoring trends in production and spring populations is an important aspect to regulating harvest in Oregon (Appendix I), and surveys and statistics generated from those analyses also can provide methods for evaluating population response to management activities. The following paragraphs synthesize information from spring populations and productivity data and illustrate how these data might be used as response variables when measuring the impact of management actions on sage-grouse populations.

Productivity trends generally followed the annual rate of population change (Figure 13A) and showed a slight increase from 1982–2009 (Table 10). The increasing trend is supported by two independent measures of productivity (Figure 13B) and suggests that recent increases in production have contributed to the stable to increasing trend statewide. These data also are consistent with the hypothesis that declines through the 1980s were due in part to poor recruitment.

Another important statistic from wing-data is the ratio of immature males to immature females in the harvest. This information can provide insight into habitat conditions that might affect chick survival because the faster growth rates of male chicks requires a higher energy diet (Swenson 1986). Chick-male to chick-female ratios less than 1:1 may indicate relatively ‘poor’ habitat conditions in which male survival is compromised, thus, the proportion of chick-males in fall harvest should indicate (predict) spring population trends.

The scope of this analysis (linear regression) was limited to 1993-2009 because survey and wing classification protocols were most consistent during this period (Table 10). From the wing-data, chick-male:chick-female ratios (MF) and chicks:female (CF), and chicks:female from brood routes (BR) were examined as predictors of annual rates of change for the following year.

Chick:adult female ratio from wing-data was the best predictor of annual rates of change lek counts in the following spring, and chick:adult female ratios was the second best predictor of lek data (Table A-2). However, chick-male:chick-female ratios were a poor predictor of annual rates of change, despite a positive correlation between these variables. These analyses indicate a strong relationship between the brood counts and annual rates of change in lek counts. Thus, if wing-data are not available annual rates of change in lek counts can provide an indirect measure of management actions on production.

Published guidelines (Connelly et al. 2000) recommended that 2.25 chicks per female are needed for stable or increasing populations. These recent wing data from Oregon indicate that lower productivity can yield stable populations as measured by rates of change. Solving the linear equation [$y = -0.428 + 0.275(\text{productivity})$] for chick:hen ratios to predict rates of population change yields 1.56 chicks per hen are needed for a stable population. Since 1993, productivity has averaged around 1.57 chicks:female. Additionally, Broms et al. (2008) proposed a sex and age-ratio kill model to estimate small game population size and applied those methods to sage-grouse populations in Oregon from 1993-2006. Estimates of population growth from their annual population sizes yielded an average 2% annual growth rate while productivity averaged 1.59. There were only two years in which productivity exceeded 2.0 chicks:female during their study, 1999 and 2002. Population stability is the product of several life-history traits within a population (e.g., adult survival, nest success, and chick survival), thus population trends should be measured from various metrics when possible.

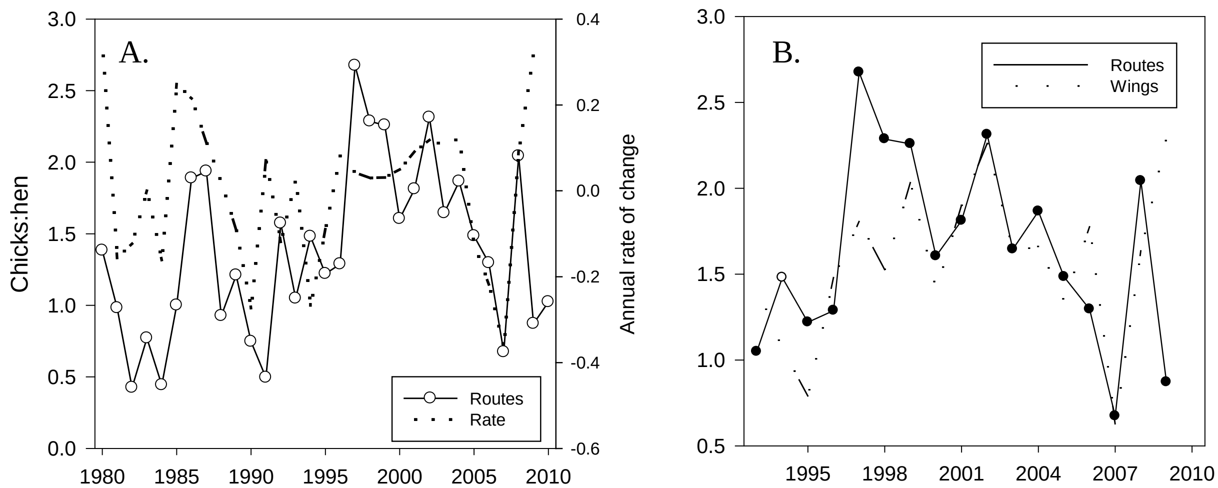


Figure 13. Changes in productivity from brood routes (line with open circles) with respect to annual rates of change in males counted at leks (dashed line) for 1980-2010 (A). Chicks:female ratios from brood routes (line with open circles) and wing-data (dashed black line) for 1993-2010 (B).

POPULATION ASSESSMENT SUMMARY

Oregon sage-grouse numbers apparently have declined over the long-term (1957-2003; See Hagen 2005). Reasons for these losses likely are the cumulative effects of habitat loss and degradation, changes in predator control methods, and increases in human disturbance. Because productivity was correlated with spring population trends, it is probable that these factors had the greatest effect on population trends of sage-grouse. Statewide spring population trends were relatively stable for the assessment period (1980-2010) with population increases in most areas from the mid 1990s through 2006. There have been wide fluctuations in annual counts of males during this period, and such fluctuations make it difficult to assess the impacts of future conservation actions. It is important that planning and evaluations account for this variation. A 5-year moving average of males per lek to assess population trends might be a practical guideline to use. Population size and trend (1980-2003) provides a benchmark for maintaining and setting population objectives. Currently, Oregon populations are below this benchmark but have not reached levels that are outside the range of natural variation.

Table 10. Sage-grouse production index (chicks: adult female ratio; C:H) and total number of wings (*n*) from fall harvest 1993 to 2009, and linear regression statistics to estimate trends in production (regressing C:H against year): coefficient of determination (r^2), *P-value*, and the slope parameter (β) and its standard error (SE).

	Baker		Burns		Lakeview		Prineville		Vale		Statewide	
Year	*n*	C:H	*n*	C:H	*n*	C:H	*n*	C:H	*n*	C:H	*n*	C:H
1993	28	1.55	156	1.61	95	1.72	19	2.00	175	1.22	439	1.42
1994	57	1.38	272	0.90	199	0.81	47	0.90	262	1.46	764	1.07
1995	26	1.00	126	0.75	152	0.52	21	0.58	175	1.15	456	0.79
1996	29	1.90	156	1.25	133	1.63	33	1.67	204	1.59	493	1.48
1997	59	1.19	152	2.18	211	1.80	39	1.57	223	1.61	586	1.81
1998	43	1.39	117	0.78	163	2.51	56	1.45	186	1.48	466	1.53
1999	60	1.61	174	1.74	226	2.34	33	1.80	271	2.01	671	2.03
2000	54	1.45	142	1.76	182	1.30	53	1.11	260	1.35	592	1.41
2001	53	1.52	176	1.91	214	1.72	62	1.94	271	2.04	664	1.90
2002	53	1.41	185	1.92	203	3.00	39	2.18	260	2.08	648	2.26
2003	53	1.21	172	1.37	228	2.17	41	0.45	254	1.47	654	1.63
2004	62	1.70	140	1.37	225	1.62	18	1.57	277	1.86	644	1.66
2005	82	1.83	132	1.32	186	1.51	23	1.56	303	1.26	621	1.34
2006	59	2.28	121	1.37	164	1.98	31	2.44	209	1.90	494	1.78
2007	22	0.38	103	0.61	134	0.84	39	1.05	120	0.43	360	0.63
2008	27	1.08	97	1.49	157	1.62	20	0.54	136	1.78	390	1.64
2009	49	2.06	73	1.92	171	2.56	29	2.63	156	2.23	400	2.31
Avg.	48	1.47	126	1.43	158	1.74	32	1.50	193	1.58	479	1.57
r^2		0.006		0.011		0.065		0.022		0.039		0.076
P-value		0.76		0.68		0.32		0.57		0.44		0.28
β (SE)	0.006 (0.02)		0.010 (0.02)		0.033(0.03)		0.019 (0.03)		0.017(0.02)		0.025 (0.02)	

MANAGEMENT OBJECTIVES FOR POPULATIONS

POPULATION GOAL

It is important to note that the population objectives in this Plan are lower than in the 2005 Plan, but these objectives are based on the same population data (see Table 8). The population objectives for this Plan are based on a new method for estimating populations that provides a statistically more rigorous estimate and consistently provide a lower population estimate using the same data. Thus, population goals are ***not*** being lowered for management purposes but for use of a more appropriate and scientifically acceptable way of estimating population trends. Population management objectives for statewide and regional populations are as follows:

STATEWIDE POPULATION

In accordance with the Wildlife Policy (ORS 496.012), the primary goal is to restore, maintain and enhance populations of greater sage-grouse such that multiple uses of populations and their habitats can continue. Regional and state population goals shall be identified based on the best information available.

(1) Policy: Manage greater sage-grouse statewide to maintain or enhance their abundance and distribution at the 2003 spring breeding population level, approximately 30,000 birds over the next 50 years.

Assumptions and Rationale

Since 1980, statewide population size has fluctuated around an average of 99% of the 2003 benchmark. Therefore, it is assumed that maintaining currently available habitat amounts and quality will sustain similar population size and distribution into the future.

Implementing the habitat enhancement and restoration guidelines in the Plan will contribute to the quality and total area of habitat over the long-term and will assist in maintaining or enhancing the abundance and distribution of sage-grouse in Oregon.

Population triggers are based on historic fluctuations (using a 5-year moving window average) from which populations recovered. Thus, the assumption is that current populations can sustain similar fluctuations and remain sustainable.

The annual percentage change was used in estimating population size relative to the 2003 population to establish thresholds for management actions.

Actions

1.1. Monitor population trends with both spring lek surveys and brood counts, and in years or areas with hunter harvests, wing-data should also be summarized to evaluate productivity and population growth. See Appendix II for details on population monitoring.

1.2. Develop a more efficient method for estimating population size, especially for regions where only a sub-sample of leks can be monitored.

1.3. Use a 5-year moving average of annual rates of change to determine trend until robust methods can be established to estimate population size.

1.4. If the trend indicates an annual decline in a population of >7% for more than three consecutive years or a decline <7% for five or more consecutive years, then federal and state agencies will need to consider management actions to reverse the decline or at least stabilize the population, including, evaluating harvest levels on a unit by unit basis.

1.5. If the statewide population estimate drops below 15,000 birds, federal and state agencies will need to consider management actions to reverse the decline or at least stabilize the population. Because of natural fluctuations in populations it is anticipated the population will drop below the 2003 benchmark, possibly by as much as 50%.

1.5a. Alternatively, if populations have increased by nearly 30% such growth (~40,000 birds) should not result in "no-action" management.

1.5b. Coordinate with land managers to address land use issues that may be affecting populations.

1.5c. The Oregon Sage-grouse and Sagebrush Habitat Conservation Team will convene to address these issues and provide recommendations.

1.6. Monitor the geographic distribution of leks on a regional basis at 5-year intervals.

1.7. The primary goal of the Plan is to maintain or enhance current populations; however, efforts to restore populations to portions of historic range may be considered at some point in the future. Such actions will need to carefully consider long-term sustainability of a reintroduced sage-grouse population with respect to the connectivity and quality of sagebrush habitats (see Regional Conservation Measures Section).

REGIONAL POPULATIONS

(a) Baker Resource Area BLM: maintain or enhance greater sage-grouse abundance and distribution at the 2003 spring breeding population level, approximately 2,000 birds.

Assumptions and Rationale

Lek count data is not continuous from 1941–2010, but the number of males counted on leks from 1941-48 (*n* = 6) has declined by 70% and of those (*n* = 3) that are still active today are down by 40%. Since systematic counts began in 1989, the number of counted males/active lek have remained relatively stable.

Baker County supports similar populations of sage-grouse than 20 years ago; therefore, it is assumed that maintaining currently available habitat amounts and quality will sustain a 2003 population size and distribution into the future.

It is unknown if there is movement (dispersal) of birds from sagebrush areas east of Interstate-84 to habitats in the southwest portion of the county. Without this knowledge it is difficult to determine if populations in the area are "closed" to immigration from other populations. Immigration and emigration could have substantial impacts on population size and trend.

The population objective assumes that the area east of Interstate-84 represents a closed population, and those near the Malheur County border are open populations (i.e., population size is regulated in part by immigration from populations North of Harper). Movements of radio-equipped sage-grouse in 2009 and 2010 from the Keating Valley and Virtue Flat regions indicated seasonal migrations into Idaho, and challenges the assumption of closed populations.

Actions

2.1. Monitor trends as described in Action 1.1.

2.2. Collect genetic and movement data to evaluate the potential for open or closed populations in this region.

2.3. Monitor distribution as described in Action 1.6.

2.4. Use the trigger for rate of change of populations as indicated in 1.4 to consider management actions.

2.5. Coordinate with land managers to address land use issues that may be affecting populations.

(**b) Vale District BLM** (excluding Baker Resource Area BLM): maintain or enhance greater sage-grouse abundance and distribution at the 2003 spring breeding population level, approximately 11,000 birds

Assumptions and Rationale

Since 1993, population size has fluctuated around the 2003 estimate, however, because this region was the location for extensive sagebrush removal programs (1960s) it is likely that populations were significantly larger prior to those treatments. Because some of those treatments are returning to sagebrush habitat, they will assist in maintaining local populations. Therefore, it is assumed that maintaining currently available habitat amounts and quality will sustain a 2003 population size and distribution into the future.

Implementing the habitat enhancement and restoration guidelines in the Plan will contribute to the quality and total area of habitat over the long-term and will assist in maintaining or enhancing the abundance and distribution of sage-grouse in Vale District BLM.

There is potential for population trends in the area to be influenced by management outside of Oregon. The extent to which management practices (i.e., population and habitat) influence shared populations with Idaho and Nevada is unknown.

Actions

3.1. Monitor trends as described in Action 1.1.

3.2. Collect movement data to evaluate connectivity with populations in Idaho and Nevada.

3.3. Monitor distribution as described in Action 1.6.

3.4. Use the trigger for population rate of change as indicated in 1.4 to consider management actions.

3.5. Coordinate with land managers to address land use issues that may be affecting populations.

3.6. Identify lek complexes that could serve as source populations for intra- and interstate translocation projects.

(c) Burns District BLM: maintain or enhance greater sage-grouse abundance and distribution at the 2003 spring breeding population level, approximately 4,300 birds.

Assumptions and Rationale

Since 1981, population size has fluctuated around the 2003 estimate; however, the 2003 population is likely smaller than in earlier periods (1980 and earlier), but data are limited.

Therefore, it is assumed that maintaining currently available habitat amounts and quality will sustain a similar population size and distribution into the future.

Implementing the habitat enhancement and restoration guidelines in the Plan will contribute to the quality and total area of habitat over the long-term and will assist in maintaining or enhancing the abundance and distribution of sage-grouse in Burns District BLM.

There is potential for population trends to be influenced by management outside of Oregon. The extent to which management practices (i.e., population and habitat) influence shared populations with Nevada is unknown.

Actions

4.1. Monitor trends as described in Action 1.1.

4.2. Collect movement data to evaluate connectivity with populations in Nevada.

4.3. Monitor distribution as described in Action 1.6.

4.4. Use the trigger for population rate of change as indicated in 1.4 to consider management actions.

4.5. Coordinate with land managers to address land use issues that may be affecting populations.

4.6. Identify lek complexes that could serve as source populations for intra- and interstate translocation projects.

(d) Lakeview District BLM: maintain or enhance greater sage-grouse abundance and distribution at the 2003 spring breeding population level, approximately 9,400 birds.

Assumptions and Rationale

Since 1981, population size has fluctuated around the 2003 estimate; however, the 2003 population is likely smaller than those of earlier periods (1980 and earlier), but data are limited.

Therefore it is assumed that maintaining the amount of currently available habitat will sustain similar population size and distribution into the future.

Implementing the habitat enhancement and restoration guidelines in the Plan will contribute to the quality and total area of habitat over the long-term and will assist in maintaining or enhancing the abundance and distribution of sage-grouse in Lakeview District BLM.

There is potential for population trends to be influenced by management outside of Oregon. The extent to which management practices (i.e., population and habitat) influence shared populations with Nevada and California is unknown.

Actions

5.1. Monitor trends as described in Action 1.1.

5.2. Collect movement data to evaluate connectivity with populations in California and Nevada.

5.3. Monitor distribution as described in Action 1.6.

5.4. Use the trigger for rate of change of populations as indicated in 1.4 to consider management actions.

5.5. Coordinate with land managers to address land use issues that may be affecting populations.

5.6. Identify lek complexes that could serve as source populations for intra- and interstate translocation projects.

5.7. Identify regions within the Klamath Basin that maybe suitable for reintroduction.

(e) Prineville District BLM: restore greater sage-grouse abundance and distribution near the 1980 spring breeding population level, approximately 3,000 birds.

Assumptions and Rationale

Since 1980, population size has declined steadily (average –0.004%). Identifying a sustainable population size based on historic populations is difficult, because of the declining trend. This population objective is based on the apparent stability of Baker County sage-grouse population that is of a similar size (~2,000) and land status (public and private land).

The causes for population declines in this region are unknown but could be related to lack of genetic diversity, population isolation, land-use practices, recreation activities, and urban development.

Therefore, this Plan assumes that maintaining and/or increasing the amount of currently available habitat and increases in quality (enhancement and restoration) will assist in restoring populations and distributions in this region.

Implementing the habitat enhancement and restoration guidelines in the Plan will contribute to the quality and total area of habitat over the long-term and will assist in maintaining or enhancing the abundance and distribution of sage-grouse in Prineville District of BLM.

Actions

6.1. Monitor trends as described in Action 1.1.

6.2. Collect genetic and movement data to evaluate genetic diversity and the potential for open or closed populations in this region.

6.3. Monitor distribution as described in Action 1.6.

6.4. Use the trigger for rate of change of populations as indicated in 1.4 to consider management actions.

6.5. Coordinate with land managers to address land-use issues that may be affecting populations.

6.6. Identify lek complexes that may require population augmentation through a translocation.

Section IV. SAGE-GROUSE HABITAT IN OREGON

Historical Distribution and Abundance

Habitat for sage-grouse in Oregon prior to Euro-American settlement encompassed 7.2 million ha (17.7 million acres) of sagebrush throughout eastern Oregon (Figure 14). The conversion of sagebrush steppe to agricultural land in just the Columbia Basin of Oregon was responsible for an estimated loss of 750,000 ha (1.5 million acre) of sage-grouse habitat, nearly all of which is currently in private ownership. It is highly unlikely that habitat or populations can be restored in the Columbia Basin given the ownership and land use practices of this region. Sage-grouse habitat has diminished by 21% compared to pre-settlement conditions (Figure 1). The current range (5.7-6.2 million ha or 14.0-15.0 million acres) is not contiguous because of natural and artificial factors. For example, Malheur National Wildlife Refuge is largely a wetland complex except portions of the Refuge that provide brood habitat. Similarly, the Alvord Desert region of Harney County is largely a salt-desert shrub community with large alkali flats that do not provide suitable habitat. Additionally, wildfires and sagebrush conversion projects have reduced the amount of suitable habitat. The impacts of these disturbances will be discussed in greater detail in as they pertain to each BLM district. Although approximately 69,000 ha (171,000 acres) of potential habitat still exists in the Klamath Basin region and is included in the current range, there have been no confirmed observations of sage-grouse in that region since 1993 (Figure 1).

Numerous activities have impacted and potentially continue to impact distribution and quality of sage-grouse habitat. Additionally, natural events and human response to these events may have a direct impact on both sage-grouse and their habitat. A discussion of past and potential future impacts follows.

Agricultural Conversion

Permanent conversion of sagebrush to agricultural lands is the single greatest cause of decline in sagebrush-steppe habitat in the Columbia Basin (Quigley and Arbelbide 1997). In the northern half of eastern Oregon, large areas of sagebrush-steppe habitat have been converted to agricultural lands (Wisdom et al. 2002). Although sage-grouse will occasionally use agricultural lands (e.g., alfalfa) as late summer and late brood-rearing habitat, row crops and dryland cereal grains are generally not beneficial habitat (Swensen et al. 1987, Blus et al. 1989). In southeastern Oregon, most conversion occurred in the late 1800s to early 1900s, reached a threshold in the mid 1950s and has remained relatively unchanged since. However, the number of irrigated acres has increased slightly in some areas since the 1950s (Figure 15).

Sagebrush Conversion

Prior to the 1980s, herbicide treatment of large tracts of land (primarily using 2,4-D) was a common method of reducing sagebrush (Braun 1987). In addition to the loss of sagebrush the use of 2,4-D resulted in the decline of forbs (Miller and Eddelman 2001). In many cases, broad herbicide treatment may have contributed to declines in sage-grouse breeding populations (Enyeart 1956, Higby 1969, Peterson 1970, Wallestad 1975). A Utah study suggests this adverse

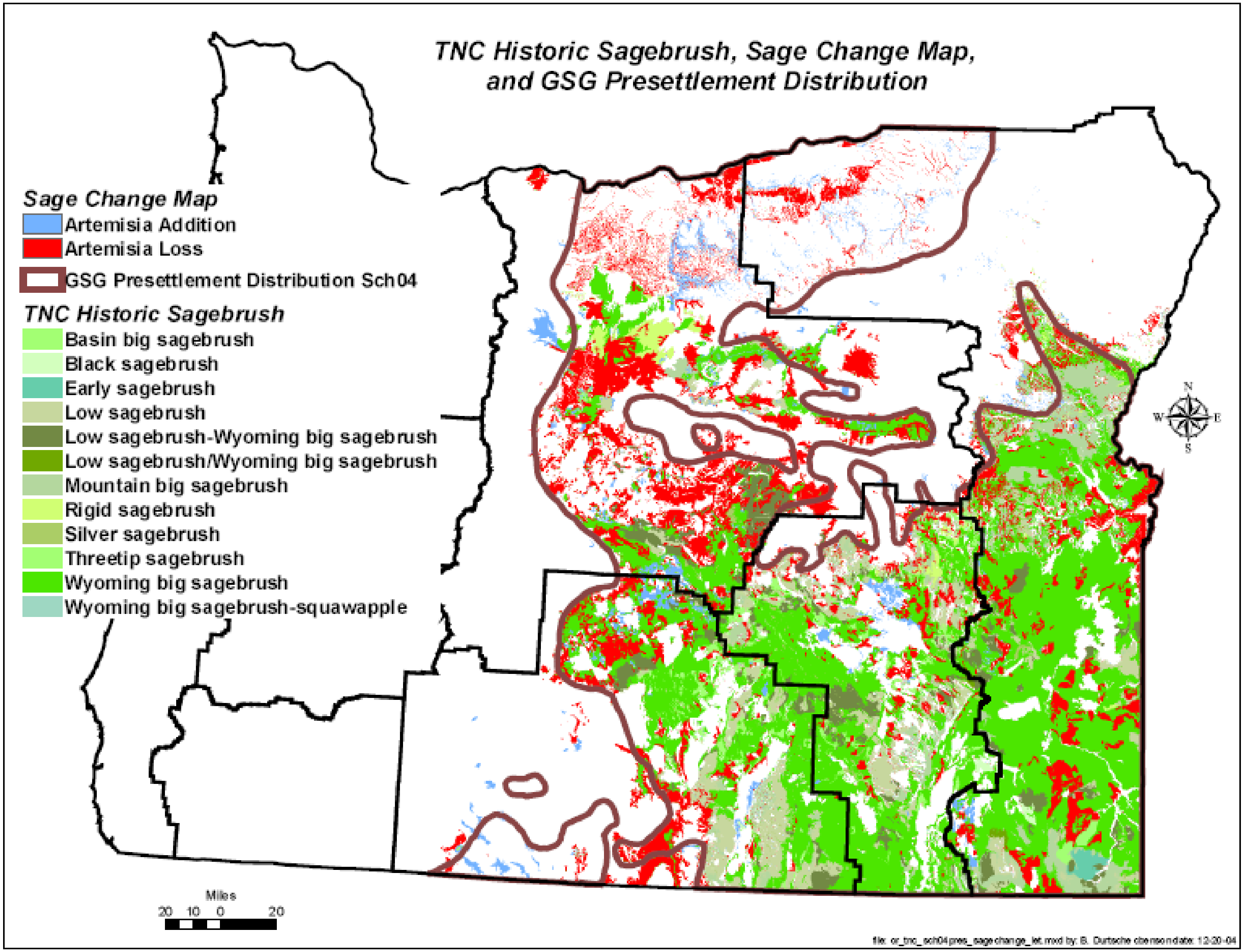


Figure 14. Changes in the distribution of sagebrush habitat in Oregon, where various shades of green indicate no change; red indicates loss, and light blue indicates gains of sagebrush (see website for color version).

impact on sage-grouse was compounded if the area was subsequently reseeded to crested wheatgrass (*Agropyron cristatum*) (Enyeart 1956). In Malheur County, for example, the Vale Project resulted in approximately 202,000 ha (500,000 ac) of sagebrush eradication projects for the benefit of livestock grazing (Willis et al. 1993). Approximately 50% of the treated area was reseeded with crested wheatgrass and various other grass mixes. Most of these treatments occurred on mild slopes in areas of moderately deep soil to deep soils which, based on current knowledge of sage-grouse, would have likely impacted breeding and winter habitats. While near monocultures of crested wheatgrass may be detrimental to sage-grouse habitat use in the short-term, it can be highly effective in stabilizing an area and reducing the risk of invasive annuals (e.g., cheatgrass). Moreover, sagebrush has been documented to re-colonize some of these seedings and return to usable sage-grouse habitat over the past 30 years (Kindschy 1991).

Reduced application rates of some herbicides (e.g., Tebuthiuron) may result in a dramatic increase in forbs and perennial grasses while retaining some sagebrush cover (Olson and Whitson 2002, Dahlgren et al. 2006). Such applications of Tebuthiuron have been documented to benefit sage-grouse in only one study (Dahlgren et al. 2006) and need to be carefully planned such that they do not result in severely depleted stands of sagebrush.

Mechanical treatments (mowing, plowing, chaining) of sagebrush have generally been more “local” or small in nature, but these too, have been known to adversely impact sage-grouse habitat if done on a broad scale (Swensen et al. 1987). Even small-scale projects to reduce sagebrush can be damaging if in the wrong location, for example, in winter habitat. However, mechanical treatments may enhance brood rearing habitats where such habitats have been degraded (Dahlgren et al. 2006).

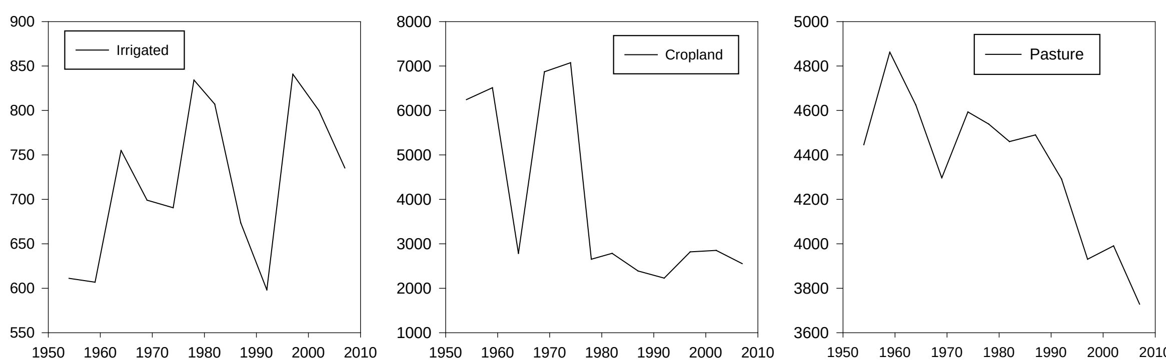


Figure 15. Changes in agricultural acreage for pasture land, cropland, and irrigated croplands, note the differences in scale on Acres (× 1000) axis. Change is calculated for sage-grouse counties in Oregon from 1954-2007 (USDA Agricultural Census data).

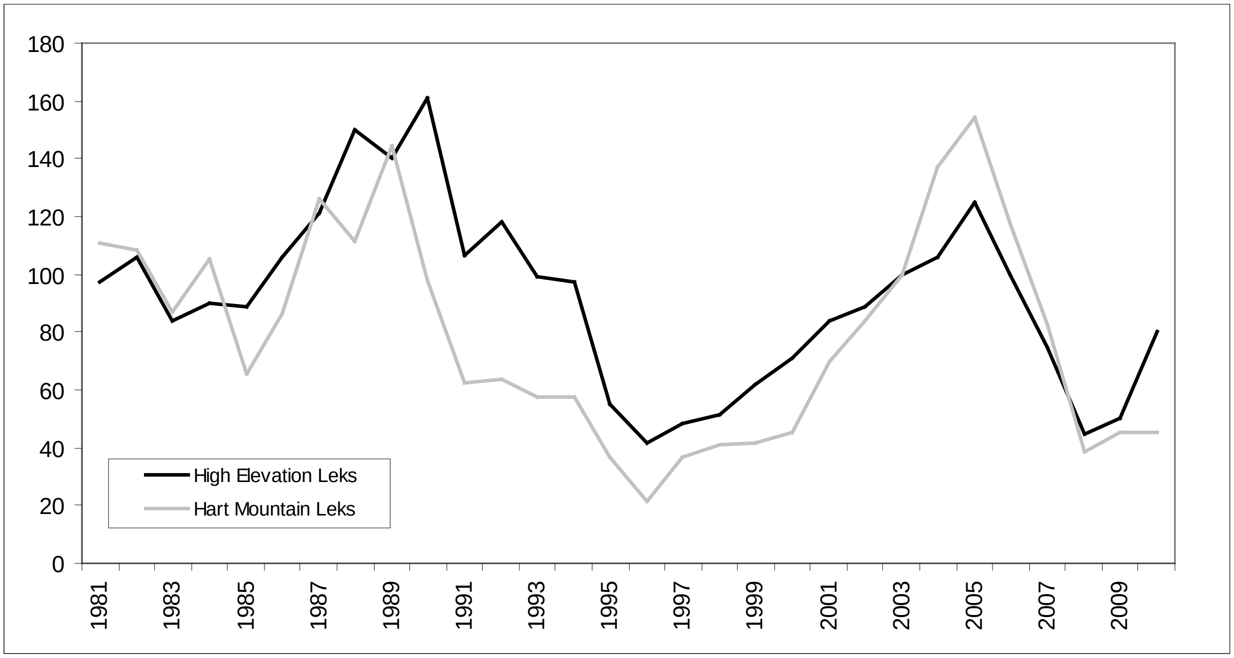
Wildfire has contributed to conversion of sagebrush communities into marginal or non-habitat (i.e., cheatgrass or medusahead grasslands). From 1980-2003, over 600,000 acres of sagebrush were affected by wildfire. Wildfire and juniper encroachment (2.8 million acres) are the two largest factors causing sagebrush habitat loss in Oregon. These factors are followed by invasive weeds.

Grazing
A variety of livestock management activities have altered sage-grouse habitat over the last century. Livestock facilities such as spring developments, water pipelines, and fencing have distributed livestock use over areas that were formerly only sporadically or lightly used by livestock. In many areas, excessive grazing has contributed to changes in plant community composition and structure and reduced certain habitat components which contribute to the health of sagebrush-steppe habitat (Mack and Thompson 1982, Wisdom et al. 2002).

Historical grazing practices.—Crawford et al. (2004: 10) provide a history of livestock grazing in sagebrush steppe,

> "Herbivory as a disturbance of sagebrush-dominated plant communities existed prior to the arrival of domestic livestock in sage-grouse habitat (Burkhardt 1996). However, the proliferation of domestic livestock in the latter 1800s represented a fundamental change in the diversity of dominant herbivores, and the timing, and selection pressures associated with herbivory (Miller et al. 1994). Historic grazing practices centered around season-long use with stocking rates far exceeding carrying capacity (Young and Sparks 1985). The net impact of these grazing practices on sagebrush-dominated plant communities was an increase in shrub abundance, a decrease in perennial grasses, and the proliferation of non-native annual grasses (Young et al. 1972, 1976). By 1900, cattle and sheep on western rangelands totaled over 30 million animals (Wagner 1978). Cattle and sheep AUM's on federal land have declined since the early 1900s (Council for Agricultural Science and Technology 1974, Laycock et al. 1996) and decreased more than 25% in the last 40 years (USDI-BLM 1990). Concurrent with reduced stocking of public rangelands has been measurable improvements in range condition during the latter half of the 1900s (Box 1990, Laycock et al. 1996)."

Recent grazing practices.—The effects of grazing on the structure and composition of sage-grouse habitat can be positive, negative or neutral and will vary with timing and intensity of use and a host of environmental factors. A positive impact of livestock grazing on sage-grouse habitat might be increased brood use of moderately grazed areas – as opposed to non-grazed or heavily grazed areas (Klebenow 1982, Dahlgren et al. 2006). A neutral impact could be the maintenance of perennial bunchgrasses with moderate levels of livestock utilization – i.e., as opposed to a reduction in heavily grazed areas (Miller et al. 1994, Bork et al. 1998, Stohlgren et al. 1999). There are indirect practical benefits to having ranchers on the landscape, such as rural fire associations and invasive weed control through early detection by ranchers. A negative affect could be a reduction in residual perennial grass cover at nesting sites, or reduction of sagebrush canopy cover or height in wintering areas (Patterson 1952, Klebenow 1982, Beck and Mitchell 2000). However, livestock removal does not necessarily result in large changes to sage-grouse populations. At Hart Mountain National Antelope Refuge where livestock have been excluded since 1995, abundance of sage-grouse have fluctuated similarly as they have elsewhere in Oregon (Inset 1). These fluctuations included a population decline that occurred at the same rate from 2007-2009 as other high elevation populations in Oregon over that time period (Inset 1).



Inset 1. Changes in greater sage-grouse populations at Hart Mountain National Antelope Refuge (gray line) and other sage-grouse populations (black line) at similar elevations (>1,500 m) as determined from lek count data, 1981-2010. Livestock removal occurred in 1995 near the lowest ebb in the cycle.

While moderate levels of livestock use are generally thought to be compatible with maintenance of perennial bunchgrass, the level of use which is sustainable varies strongly in accordance with a number of factors (Holocheck et al. 1999, Stohlgren et al. 1999). Generally, cool season bunchgrasses present across much of the sage-grouse range are most vulnerable to the effects of defoliation in late spring and early summer. Excessive grazing during this time can reduce cover and vigor of perennial grasses and increase opportunity for invasion of undesirable species. Some grasses (e.g., Indian ricegrass [*Oryzopsis hymenoides*] or Sandberg blue grass [*Poa nevadensis sandbergii*]) tolerate high levels of use whereas other species are more sensitive to grazing (e.g., Idaho fescue [*Festuca idahoensis*] or Thurber needlegrass [*Stipa thurberiana*]). Drought can increase adverse effects of livestock grazing on vegetation and soils (Vallentine 1990). In some instances, failure to make timely adjustments in livestock use during drought has resulted in limited plant regrowth, overuse in wet meadows and riparian areas, and has negated gains in rangeland conditions made during higher-precipitation years (Thurow and Taylor 1999).

Few research efforts have addressed the effects of livestock grazing on sage-grouse demography, and as a result, management and planning activities must rely on indirect evidence for guidance.

Feral horses and burros.– A recent review by Beever and Aldridge (2011) summarizes potential effects of grazing by herds of free-roaming equids on sage-grouse habitats. Additionally, feral horses may serve as a vector for the spread of WNv in sagebrush habitats. The magnitude and extent of impacts from free-roaming horses and burros to sage-grouse habitats will vary according to a variety of biotic and abiotic factors (e.g., soil type, elevation, precipitation, seasonality of grazing). However, Beever and Aldridge (2011) summarize equid induced changes to sagebrush and other vegetation communities that support sage-grouse to include: reduction in grass abundance and cover, reduction in ant hills (an important food source for grouse), increased soil compaction, increase in unpalatable forbs, greater fragmentation of shrubs, and less shrub cover. Beever and Aldridge (2011) conclude that the influence of feral equids on sage-grouse habitat is likely to be negative but the scale of the effect warrants further study. The following conservation actions are offered: 1) long-term conservation objectives should consider the appropriate management level of feral equids that can be maintained in conjunction with other authorized multiple uses, 2) have spatially explicit management goals as to where and when feral equids will occupy public land, 3) continue extensive research on immunocontraception as a method to manage herd sizes, and 4) consider herd reductions during drought periods to reduce the impact on the ecosystem (Beever and Aldridge 2011).

Riparian Areas/Wetlands

Historic management of riparian areas and wetlands (playas are included as wetlands) within sage-grouse habitat has led to degraded ecological function. Stream channels and wetlands have been degraded, channelized, dredged and filled, resulting in the loss of connectivity between the stream channels and the flood plains. This de-watering has led to site desiccation and a loss of associated riparian/wetland plant communities. However, these habitat types have become a priority for restoration , resulting in considerable improvement in habitat quality (e.g., Trout Creek Mountains). Sage-grouse adults and chicks depend on high quality forage (e.g., forbs) in these riparian/wetland areas during the late growing season when upland communities have desiccated (Savage 1968, Oakleaf 1971, Crawford et al. 2004, Gregg and Crawford 2009). Chick survival has been identified as one of the greatest limiting factors for sage-grouse populations (Johnson and Braun 1997, Holloran 2005, Walker 2008). Research suggests that when sage-grouse are forced to transition to a fall/winter diet of sagebrush earlier in the season during drought years, sage-grouse chicks have lower survival (Drut et al. 1994). In effect, riparian/wetland areas help fill the needs of a protein rich diet of forbs and insects before they change to a diet of sagebrush leaves during winter.

Recreation

The impacts of recreational activity on sage-grouse habitat have been poorly documented in the literature. However, displaying males or visiting female sage-grouse have been known to abandon lek sites frequented by birdwatchers and photographers who observe and photograph at distances not tolerated by the birds (Call 1979). Off highway vehicle (OHV) use also may be detrimental to sage-grouse breeding or nesting activities if the timing and intensity of the activity conflicts with sage-grouse use of those areas. Intensive off-trail OHV use may cause nest abandonment, if laying or incubating females are flushed from nesting locations. Previous work on sage-grouse indicates that it is one of the most sensitive grouse species with respect to abandoning a nest once disturbed (Patterson 1952).

Climate Change

Global climate change models project more variable and severe weather events, higher temperatures, drier summer soil conditions, and rainier winter seasons across much of sage-grouse range (Miller et al. *in* press). Projected changes in climate regimes for the sagebrush biome may influence sage-grouse conservation both directly and indirectly (Neilson et al. 2005, Schrag et al. 2010). While there are differences in the future projections as to the change in distribution and abundance of sagebrush there are some commonalities among various studies (Perfors et al. 2003, Poore et al. 2009). Sagebrush tends to occur in cold dry areas characterized as "continental" exhibiting hot temperatures during summers and recurring hard frosts each winter (Neilson et al. 2005). Most precipitation occurs in the form of snow, and results in plant communities that are frost tolerant and dependent on deep soil moisture to sustain them over the dry summers. Generally, these conditions enable sagebrush to out-compete shallow rooted herbaceous vegetation, and limit the expansion of woody vegetation (e.g., juniper, pinyon pine). Thus, as changes in temperature and timing and type of moisture occur plant community composition and distribution are projected to change commensurately.

Most climate change projections predict an overall decrease in sagebrush distribution as increases in the mean daily temperature and summer precipitation reduce the competitive advantage of sagebrush over the herbaceous component (Schwinning et al. 2005). Additionally, projections strongly suggest a northern latitudinal and higher elevational shift in sagebrush distribution (Bachelet et al. 2001, Shafer et al. 2001, Neilson et al. 2005, Schrag et al. 2010). The mechanisms for the change will likely occur from the synergistic interactions of increased temperatures, elevated carbon dioxide, and changes in periodicity and abundance of precipitation.

Increases in temperature may have the most significant impact to the sagebrush biome as frost sensitive woody vegetation from southern deserts would advance northward (Shafer et al. 2001, Neilson et al. 2005, Schrag et al. 2010). Woodland encroachment can potentially distribute in two different directions. Under an increased precipitation and temperature regime woodlands would expand from higher elevations down into lower basins. Under a decreased precipitation and increased temperature, woodlands may shift upwards in elevation and frost sensitive desert shrubs may invade sagebrush communities (Neilson et al. 2005). As woodlands increase so will fuel loads. This combined with a general drying out of the western rangelands will increase the risk of catastrophic wildfires (McKenzie et al. 2004). The risk of wildfire is further exacerbated by the predicted increase of annual grasses under elevated carbon dioxide levels (Miller et al. 2011). Thus, some of these woodlands may quickly convert to annual grasslands (Miller et al. 2011) resulting in an overall reduction (50-80%) of the sagebrush biome (Neilson et al. 2005).

Elevated temperatures may indirectly affect sage-grouse by prolonging summer period where the transmission risk of West Nile virus (WNv) is substantially increased as grouse seek mesic sites for forage and water (Schrag et al. 2010). Under elevated temperature regimes WNv exposure period would increase for at least another month starting in June of each year and extending well through August. Projections suggest a westward and higher elevation expansion of WNv transmission.

Other Land Uses

Commercial or industrial developments (i.e, energy development and transmission) have had varied but generally negative impacts on sage-grouse demography and habitat use (Naugle et al. 2011). Currently, there is a paucity of specific information about the effects of renewable energy development on sage-grouse ecology. Thus, understanding the impacts of habitat fragmentation is largely derived from studies of transmission line construction, and oil and natural gas exploration in areas of the intermountain West. A recent review of known impacts of wind energy and sage-grouse documented individual birds or flocks of birds in close proximity to wind turbines (Johnson and Holloran 2010). This review only documented behavior of individual birds and did not demonstrate population level impacts in a rigorous pre and post construction experimental design.

Generally, oil and gas developments within 2-4 miles of leks and/or nesting areas had deleterious effects on populations (Lyon and Anderson 2003, Holloran 2005, Walker et al. 2007). Oil and gas fields may differ in overall vertical structure and vehicle traffic compared to renewable energy developments, but they are similar from the standpoint that roads and infrastructure fragment native habitat. They also differ in that oil and gas fields expand over time and well density may change over time, whereas wind energy developments are constrained by a set density of wind turbines that is established during the planning phase, and that density is realized quickly during construction of the facility.

Sage-grouse feed exclusively on sagebrush during winter months, and this habitat is limited by its availability above the snow pack. Windswept ridges that keep sagebrush exposed during the winter may be prime sites for wind energy development. Because sage-grouse are dependent on sagebrush for winter forage, loss of winter habitat can have severe impacts on survival and subsequent breeding population size (Swenson et al. 1987, Connelly et al. 2004). Recent work on coal-bed methane development indicates 3 wells per 1.5 sections of land diminishes the use of otherwise suitable sage-grouse winter habitat by 10% and with 22 wells use is diminished by 47% (Doherty et al. 2008). The latter figure (22 wells / 988 acres) is likely similar to some of the densities observed for placement of wind turbines (BLM 2010). Alternatively, geo-thermal developments would likely have lower well densities (1 well/ 3 mi^2) than typical oil and gas fields. No data were available to assess how a solar array may impact sage-grouse habitat.

Yearling males avoid leks in developed areas and are displaced to the periphery of gas fields. Recruitment of males to leks also declines the closer a lek is to the center of a development (Holloran et al. 2007, 2010). Perhaps the most important finding from these studies is that sage-grouse declines are partially explained by lower annual survival of female sage-grouse, and those impacts have resulted in population-level declines. Strong site fidelity and reduced survival of adult sage-grouse combined with lek avoidance by yearling birds may explain the observed time lags of three to four years between development activities and loss of lek attendance (for more details see Holloran 2005, Holloran et al. 2005, 2010; Walker et al. 2007).

Transmission lines – Perching on power poles and transmission structures increases a raptor or corvid's range of vision, allowing for greater speed and effectiveness in searching for and acquiring prey (Steenhof et al. 1993, Manville 2004). Increased abundance of raptors and corvids within occupied sage-grouse habitats may result in predation rates outside the range of natural variation (Lammers and Collopy 2007, Coates 2007). Population level impacts to sage-grouse populations have been mixed (Washington Dept of Fish and Wildlife 2008, Johnson et al. 2011)

Transmission structures may also provide nesting sites for corvids and raptors in habitats with low vegetation and relatively flat terrain. Thus, these birds may preferentially seek out transmission structures in areas where natural perches and nesting sites are limited.

For example, within one year of construction of a 372.5 mi transmission line in southern Idaho and Oregon, raptors and common ravens (*Corvus corax)* began nesting on the support structures, and within 10 years of construction 133 pairs of raptors and ravens were nesting on the transmission structures (Steenhof et al. 1993). Additionally, corvids increased use in areas close to turbines in England (Devereux et al. 2008). Raptor observations have remained stable over a 5 year period after construction of a power line in Nevada, but common ravens have increased >200% (Atamian and Sedinger 2007).

Case studies **–** Golden eagle (*Aquila chrysaetos*) predation of sage-grouse increased from 26% to 73% (of the total predation) after a transmission line was constructed within 220 yd of an occupied lek in northeastern Utah (Ellis 1984). The lek was extirpated, and Ellis (1984) concluded that the presence of the transmission line resulted in changes in sage-grouse dispersal patterns and fragmentation of the habitat. In Washington, 95% (19 of 20) of leks ≤4.7 miles from 500 kV transmission lines are now unoccupied, while the unoccupied rate for leks >4.7 miles is 59% (22 of 37 leks; Washington Department of Fish and Wildlife 2008). Leks within 0.25 miles of new power lines constructed for coalbed methane development in the Powder River Basin of Wyoming had significantly slower growth rates compared to leks further from these lines, which was presumed to be the result of increased raptor predation (Braun et al. 2002).

The presence of a power line may fragment sage-grouse habitats even if raptors are not present. Braun (1998) found that use of otherwise suitable habitat by sage-grouse near power lines increased as distance from the power line increased for up to 660 yd. The report also noted, based on unpublished data, the presence of power lines may limit sage-grouse use within 0.6 miles in otherwise suitable habitat. Similar avoidance behavior has been documented in closely related species such as greater (*Tympanuchus cupido*) and lesser prairie-chickens (*Tympanuchus pallidicinctus*), where habitats within 1 mile of power lines were avoided (Hagen et al. 2004, Pitman et al. 2005, Robel et al. 2005, Pruett et al. 2009).

DEFINING SAGE-GROUSE HABITAT USE

Sage-grouse use large landscapes, often traveling over vast areas to fulfill various seasonal habitat requirements (Doherty et al. 2010). Sage-grouse require specific vegetation types and/or structure to meet daily nutritional and protection needs, and are a multi-scale species that will require innovative approaches to management strategies and techniques. For the purposes of this document **broad-scale management** includes actions at the state or interstate level; BLM districts and/or planning areas within a district are considered **mid-scale;** pastures (allotments) are **fine-scale**; and **site-level** would include an ecological site (Karl and Sadowski 2005). The integration of multi-scale management will be discussed, but the definitions of scale are pertinent to the material in the following paragraphs. This section describes some of the basic habitat requirements of Oregon sage-grouse and provides an assessment of habitat availability at the state (broad-scale) and BLM district scales (mid-scale).

Limitations to Vegetation Information

Vegetative characteristics of sage-grouse habitat have been described primarily from Hart Mountain National Antelope Refuge (HMNAR), Steens Mountain, and Beatys Butte regions. However, additional work has been conducted by BLM in Deschutes and Crook counties (Hanf et al. 1994, Bruce 2008, Freese 2009), and ODFW conducted a study on winter ecology that included Jordan Valley, Jack Creek, and HMNAR (ODFW unpublished data). The following descriptions summarize vegetative characteristics of nesting, brood-rearing and winter habitats in Oregon. Characteristics of leks were excluded primarily because lek sites are not limiting to populations and the descriptions in Section II also pertain to Oregon. Most vegetation measurements and characterizations have been stratified by sagebrush cover type, which is important when comparing to other states or to established guidelines (Connelly et al. 2000b).

There has been a debate as to the appropriate scale at which to apply the management guidelines developed by the Western Association of Fish and Wildlife Agencies (Connelly et al. 2000b). It would appear that the guidelines were developed for patch scales but monitoring and evaluation techniques are often conducted at the community scale (Bates et al. 2004, Schultz 2004). There is a limitation: the sub-sampling scheme around nest sites (e.g., perpendicular 10 m [32.8 ft] transects centered over the nesting shrub) may reflect an accurate assessment of canopy cover at the nest site. The nest site scale (i.e., patch scale) may overestimate shrub cover relative to measurements at larger scales (e.g., community scale), making it difficult to use cover values generated at the nest site to imply appropriate cover values at larger scales (Hagen 1999, Bates et al. 2004). The implication is that allotment and pasture estimates would be similarly affected. Bates et al. (2004) also report highly variable estimates of shrub, forb, and grass cover in relatively undisturbed Wyoming sagebrush communities, suggesting that managing for an average cover at a 10 m scale may be inherently difficult. In an attempt to alleviate some of these problems, the data for Oregon studies are summarized by “nesting area” (as opposed to nest site or nest shrub), which is the vegetation outside a 3 m^2 (32.3 ft^2) area around the nesting shrub (Gregg 1991, Hanf et al. 1994). This approach does not entirely alleviate the problem of over-estimation by perpendicular transects, it removes the core of redundant sampling at the nest site, and describes the vegetation at a slightly larger scale.

General Description

Call and Maser (1985) summarized characteristics of quality sage-grouse habitat in Oregon as sagebrush steppe at elevations of 1,220 to 2,438 m (4,000 to 8,000 ft) with annual precipitation of 25 to 38 cm (10 to16 in) and rolling topography with slopes generally less than 30%. Altitudinal migrations by sage-grouse have been documented in Oregon (Batterson and Morse 1948). Such movements occur as herbaceous plants of lower elevations desiccate in late spring and grouse move from the valleys and into the mountains. Call and Maser (1985) indicated that grouse likely occur in sagebrush areas outside of the documented elevation and precipitation gradients but numbers were lower in these sub-optimal conditions.

Freese (2009) developed predictive models of breeding and summer use areas on the GI Ranch in eastern Crook County. Habitats used by sage-grouse during the breeding season were best predicted by areas of 1,400 – 1,450 m in elevation, containing low and mountain big sagebrush communities (both with <5% juniper cover), slopes <20% and little topographic relief (ruggedness index <0.1). Habitats used by sage-grouse during summer were best predicted as areas of 1,400 –

1,625 m in elevation, within 2 miles of a lek, and a mix of cover types which included; low sagebrush, mountain big sagebrush, a mix of intermingling low and mountain big sagebrush, mountain big sagebrush-bitterbrush, and grey rabbitbrush. Sage-grouse generally selected sagebrush habitats with <5% juniper cover versus those exceeding 5% cover. Distance to mesic habitats (i.e., "green distance") was also an important predictor of summer habitat use.

Table 11. Summary of sage-grouse nest site characteristics stratified by study area and sagebrush stand type: LS = low sagebrush, MBS = mountain big sagebrush, mountain shrub, MXD = mixed shrubs, WBS = Wyoming big sagebrush, and ALL = stand types not differentiated in study. All values reported are canopy coverage estimates (%).

			Canopy Cover of Vegetation Type (%)			
Study Area[a]	Cover type	*n* (# nests)	Low shrub (<40 cm)	Mid shrub (40-80 cm)[d]	Tall grass (>18cm)[e]	Key forbs[e]
Beatys	LS	8	26.4	2.9	8.1	3.6
	MBS	6	12.6	17.8	17.4	3.2
HMNAR	LS	7	16.0	5.0	17.0	7.0
	MBS	27	13.0	18.0	12.0	11.0
	MS	5	12.0	12.0	19.0	10.0
Jackass	LS	19	29.0	2.0	9.0	10.0
	MXD	12	19.0	7.0	11.0	6.0
	WBS	19	7.0	13.0[d]	14.0	11.0
Prineville	ALL	20	9.0	11.0	17.0	4.0
Pooled[b]	LS	34	25.7	2.8	10.7	9.0
	MBS	33	12.9	18.0	13.1	11.1
	OTH[c]	69	11.5	13.5	14.2	8.7

[a] The study areas statistics come from the following sites: Beatys = Crawford and Carver (2000), HMNAR (Hart Mt. National Antelope Refuge) and Jackass = Gregg (1991), and Prineville = Hanf et al. (1994).
[b] Pooled estimates are a weighted mean within a habitat type.
[c] OTH = a weighted mean across all habitats except for low sage.
[d] Tall shrub category was excluded because in most studies it was ≤4%, and was 4% at Jackass Creek.
[e] Canopy cover was only differentiated between grass stature and forb type in Crawford and Carver (2000), all other estimates are total canopy cover of grasses and forbs.

Nesting

Sage-grouse nest in a variety of cover types, but most nests are under sagebrush. Other shrubs used for nesting cover include bitterbrush, greasewood (*Sarcobatus vermiculatus*), horsebrush (*Tetradymia* spp.), low sagebrush, mountain mahogany (*Cercocarpus* spp.), rabbitbrush, shadscale saltbush (*Atriplex confertifolia*), snowberry, and western juniper (*J. occidentalis*).

Nests also have been found on bare ground devoid of cover under basin wildrye (*Leymus cinereus*). The most suitable nesting habitat includes a mosaic of sagebrush with horizontal and vertical structural diversity. A healthy understory of native grasses and forbs provides 1) cover for concealment of the nest and female from predators, 2) herbaceous forage for pre-laying and nesting females, and 3) insects as prey for chicks and females.

Vegetative cover near nesting areas was comparable to other studies throughout sage-grouse range (Table 11) and mid-sized shrubs (40-80 cm) generally comprised >13% canopy cover with the exception of low sagebrush stands. Low sagebrush stands had shrub canopy cover >25% but was lower in stature (<40 cm). Combined grass and forb cover were >16% and in most cases >19%; however, the vertical structure of herbaceous cover was not measured in most studies. Mountain big sagebrush (MBS) communities tended to have greater mid-shrub and herbaceous cover than low sage (LS) or Wyoming big sagebrush (WBS) stands.

Table 12. Summary of canopy cover estimates for sage-grouse brood rearing habitats in Oregon. The data are stratified by study area, brood rearing stages early (≤6 weeks post hatch) and late (7 to 12 weeks post-hatch), and by sagebrush stand type: LSBB = low sage blue-bunch wheatgrass, LSBF = low sage fescue, LS = low sage, MXD =mixed shrubs, WBS = Wyoming big sage, and MBS = mountain big sage. All values reported are canopy coverage estimates (%).

			Canopy cover estimates (%)				
Brood stage / area[b]	Cover type	*n*	Key Forbs	Non-key Forbs	Short Grass[a]	Low shrub (<40 cm)	Mid shrub (40-80 cm)
Early							
HMNAR	LSBB	14	2.0	7.0	10.0	21.0	0.0
	LSBF	46	3.0	12.0	16.0	22.0	0.0
	MBS	27	3.0	14.0	15.0	18.0	9.0
Jackass	LSBB	44	7.0	14.0	8.0	25.0	1.0
	MXD	23	5.0	14.0	9.0	21.0	6.0
	WBS	16	1.0	10.0	10.0	5.0	15.0
Late							
HMNAR	LSBF	15	4.0	19.0	17.0	19.0	0.0
	MBS	21	4.0	19.0	16.0	17.0	14.0
Jackass	LSBB	7	1.0	3.0	3.0	36.0	0.0
	MXD	7	5.0	12.0	9.0	13.0	12.0
	WBS	18	3.0	9.0	11.0	5.0	14.0
All							
Beatys	LS	42	4.6	9.6	13.8	13.0	0.4
	MBS	42	4.6	8.2	11.1	3.2	17.7
Pooled[c]	LS	124	5.9	15.9	16.8	28.1	0.5
	MBS	90	4.0	12.5	13.4	10.9	14.2
	OTH	154	3.8	12.0	11.9	11.2	13.0

[a] Height of grass was differentiated only in the Beatys study area.
[b] HMNAR (Hart Mountian National Antelope Refuge) and Jackass data came from Drut (1992), and Beatys from Crawford and Carver (2000).
[c] Pooled estimates were calculated as a weighted mean within a stand type, OTH = all types except for low sage stands.

Brood-rearing

Female sage-grouse with broods seek out mesic sites for foraging especially later in the season as lower elevation sites begin to desiccate. Brood-rearing habitat in Oregon typically has >15% forb cover (Table 12). Studies have differentiated between "key forbs" and "non-key forbs" with the latter typically comprising most of the forb cover. Low and mid-shrub cover was slightly less in brood areas than in nesting areas (Tables 11&12), but typically was > 11%. However, there was less total shrub cover at brood areas (25%) than nest areas (33%) in mountain big sagebrush stands (Gregg 1991, Drut 1992, Hanf et al. 1994, Crawford and Carver 2000). Chick survival appeared to be linked to the availability of insects (Lepidoptera: caterpillars) and forbs (slender phlox) in south central Oregon and northern Nevada (Gregg and Crawford 2009). Alfalfa and hay fields may be used by sage-grouse when proximate to nesting and early summer habitats (ODFW, unpublished data).

Table 13. Sagebrush canopy coverage (%) and height (cm) at sage-grouse winter use sites in Oregon. Data are stratified by sagebrush stand type: BSB = big sagebrush, SSB = silver sagebrush, LS = low sage, LSMX = low sage and mixed shrub, Mosaic = low sagebrush with inclusions of big sagebrush, CRWS = crested-wheatgrass seeding, and grassland = native grassland.

	Study Areas[a]								
	HMNR		Jackass		Jordan Valley		Prineville[b]	GI Ranch[d]	
Cover type	% Cover	Ht (cm)	% Cover	Ht (cm)	% Cover	Ht (cm)	% Cover	2007 % Cover	2008 % Cover
BSB	8.7	46	10.2	57.4	5.0	54.1	15.5	3.7	2.1
SSB	ND	ND	ND	ND	ND	ND	17.0[c]	1.1	0.1
LS	7.2	27.6	8.5	24.2	4.8	30	12.5	19.7	2.1
LSMX	7.1	24.3	6.2	27.1	3.5	33.5	ND	ND	ND
Mosiac	6.9	28.7	9.1	36.8	6.4	43.4	ND	ND	ND
CRWS	ND	ND	ND	ND	3.1	34.6	ND	ND	ND
Grassland	ND	ND	ND	ND	ND	ND	4.0[c]	ND	ND
Rabbitbrush	ND	ND	ND	ND	ND	ND	ND	4.4	0.1

[a] HMNR (Hart Mountain National Antelope Refuge), Jackass and Jordan Valley measurements were from Willis (1990), GI Ranch from Bruce (2008) and Freese (2009), and Prineville data from Hanf et al. (1994).

[b] Shrub height was not recorded by Hanf et al. (1994).

[c] SSB and grassland were used only during the mild winter of 1991-92, BSB and LS were averaged across the 2 winters only differing by 1 percentage point.

[d] Shrub height was recorded as an average for all shrub species in a plot and averaged 43.1 and 42.8 cm in 2007 and 2008, respectively. Cover measurements were estimated using different methods in each year.

Winter

Shrub cover can be relatively sparse in winter habitats (Table 13). Harsh winters can alter habitat availability as has been documented with radiomarked sage-grouse in Oregon (1992-1993) and (2008-2009). Extreme winter conditions can affect survival of sage-grouse (Anthony and Willis 2009). Winter use sites in harsher years had greater shrub canopy cover in southwest Crook and east Deschutes counties (Hanf et al. 1994). However, there was little difference in vegetation structure between 2 winters of varying severity on GI Ranch (Bruce 2008, OSU, unpublished report). Typically shrub cover and height is not limiting in winter habitat except for years of greater than average snowfall. Even in these more extreme winters sage-grouse may continue to use low sagebrush as it is often windswept and relatively free of snow (Lakeview BLM Distict, unpublished data). Shrub cover values and heights in Oregon are similar to those found elsewhere, except perhaps for the usage of low sagebrush types with canopy cover <10%.

BROAD AND MID-SCALE HABITAT ASSESSMENTS

The objectives of this assessment are: 1) describe the change in sagebrush habitats from the late 1800s to present, 2) provide descriptive statistics as to the landcover types in sage-grouse habitat, 3) examine the cumulative effects of fire, seedings, juniper, agriculture, and natural variability that may compromise the continuity of sage-grouse habitat, and 4) evaluate the risks and opportunities for habitat conservation in Oregon based on land ownership and habitat type. A summary of habitat conservation efforts that have been accomplished since 2005 is included in the Implementation Section of the Plan. Following the *Population Status* section, these assessment units for habitat availability were based on BLM district boundaries.

Changes in Sage-Grouse Habitat

Historic and current sagebrush habitat maps were developed using geographic information system (GIS) data and analyses. Historic sagebrush habitats were determined from the Oregon Natural Heritage Program's Pre-settlement Vegetation Map (Tobalske 2002). This map was largely based on notes of Land Surveyors from the mid- to late 1800s, and supplemented with current soils information. Any vegetation type that included an *Artemisia* spp. was considered as historic sage-grouse habitat. Current sagebrush habitat was from the USGS coverage referred to as SAGESTICH, which is a comprehensive GIS database covering most of the western states that have sage-grouse populations. The current vegetation map was subtracted from the historic map and the difference indicates changes in sagebrush habitat over time (Figure 14). Juniper expansion was estimated by comparing Tobalske's (2002) historic vegetation map and Oregon GAP land cover.

The assessment of current conditions for the state (broad-scale) and BLM districts (mid-scale) was conducted using a composite data set. This included the combination of the 1991 National Land Cover Data (NLCD) with the SAGESTICH coverage. Briefly, NLCD has finer resolution (30 m) than SAGESTICH (90 m), but the latter has greater detail with respect to vegetation types. For example, NLCD only identifies shrubland whereas SAGESTICH classifies the type of shrubland vegetation (e.g., sagebrush vs. rabbitbrush). The combination of the 2 resulted in a more detailed map. Additional layers were acquired from Oregon BLM that identified recent fires (>1980) and grass seedings (primarily crested wheatgrass) in Oregon. Based on this analysis current habitat status was delineated as follows:

1) Sagebrush,

2) Potential habitat,

3) Agriculture, and

4) Non-habitat.

Sagebrush includes all subspecies of *Artemisia* spp. that occur in Oregon. *Potential habitats* are recognized as sites that currently are *potentially* useful to sage-grouse but the extent of which is unknown, or sites that have been disturbed by various treatments (natural or artificial) and there is *potential* for a transition from its current state to sagebrush. While most *agriculture* is in private ownership and much of it might be considered "non-habitat," acres for this category were provided separately as there may be opportunities for partnerships with private landowners and NRCS (and Farm Bill funded projects) in the future. *Non-habitat* includes areas both naturally and artificially (and likely permanently) not suitable.

Potential habitats are sub-classified as *habitats* that are *potentially* useful to sage-grouse but the extent of which is unknown and include:

- Sagebrush/wetland mix,
- Sagebrush/hay mix, and
- Other shrub

or *habitats* that have *potential* to transition from a disturbance (natural or human-caused) to sagebrush and include:

- Grassland,
- Sage/juniper mix,
- Fire, and
- Seedings.

ANALYSIS OF CUMULATIVE EFFECTS

The long-term decline of sage-grouse is likely a result of the cumulative impact of the several previously identified risks. The objective of this analysis was to quantify the amount of remaining habitat and the extent of connectedness (or fragmentation) of that habitat with respect to cumulative impacts of disturbances. The approach used GIS to identify vulnerable and intact habitat regions, based on landscape level assessments of cumulative effects of habitat modifications and human-caused disturbance (e.g., power lines, roads), and the resulting map is referred to as a connectivity model. In this context, the term "model" was used as a description of the sagebrush system that accounts for its known habitat characteristics. Thus, at this stage future status of habitats was not projected or predicted with these models, although that may be an appropriate use (e.g., land-use or fire planning). The maps generated from this model visually and quantitatively depict areas of vulnerable and intact habitats. These maps will be useful for developing population and habitat objectives at state and local levels, as well as the type(s) of management actions that may be appropriate for a given area.

It is important to understand that connectivity maps DO NOT describe the habitat condition with respect to understory structure and composition of habitat blocks. Identifying these factors will be important to management and implementation groups, and likely would be an identified need in monitoring habitat (Appendix II). The habitat monitoring described will facilitate and complement this need in local areas on public lands.

Methods

Models developed to establish habitat objectives in the 2005 Plan are described below and retained for consistency in evaluating performance in meeting the stated objectives. However, a new set of maps have been developed using more recent GIS data-layers. The intent of the new maps is to ensure that the best available information is being used to evaluate current distribution of sagebrush habitats, plan land use actions, and assess future impacts.

Baseline Habitat Model from 2005

Development of the connectivity model (map) required 3 basic steps: 1) develop a baseline of current habitat status (referred to as habitat capability model), 2) estimate the amount of disturbance on the landscape from human developments (referred to as disturbance model), and 3) combine the 2 layers to develop a connectivity model. Model validation conducted in the field by recording the dominant cover type, using Global Positioning Systems (GPS) and photographs at random locations indicated that >80% of viability categories were accurately classified.

GIS and satellite imagery data was used from the *Changes in Sage-Grouse Habitat* (NLCD and SAGESTICH) and Oregon BLM fire maps as a baseline of current habitat capability (Appendix IV). Habitat capability was defined and ranked most-to-least capable of supporting sage-grouse from 1 to 4, respectively, based on 160 acre units. Within each 160 acre unit, the dominant cover type (>50%) determined the overall viability. For continuity the terms *sagebrush, potential and non-habitat* were used in conjunction with this analysis. *Sagebrush* habitats were ranked 1 (the highest), *potential habitat* was ranked 2, non-sagebrush shrublands and grasslands, all other native vegetation (comprised of both *potential* and *non-habitat*) were ranked 3, and *non-habitat*s (including bare rock, alkaline flats, and agriculture) were ranked 4, as least capable of supporting grouse. Each ranking was referred to as a level of *viability.*

- **High Viability** refers to areas of intact *sagebrush* habitat
- **Moderate Viability** refers to areas of *potential* sagebrush habitat
- **Low Viability** typically refers to native vegetation that is not likely sage-grouse habitat (e.g., forest types)
- **Negligible Viability** refers to habitat converted to agriculture or urban developments, and natural features such as bare ground or rock cliffs

The second step in this process was to delineate a disturbance model layer. This was comprised of roads, power lines, and urban or rural industrial developments; these disturbances downgraded otherwise viable habitat to negligible viability.

The synthesis of these two models reveals a broad- and mid-scale depiction of sagebrush and non-sagebrush areas throughout sage-grouse range in Oregon. A coverage of "land status" was used to describe ownership and management of sage-grouse habitats in the state.

Updated Habitat Maps

The updated maps were created from a simple raster geospatial model created to depict areas of potential juniper encroachment into sagebrush in Oregon. The model is based on reclassified Northwest GAP, Southwest GAP, and LANDFIRE existing vegetation type (EVT) land cover data. Of particular interest was improving mapping of juniper encroachment areas that were not well represented in the 2005 Baseline. Thus, in the updated maps land cover classes representing sagebrush cover types were combined into a single sagebrush class, and those representing juniper cover types (as defined in the land cover data used) were combined into a juniper class. The boundary between the two plant cover types was identified, and a neighborhood function was used to define a 120 meter buffer from the boundary into the sagebrush plant community group.

Additionally, slope and ruggedness indices were not used to rank sagebrush habitats as those filters tended to omit important and well documented sage-grouse habitats (e.g., Lookout Mountain, and Trout Creek Mountains) in the 2005 assessment.

Products

The resulting 2005 Baseline maps identify sets of priority areas with respect to maintenance of high (rank of 1) or moderate viability (enhancement areas; ranked = 2 or 3) areas across the state (broad-scale) and for each BLM district boundary (mid-scale). This ranking will facilitate management of sagebrush areas that cross administrative boundaries. Tabular data for each map included amounts of land-cover types within each habitat block and its ownership. Methods for maintaining or enhancing a particular region will be determined by the local implementation team, however some ideas are provided as to how this might be achieved (Section V). Updated maps and tabular data are provided (Table 17).

CURRENT TRENDS AND STATUS OF SAGEBRUSH HABITAT

Statewide Ownership and Management

Sagebrush habitats have been reduced by 21% in Oregon from the late 1800s (Table 14), most of which occurred in the north-central region of the potential historic habitat range (Figure 14). This analysis included all lands within BLM district boundaries east of the Cascades. Because this estimate was based on vegetation type instead of a coarse-grained range map, it is lower than previous calculations of 50% and 33% by Crawford and Lutz (1985) and Willis et al. (1993), respectively, The BLM is the primary land manager and administers most of the currently occupied sage-grouse habitat (70%) followed by private ownership (21%). Oregon Department of State Lands (DSL), U.S. Forest Service, and U.S. Fish and Wildlife Service combined have jurisdiction for 8% of the current habitat (Table A-3). The remaining <1% of current habitat is managed by other federal and state agencies. Clearly management activities on BLM land will have the largest impact on sage-grouse based on land area alone.

Habitat Connectivity
There were 3.7 million ha (9.2 million acres) classified as high viability in Oregon (Table A-4), 2.6 million ha (6.5 million acres) of which was administered by the BLM. An assessment of habitat connectivity using only those high viability habitat blocks that were >1,000 ha (2,500 acres) identified several areas of contiguous habitat (Figure 16). The two largest areas depicted in this map encompass >2.4 million ha (6.0 million acres). Despite the vast area of sagebrush that these regions cover, several areas within these remain contiguous only because of small and tenuous corridors. Both human-caused and natural barriers in Burns District BLM separate these 2 contiguous areas. From the statewide scale, it is evident that connectivity is limited between sage-grouse in the Baker Resource Area and northern Malheur County.

Table 14. Historic and current habitat (acres) of sage-grouse in Oregon as determined from The Nature Conservancy and Oregon Natural Heritage Program (2002) map of historic vegetation. Current sagebrush habitat was determined from the SAGESTICH map of Oregon.

Status	Assessment Area					
	Baker[a]	Burns	Lakeview	Prineville	Vale[b]	Total
Acres						
Historic	934,374	3,898,174	3,533,586	3,417,371	5,878,473	17,661,978
Current	771,134	3,554,844	2,935,542	1,798,738	4,917,529	13,977,787
Loss	163,240	343,330	598,044	1,618,633	960,944	3,684,191
% Change	–17.4	–8.8	–16.9	–47.4	–16.3	–20.9

[a] Includes sagebrush only within Baker County.
[b] Includes sagebrush in all areas of Vale District BLM Boundary except for Baker County.

Natural and Anthropogenic Disturbances
Statewide from 1980-2003, habitat identified as conversion from sagebrush to non-sagebrush communities was due a result of historic fire (259,201 ha [640,496 acres]) and non-native seedings (120,247 ha [297,135 acres]) (Table 15). Some of these areas have not been lost ecologically but are in a transitory state and likely will return to sagebrush habitat. Many of these acres likely were converted to grassland as a result of recent fires, and it will be several years before they return to sage-grouse habitat. Low elevation sites burned by wild or prescribed fire are especially susceptible to invasion of annual grasses and exotic weeds. Sage-juniper mix was ranked as the third largest disturbance (76,345 ha [188,651 acres]), but described only those areas where juniper and sagebrush habitats were adjacent to one another. Alternatively, juniper expansion has increased by nearly 2-fold in sage-grouse range (from 1.6 to 3.3 million acres), much of which has occurred in the Prineville region, since European settlement. To maintain connectivity of habitat and sage-grouse populations, efforts will be required to rehabilitate acres lost to conversion of exotic weeds and grasses, juniper encroachment, and seedings within the extant range of sage-grouse. Most sage-grouse habitat is grazed annually by wildlife and domestic livestock. Public land livestock grazing is based on prescribed forage utilization including some rest-rotation (or deferred rotation) systems. However, the number of authorized Animal Unit Months (AUMs) has been effectively reduced by 50% since 1940 from >1.1 million to 550,000 in 2003 (U.S. Department of Interior, Public Land Statistics 1941-2003).

Habitat Assessment Units
The current range of sage-grouse in Oregon occurs entirely within an area encompassed by 4 BLM Districts (Figure 1). The status of sage-grouse habitat was briefly summarized as the amount of remaining habitat, current ownership, risks, and types of habitat treatment or rehabilitation potential within each of the BLM districts. Because of the preponderance of private land and limited connectivity information, Baker County was summarized separately from that of Jordan and Malheur Resource Areas within the Vale District administrative boundary. These factors were assessed by BLM district administrative boundaries, because of the availability of habitat measures by district and BLM is a primary land manager within most of the district boundaries.

To describe the status of sagebrush, these data were summarized at 2 levels for each assessment area 1) within the entire administrative boundary and 2) within the current range of sage-grouse within in an administrative boundary. Both summaries were provided to depict the total area of sagebrush habitat remaining in eastern Oregon using entire administrative boundaries, and the total area of habitat available for sage-grouse to occupy within their current range. The former provides insights into unoccupied areas of sagebrush that may be targeted for translocations at some point in the future. The analysis within the current range provides a management focus for maintaining or enhancing populations and their habitats.

Updated Assessment Units
The geographic boundary of the Implementation Teams was used to delineate the updated habitat status. The boundaries were defined by combining BLM administrative boundary and current sage-grouse distribution map (Schroeder et al. 2004). The goal is to provide a characterization of habitat distribution and conservation opportunities and risks within each of the implementation regions.

Generally, the updated assessment maps provided similar results in terms of acres and proportional composition of habitat types. The largest difference was the estimated acres of juniper encroachment areas (sage-juniper). Based on these refined boundaries, 76% of the area (10.7 million acres) was in sagebrush types (Table 17). Potential habitat was comprised primarily of sage-juniper mixes (1.4 million acres), invasive grasses and forbs (1.1 million acres) and juniper (1.1 million acres) of presumably later seral stages (Phase II or III). Burned grasslands and shrublands only comprised 2% of the land area (250,000 acres).

Baker Resource Area
Administrative boundary.—Sagebrush habitat has decreased by 17%, much of which was lost due to conversion to agriculture. Currently the BLM administers 31% of sage-grouse habitat and 68% is in private ownership (Appendix IV, Table A-5). Contrary to other assessment areas in the state, steeper slopes (35% of the area) and rugged topography (13% of the area) reduced considerable amounts of sagebrush to moderate viability (potential habitat) in Baker County. Non-sagebrush shrubland occupied 22% of potential sagebrush habitat (Figure 17).

2005 status of habitat.—Eighty two percent (225,667 ha or 557,633 acres) of this region was comprised of sagebrush habitat. However, only 56,352 ha (139,247 acres: 25%) were ranked as high viability, which suggested that the area contained smaller and more fragmented habitats than other regions of the state (Table 16). This was especially true east of Baker City, where agricultural practices and recreational activities, may limit habitat suitability. In general this region is one of the most isolated from other habitat blocks (Figure 16). Much of this isolation is due to rugged and steep sagebrush terrain, and extensive forests. The area near Interstate-84 may serve as a migratory or dispersal corridor.

Current distribution and status of habitat.—Fifty nine percent (176,434 ha or 435,979 acres) of this implementation team area was comprised of sagebrush, and 88% of that appeared to be high viability habitat (Table 17). The assessment area boundary was larger in 2009 including parts of Union County, but the larger area estimated to have encroaching juniper reduced the availability of sagebrush from the 2005 estimate (Table 18). Invasive weeds and sage-juniper are the 2 largest risks to the estimated 435,979 acres of sagebrush in the Baker Implementation Area (Table 17).

Burns District

Administrative boundary.—Sagebrush habitat has decreased by 8.8% much of which was conversion of private land to agriculture (Table 14). Currently the BLM administers 73% of sage-grouse habitat (Appendix IV, Table A-6), and 22% is in private ownership. Similar to statewide patterns, potential habitat was largely a result of fire (9%), seedings (10%), and juniper encroachment (Table 15). Generally, sage-grouse habitat north of Highway 20 is most impacted by juniper encroachment, but higher elevation areas in the Steens Mountain region have also been impacted by juniper. Malheur National Wildlife Refuge is in the middle of this District, but it provides only a relatively small area of brood habitat along the eastern edge and southeast corner of the refuge.

2005 status of habitat.—Sagebrush habitats comprised 68% of this region (1,231,238 ha or 3,042,442 acres), most of which (80%) was ranked as high viability (Table 16). Reasonable habitat connectivity exists in this district (Figure 18) as evidenced by the inclusion of over half of the two largest contiguous areas of sagebrush in the state (Figure 16). Sagebrush areas north of Highway 20 are impacted from juniper and ponderosa pine encroachment (7%) and likely contribute to the fragmentation in this portion of the district. Natural features (e.g., Malheur and Harney Lakes) and conversion to agriculture impact sagebrush connectivity between the town of Burns and Steens Mountain.

Current distribution and status of habitat.— Sixty seven percent (1,236,629 ha or 3,055,778 acres) of this implementation team area was comprised of sagebrush, and 85% of that was high viability habitat (Table 17). Other shrub cover types encompassed a much larger area in 2005 than 2009, likely as a result of different land cover data (Table 18). Juniper and sage-juniper are the 2 largest risks to the estimated 3.1 million acres of sagebrush in the Burns Implementation Area (Table 17).

Table 15. Current habitat acres in five assessment areas of eastern Oregon, 2009. These are total acres for each assessment area, and includes areas of non-habitat (e.g., forests) to provide a complete profile of the habitat in these regions.

	Assessment Area											
Cover type	Baker	% [a]	Burns	%	Lakeview	%	Prineville	%	Vale	%	Total	% [a]
Sagebrush	595,948	62.1	3,109,217	67.1	2,920,710	60.0	2,906,517	42.7	5,869,863	60.6	15,402,255	56.9
Potential[b]												
Other shrub	257,900	26.9	889,298	19.2	1,384,876	28.5	3,234,631	47.5	2,686,001	27.7	8,558,172	31.5
Fire	-[c]	0.0	201,771	4.4	100,975	2.1	7[c]	0.0	337,750	3.5	640,496	2.4
Grassland	85,803	8.9	145,953	3.1	361,641	7.4	514,493	7.6	614,812	6.4	1,739,708	6.4
Seedings	-[c]	0.0	104,967	2.3	43,925	0.9	-[c]	0.0	139,186	1.4	297,135	1.1
Sage/juniper	1,484	0.2	79,364	1.7	13,487	0.3	93,431	1.4	1,998	0.0	188,651	0.7
Sage/wetland	820	0.1	29,079	0.6	10,322	0.2	2,599	0.0	9,241	0.1	51,309	0.2
Sage/hay	17,360	1.8	75,872	1.6	31,295	0.6	55,731	0.8	86,259	0.9	249,157	0.9
Subtotal	363,366	37.9	1,526,305	32.9	1,946,521	40.0	3,900,893	57.3	3,810,794	39.4	11,724,637	43.2
Agriculture	112,304		193,212		539,254		944,160		1,562,348		3,351,278	
Non-habitat	903,201		941,014		3,727,419		5,295,237		1,700,786		12,567,657	
Total[d]	1,974,817		5,769,747		9,133,904		13,046,807		13,120,551		43,045,827	

[a] Percent shown only of sagebrush and potential habitat total (i.e., what % of sagebrush and potential sagebrush is currently in a given condition).

[b]Potential habitat are those habitats that have some capability of transitioning to sagebrush or are potentially important to sage-grouse (e.g., interface of sagebrush and emergent herbaceous wetlands “sage/wetland”). In some cases this is not feasible, because the site has transitioned into a steady state and cannot return to sagebrush without considerable intervention (e.g., cheatgrass or mature juniper stands).

[c] Fire and seeding disturbance data were not available at the time of this report.

[d] Total acreage differs from Table 17 because the data in Tables 18 and 19 are a composite of SAGESTICH and NLCD, where Table 17 is based solely on SAGESTICH.

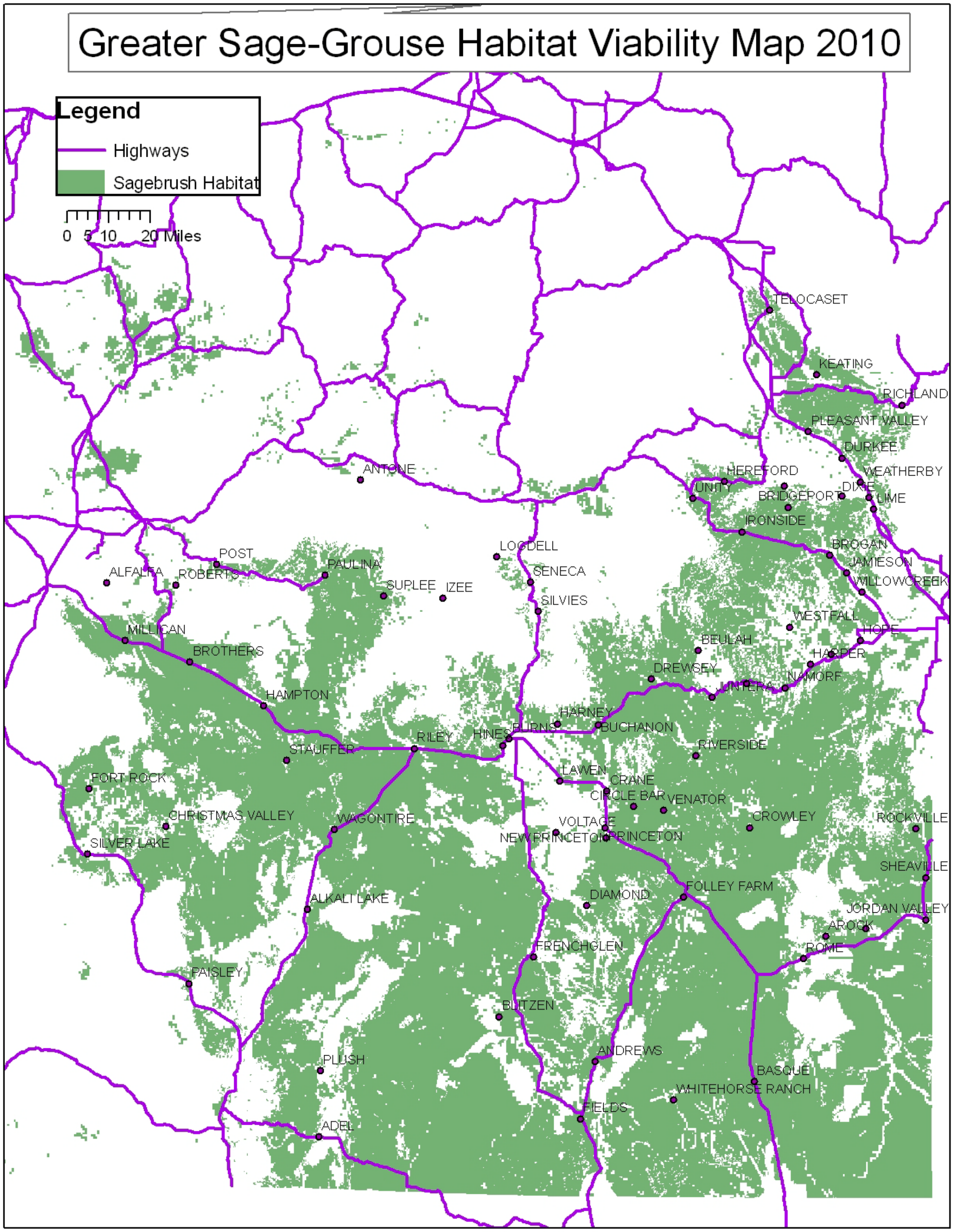


Figure 16. Connectivity model output showing contiguous sagebrush habitat patches in Oregon.

Lakeview District

Administrative boundary.— Sagebrush habitat has decreased by 17% in this district (Table 14). The Hart Mountain National Antelope Refuge is surrounded by lands managed by Lakeview BLM, and comprises approximately 121,000 ha (300,000 acres) of US Fish and Wildlife Service land in this region (Appendix IV, Table A-7). Sagebrush habitat in this region is administered primarily by BLM (78%) and secondarily by private land owners (11%). Conversions of sagebrush to irrigated fields occurred primarily in Christmas Valley. Non-sagebrush shrublands comprised the majority (52%) of potential habitat, followed by seedings/grasslands (12%) and fire (5%). There are several large seedings in Lakeview District that may compromise future connectivity if further loss of sagebrush occurs.

2005 status of habitat.—Sagebrush habitats comprised 72% (1,038, 474 ha or 2,566,113 acres) of this region, and most (93%) of this habitat was ranked as high viability (Table 16). Connectivity was high in this region with the most contiguous patch of sagebrush in the state extending from the Nevada border to north of Hwy 20 (Figure 19). However, Christmas Valley and the area north of Summer Lake are highly susceptible to future isolation given the relatively narrow corridors of habitat connecting them to the larger habitat areas (Figure 16).

Current distribution and status of habitat.— Sixty seven percent (902,316 ha or 2,229,673 acres) of this implementation team area was comprised of sagebrush, and 92% of that was high viability habitat (Table 17). Sagebrush and other-shrub cover types were estimated to cover a much larger area in 2005 than 2009 (Table 18). Invasive weeds and sage-juniper are the 2 largest risks to the estimated 2.2 million acres of sagebrush in the Lakeview Implementation Area (Table 17). However, mixed-shrub communities, largely greasewood flats, comprised most of the potential habitat category. Greasewood flats are naturally occurring habitats at lower elevations on alkaline soils, so there are few if any conservation opportunities in this community type.

Prineville District

Administrative boundary.—Sage-grouse habitat has decreased by 47% most of which occurred in the Columbia Basin and was largely private land converted to agriculture (Table 14). BLM administered lands (41%) and private land ownership (48%) are nearly equal in this region (Appendix IV, Table A-8), which will require additional efforts to identify willing land owners to participate in conservation projects. Although not quantified in the habitat map, extensive human disturbance (e.g., ATVs, mountain biking, horseback riding) from the urban areas of central Oregon impact habitat quality. Cumulative effects of power line corridors, juniper, and human disturbance are some of the factors limiting this population.

2005 status of habitat.—Only 47% (325,832 ha or 805,146 acres) of the region was in sagebrush, but the available habitat is relatively connected as 79% of it was ranked as high viability in the region (Table 16). Because the Prineville District is at the northern edge of sage-grouse range, connectivity in this region is especially important (Figure 20). The primary habitat block (Figure 16) where sage-grouse occur is contiguous with the area shared by Lakeview and Burns districts. The Crooked River area is highly fragmented by juniper encroachment and other disturbances. Juniper encroachment south of Highway 20 threatens the connectivity of Prineville sagebrush habitats to other areas. A total of 366,998 acres of habitat is scattered throughout the northern

Table 16. Habitat acres within five sage-grouse assessment areas of eastern Oregon, 2003. These are acres within the current range of sage-grouse for each region to provide a profile of available habitat in occupied range. These tables are based on the 2005 assessment.

	Assessment Area											
Cover type	Baker	%[a]	Burns	%	Lakeview	%	Prineville	%	Vale	%	Total	%
Sagebrush	557,633	82.0	3,042,442	68.0	2,566,113	72.1	805,146	47.1	4,298,392	73.1	11,269,726	69.1
Potential[b]												
Other shrub	92,004	13.5	811,692	18.1	695,986	19.5	820,827	48.1	815,567	13.9	3,236,076	19.9
Fire	-[c]	0.0	201,372	4.5	99,738	2.8	7[c]	0.0	321,472	5.5	622,589	3.8
Grassland	17,185	2.5	132,059	3.0	118,166	3.3	43,512	2.5	233,202	4.0	544,124	3.3
Seedings	-[c]	0.0	103,286	2.3	43,925	1.2	-[c]	0.0	145,535	2.5	292,746	1.8
Sage/juniper	1,063	0.2	78,763	1.8	4,118	0.1	7,396	0.4	2	0.0	91,342	0.6
Sage/wetland	553	0.1	29,074	0.7	6,502	0.2	1,614	0.1	8,323	0.1	46,066	0.3
Sage/hay	10,662	1.6	73,545	1.6	26,592	0.7	29,468	1.7	57,856	1.0	198,123	1.2
Subtotal	121,465	18.0	1,429,791	32.0	995,025	27.9	902,824	52.9	1,581,957	26.9	5,031,062	30.9
Agriculture	40,106		188,224		105,526		62,993		185,459		582,308	
Non-habitat	45,056		669,666		352,917		398,854		131,721		1,598,214	
Total[d]	764,259		5,330,124		4,019,581		2,169,817		6,197,529		18,481,310	

[a] Percent shown only of sagebrush and potential habitat total (i.e., what % of sagebrush and potential sagebrush is currently in a given condition).

[b]Potential habitat are those habitats that have some capability of transitioning to sagebrush or are potentially important to sage-grouse (e.g., interface of sagebrush and emergent herbaceous wetlands “sage/wetland”). In some cases this is not possible, because the site has transitioned into a steady state and cannot return to sagebrush without considerable intervention (e.g., cheatgrass or mature juniper stands).

[c] Fire and seeding disturbance data were not available at the time of this report.

[d] Total acreage differs from Table 17 because the data in Tables 18 and 19 are a composite of SAGESTICH and NLCD, where Table 17 is based solely on SAGESTICH.

Table 17. Current habitat acres within five sage-grouse Implementation region boundaries of eastern Oregon, 2009.

	Implementation Regions											
Cover type	Baker	%[a]	Burns	%	Lakeview	%	Prineville	%	Vale	%	Total	%
Sagebrush	435,979	62	3,055,778	65	2,229,673	59	926,869	55	4,094,486	72	10,742,785	76
Potential[b]												
Other Shrub	86,808	12	177,333	4	417,977	11	25,169	1	187,842	3	895,129	6
Burned Grass	ND	0	24,740	1	41,972	1	ND	0	15,535	0	82,246	1
Burned shrub	ND	0	37,989	1	82,622	2	ND	0	38,627	1	159,237	1
Native Grass	36,516	5	117,058	2	153,957	4	64,543	4	407,131	7	779,205	5
Invasive	56,382	8	45,223	1	362,901	10	18,986	1	587,879	10	1,071,371	8
Sage-Juniper	61,133	9	534,048	11	194,754	5	326,564	19	235,413	4	1,351,912	10
Juniper	27,067	4	474,368	10	122,952	3	321,500	19	106,074	2	1,051,962	7
Wetland	1,742	0	261,835	6	202,194	5	4,497	0	46,072	1	516,340	4
Subtotal	269,647	38	1,672,595	35	1,579,329	41	761,259	45	1,624,573	28	3,484,120	24
Non-habitat	89,133		292,566		222,710		149,212		363,117		1,116,738	
Agriculture	45,445		330,120		79,202		24,304		131,238		610,308	
Total	840,203		5,351,059		4,110,914		1,861,645		6,213,413		18,377,234	

[a] Percent shown only of sagebrush and potential habitat total (i.e., what of sagebrush and potential sagebrush is currently in a given condition).

[b]Potential habitat are those habitats that have some capability of transitioning to sagebrush or are potentially important to sage-grouse (e.g., interface of sagebrush and emergent herbaceous wetlands “sage/wetland”). In some cases this is not possible, because the site has transitioned into a steady state and cannot return to sagebrush without considerable intervention (e.g., cheatgrass or mature juniper stands).

portion of the Prineville District boundary, much of which was near Madras and the Warm Springs Indian Reservation and outside the current range of the species.

Current distribution and status of habitat.— Sixty seven percent (507,246 ha or 1,861,645 acres) of this implementation team area was comprised of sagebrush, and 74% of that was high viability habitat (Table 17). Sagebrush was estimated to cover a larger area in 2009 than 2005, and other shrub communities were estimated to cover a much larger area in 2005 than 2009 (Table 18). Juniper and sage-juniper are the 2 largest risks to the estimated 926,869 acres of sagebrush in the Prineville Implementation Area (Table 17). Invasive weeds occupied 18,986 acres of potential sagebrush habitat in the region.

Vale District

Administrative boundary.—Sagebrush habitat has decreased by 17% of its historic sage-grouse range (Table 14). As in the case of Prineville, much of this loss occurred in the Columbia Basin and is largely private agricultural land today. Land ownership (Appendix IV, Table A-9) is primarily BLM (73%), private (20%), and Oregon Department of State Lands (DSL; 7%). Some of the largest areas of state land occur in the Owyhee and Malheur River basins. Sagebrush areas lost to fire (136,683 ha [337,750 acres]) and seedings (59,992 ha [148,243 acres]) are the largest in Vale (Table 15). Lower elevations in the southern portion of the Vale District are susceptible to cheatgrass invasion following disturbances.

2005 status of habitat.—Sagebrush comprised 1,739,505 ha (4,298,392 acres: 73%) of this region, and most (71%) was ranked as high viability (Table 16). Overall habitat connectivity was reasonable in this region (Figure 18) with more than half of the largest contiguous sagebrush area occurring in this region; however, the southern portion is comprised of a few large contiguous habitat patches and large disturbed areas. Several of these disturbed areas were the result of seeding projects in the 1960s. Nearly the entire sagebrush habitat in the Malheur County portion Vale District was protected mostly by regulatory limitations. This reflects the Southeastern Oregon Resource Management Plan (SEORMP) that identified sage-grouse as a focal species for much of the conservation efforts.

Current distribution and status of habitat.— Sixty seven percent (1,656,979 ha or 4,094,486 acres) of this implementation team area was comprised of sagebrush, and 72% of that was high viability habitat (Table 17). Sagebrush and other shrub cover types were estimated to cover a much larger area in 2005 than 2009 (Table 18). Invasive weeds were the greatest risk to the estimated 4.1 million acres of sagebrush in the Vale Implementation Area (Table 17), and sage-juniper was the second largest habitat affecting sagebrush availability in the region.

Table 18. The differences (2009 acres – 2005 acres) in estimated habitat acres from 2005 mapping and 2009 mapping within five sage-grouse Implementation regions of eastern Oregon, 2009. The differences are not necessarily a result (but may be especially in the case of fire) of changes in habitat, but from using different data sources and modeling approaches. Negative values indicate greater acres estimated in 2005 than 2009.

	Difference in estimated habitat acres					
Cover type	Baker	Burns	Lakeview	Prineville	Vale	Total
Sagebrush	–121,654	13,336	–336,440	121,723	–203,906	–526,941
Potential[a]						
Other shrub	–5,196	–634,359	–278,009	–795,658	–627,725	–2,340,947
Fire		–138,643	24,856		–267,310	–381,106
Grassland	75,713	30,222	398,692	40,017	761,808	1,306,452
Seedings						
Sage/juniper	60,070	455,285	190,636	319,168	235,411	1,260,570
Sage/wetland	1,189	232,761	195,692	2,883	37,749	470,274
Sage/hay						
Subtotal	148,182	242,804	584,304	–141,565	42,616	876,341
Non-habitat	71,144	97,268	–7,255	71,858	337,470	570,486
Agriculture	5,339	141,896	–26,324	–38,689	–54,221	28,000
Total	75,944	20,935	91,333	–308,172	15,884	–104,076

[a]Potential habitat are those habitats that have some capability of transitioning to sagebrush or are potentially important to sage-grouse (e.g., interface of sagebrush and emergent herbaceous wetlands "sage/wetland"). In some cases this is not possible, because the site has transitioned into a steady state and cannot return to sagebrush without considerable intervention (e.g., cheatgrass or mature juniper stands).

SUMMARY OF HABITAT ASSESSMENT

In the Columbia Basin the majority of habitat loss occurred during the late 1800s and early 1900s as a direct result of sagebrush steppe conversion to agricultural land. Within the sage-grouse range in Oregon, 2 million ha (5 million acres) of the current range has been marginalized by fire, juniper encroachment, and other conversions in the last 20-30 years. Currently, there are >6 million ha (15 million acres) of sagebrush habitat much of it in the Great Basin ecosystem. The connectivity mapping indicated that approximately 3.7 million ha (9.2 million acres) are largely connected blocks of habitat; however, the understory condition of most of these acres is unknown. Compared to other states within the range of sage-grouse, Oregon has large expanses of contiguous habitat with minimal threats of fossil fuel exploration or development. However, there is potential for renewable energy developments (i.e., geo-thermal, solar, and wind) in most sage-grouse regions in Oregon. The current status of sagebrush habitat is a landscape comprised of 70% sagebrush and 30% potential habitat that has supported sage-grouse populations over the last 30 years. Thus, to meet population objectives of this Plan, the current distribution of sagebrush communities should be maintained (minimum) or enhanced (optimum). The current landscape configuration is consistent with the habitat assessment described by Karl and Sadowski (2005), which identifies a goal of maintaining 70% of sagebrush rangelands in later structural stages (sagebrush classes 3, 4, and 5) of sagebrush at broad- and mid-scales.

Sagebrush classes.—The following plant community structural classifications have been developed for big sagebrush habitats based on shrub cover. Sagebrush cover is a key factor in providing security cover, nesting cover, winter forage, migratory corridors, and thermal relief for sage-grouse. However, sagebrush class does not describe grass and forb understory, also important habitat components. Forb and grass composition data for conservation planning can be obtained from Ecological Site Inventories, Rangeland Health Assessments, or other available rangeland surveys normally possessed by land managing agencies. Sagebrush communities (1 to 5) can be further classified by type of understory composition (Appendix II).

Future assessments should consider layering structural classes and ecological conditions in a geographic information system, so that a clear picture of sage-grouse habitat quality, composition, and resilience to disturbance can be determined. Communities that still retain a cover of sagebrush but are at risk of shifting to a permanent state of introduced grasses and forbs following a disturbance event can also be identified. As described in the table below, classes 1 and 2 are grass/forb structural types that may be important to sage-grouse for herbaceous forage. However, classes 1 and 2 will not support nesting activity, because they lack security cover for brood rearing, they cannot support winter use, and in large blocks they represent fragmented habitat. On the other hand, classes 3, 4, and 5 may each fulfill most of the yearlong habitat requirements of sage-grouse and other species because of the availability of shrubs, grasses, and forbs in combination.

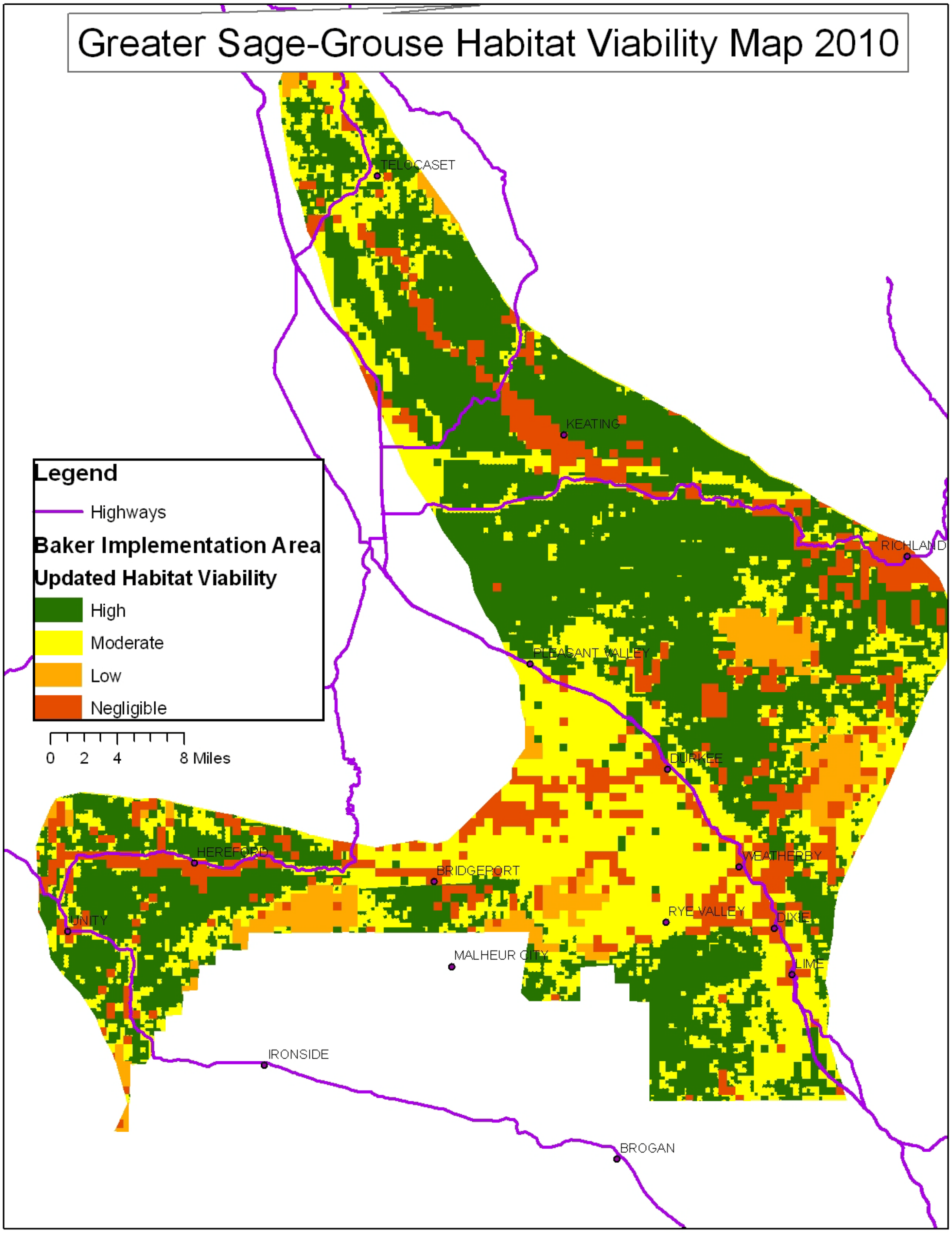


Figure 17. Connectivity model outputs for the Baker Resource Area/County Boundary. Various colors depict high, moderate, low, and negligible habitat viability categories.

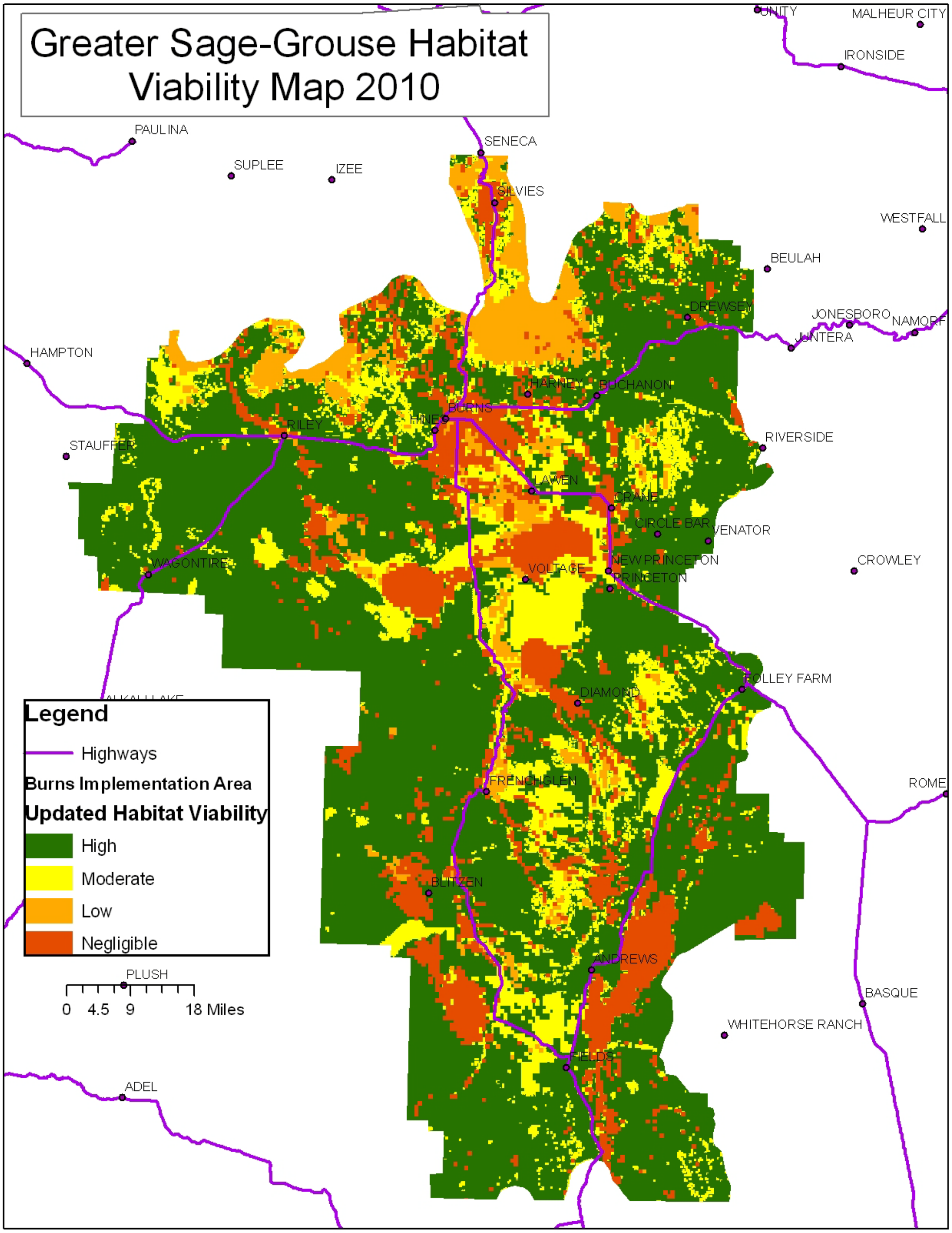


Figure 18. Connectivity model outputs for the Burns BLM District Boundary. Various colors depict high, moderate, low, and negligible habitat viability categories.

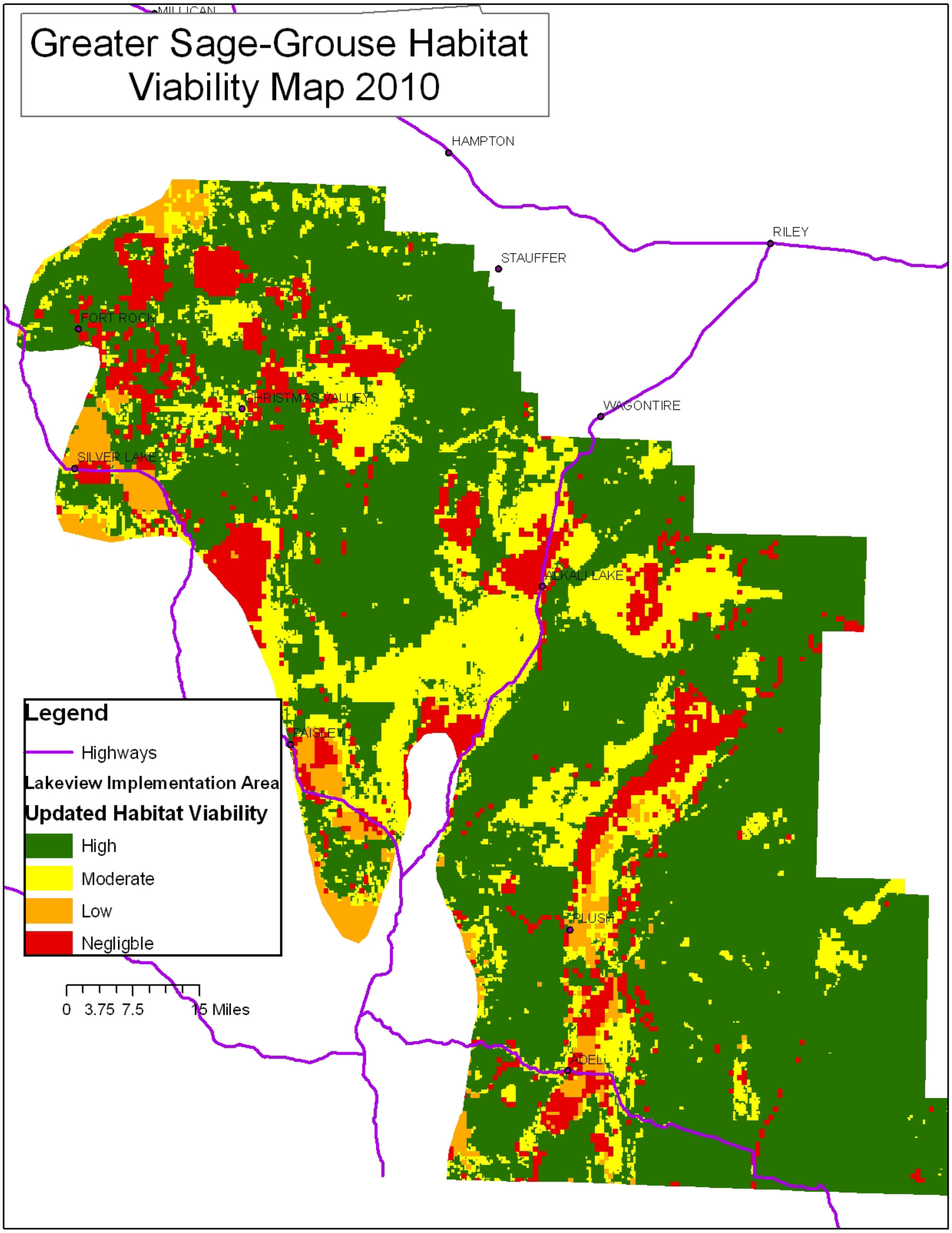


Figure 19. Connectivity model outputs for the Lakeview BLM District Boundary. Various colors depict high, moderate, low, and negligible habitat viability categories.

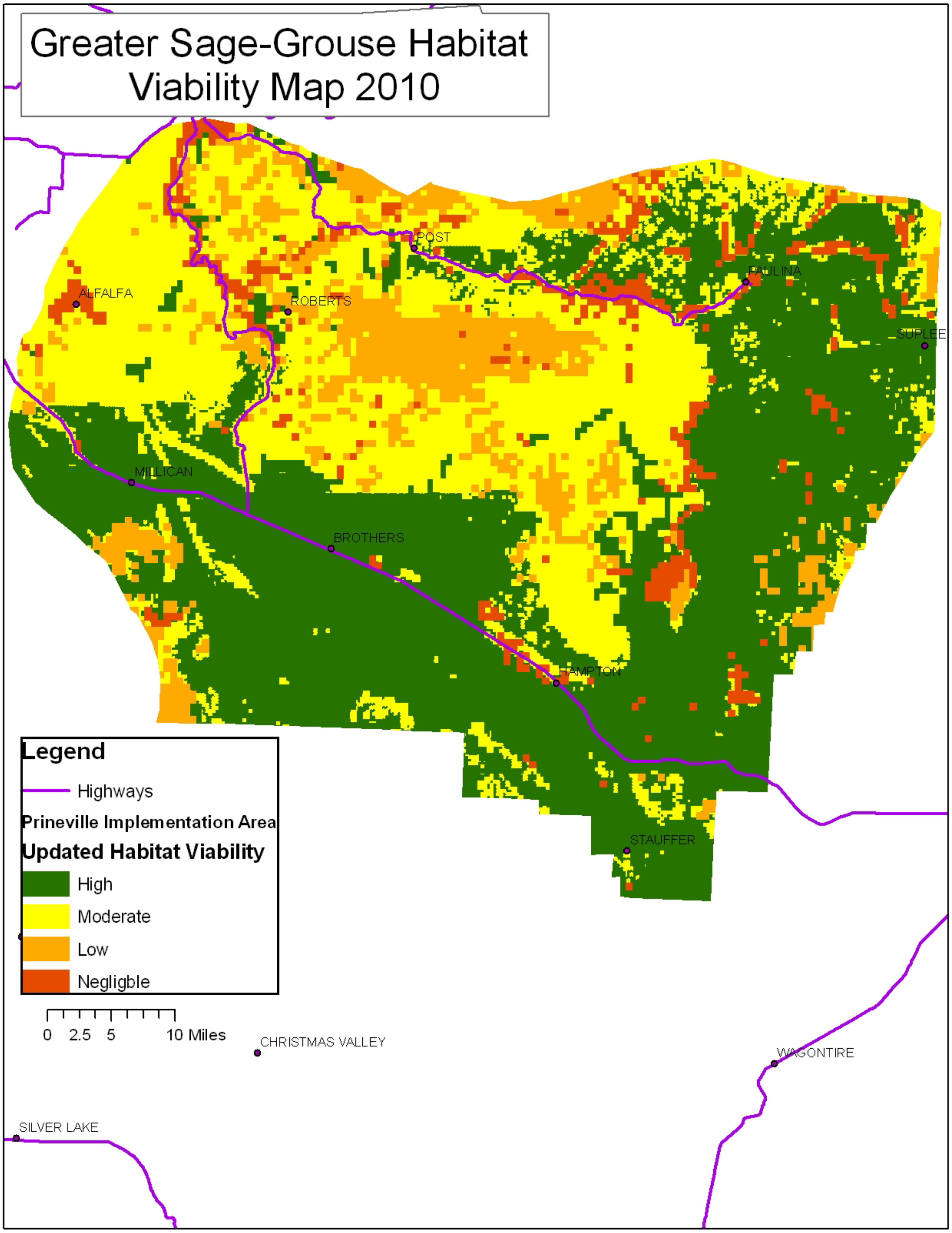


Figure 20. Connectivity model outputs for the Prineville BLM Boundary. Various colors depict high, moderate, low, and negligible habitat viability categories.

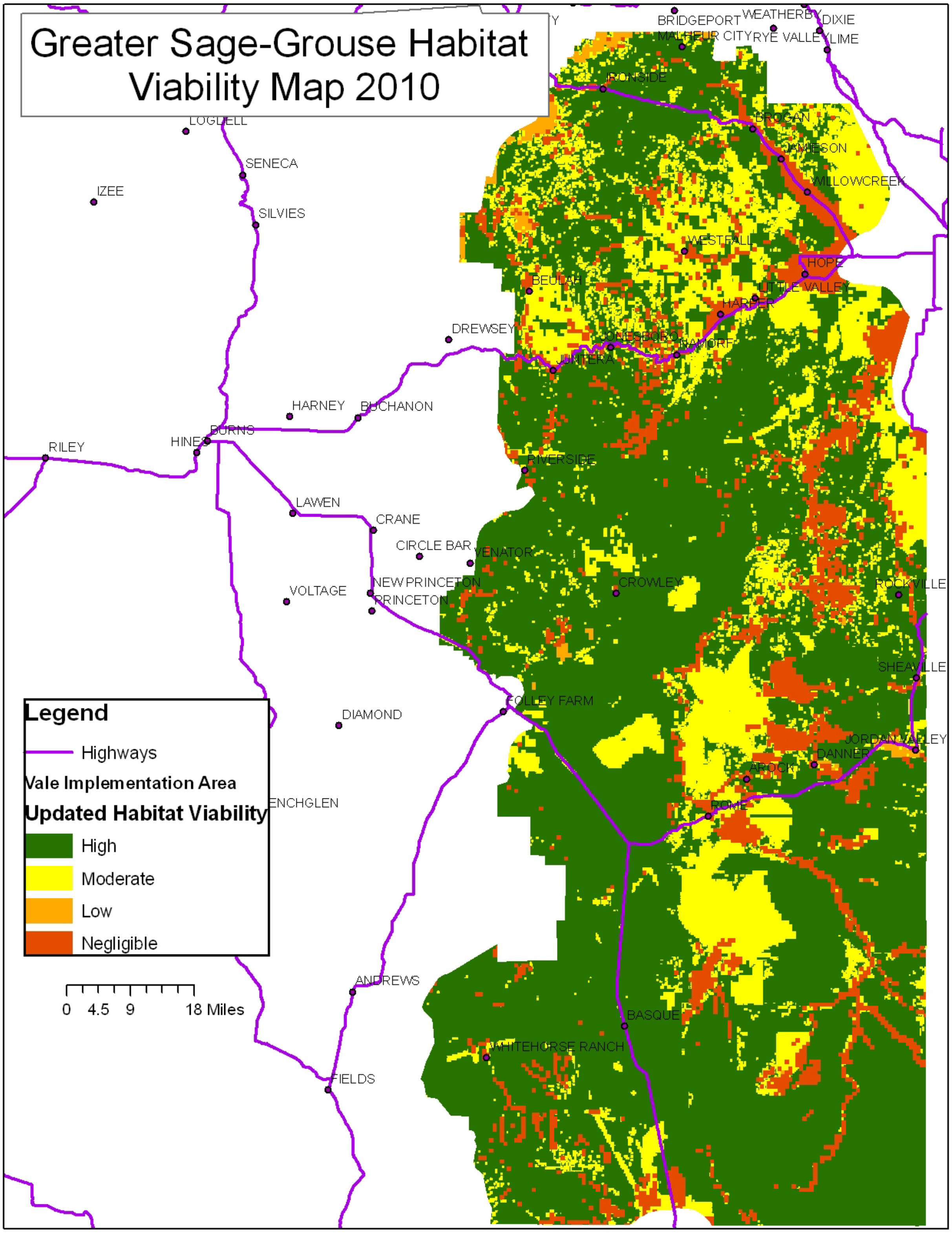


Figure 21. Connectivity model outputs for the Vale BLM District Boundary. Various colors depict high, moderate, low, and negligible habitat viability categories.

Class 1: **No sagebrush canopy cover**— Characteristic of rangelands that exhibit a grassland aspect and low vegetative structure. Generally common and widespread species of wildlife (e.g., pronghorn and horned larks) can be supported. Forage and insects are often abundant even for species that are dependent on sagebrush cover availability for nesting, hiding and so on. Class 1 rangelands do not necessarily pose a threat to wildlife diversity because they may in fact meet part or all of the habitat requirements of certain wildlife species. Native or nonnative Class 1 rangelands may be a wildlife issue of concern due to habitat fragmentation where they dominate large tracts of land within a GMA. Depending on rangeland condition and site potential, grass and forb values are highly variable.

Class 2: Trace to 5%— Characteristic of rangelands that exhibit a predominantly grassland aspect and low vegetative structure. Canopy cover in this range of values is often indicative of relatively recent fire or other treatment effects. They may indicate that recolonization of sagebrush is underway or a site that has transitioned into a steady state dominated by grasses. Generally common and widespread species of wildlife (e.g., pronghorn and horned larks) can be supported. Most of the complex shrub cover needs of sage-grouse and other sagebrush dependent wildlife (structure, forage, and cover) are very limited or absent altogether in Class 2 rangelands. Connelly et al. (2000b) refer to the cessation of sage-grouse nesting where live sagebrush canopy cover values go below 5%. Depending on rangeland condition and site potential, grass and forb values are highly variable

Class 3: >5%, up to 15%— Characteristic of rangelands that exhibit a shrub land aspect and desirable complex vegetative structure that is capable of supporting a variety of sagebrush-dependent wildlife (including many special status species), especially at the higher canopy values of 10 to 15%. Connelly et al. (2000b) suggest that sage-grouse are able to winter within habitats that support at least a 10% canopy cover of sage if the shrub cover is available 25 to 30 cm (10 to 12") above snow cover. Sage-grouse nesting habitat values are thought to be present at the upper (near 15%) sagebrush canopy cover values. Unpublished BLM surveys suggested sagebrush obligate songbirds began to reoccupy crested wheatgrass grasslands where the sagebrush canopy was more than 5%. Songbird studies in Nevada crested wheatgrass seedings showed that a balanced composition of grassland and shrub dependent species were present when shrub overstory recovery was around 10% line intercept values. Depending on rangeland condition and site potential, grass and forb values are highly variable.

Class 4 : >15%, up to 25%— Characteristic of rangelands that exhibit a shrubland aspect and desirable complex vegetative structure that is capable of supporting a wide variety of sagebrush-dependent wildlife (including many special status species). Sage-grouse breeding and wintering can both occur within habitats with Class 4 shrub cover. Depending on rangeland condition and site potential, grass and forb values are highly variable.

Class 5: >25%— Characteristic of rangelands that exhibit a shrubland aspect and complex vegetative structure that is capable of supporting sagebrush dependent species. Class 5 types may, though not always, support diminished herbaceous cover values. However, Class 5 cover values need to be present for some species such as the pygmy rabbit. Mule deer and elk use this type of habitat for hiding in rangelands where topographic cover is limited and/or tall structure provided by mountain shrubs is absent. Class 5 shrub cover does not necessarily imply poor or low value habitat conditions for wildlife.

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MANAGEMENT OBJECTIVES FOR SAGE-GROUSE HABITAT

HABITAT GOALS

The overarching habitat goals are to 1) maintain or enhance the current range and distribution of sagebrush habitats in Oregon, and 2) manage those habitats in a range of structural stages to benefit sage-grouse. Attaining the population objectives is largely dependent upon achieving habitat goals. To meet this statewide goal over the next 50 years, the conservation focus for habitat should include an objective that conserves ≥70% of sage-grouse rangelands that are capable of supporting sagebrush habitats in advanced structural stages, sagebrush class 3, 4 or 5, with an emphasis on classes 4 and 5. The remaining 30% should include areas of juniper encroachment, non-sagebrush shrublands, annual grasslands and non-native perennial grasslands that potentially can be rehabilitated or enhanced. The "70/30" goal is based on a habitat assessment described in BLM Technical Bulletin 417 (Karl and Sadowski 2005).

Managing for a statewide landscape of 70% sagebrush and 30% potential habitat approximates the current status of intact and disturbed sagebrush habitat, respectively, in Oregon. Managing the landscape to approximate these proportions over time provides a conservation focus for sagebrush types, while providing land managers opportunities to inventory and assess structure and composition of sagebrush communities that are beneficial to sage-grouse. Managing for an intact understory of grasses and forbs is also a critical component in maintaining the resilience and resistance of these communities. Ultimately a more specific habitat goal for sage-grouse is envisioned that focuses on the sagebrush community types critical to the species.

Several recent studies have indicated that when 70% of an area (e.g., nest site) or broader landscape (e.g., 40 mile lek radius) is in sagebrush cover it serves as a biological threshold for sage-grouse habitat selection, increased performance in life history stages, and population persistence (Walker et al. 2007a; Aldridge et al. 2008; Doherty et al. 2008, 2010; Knick and Hanser 2011*;* Johnson et al. 2011; Shepherd et al. *in press*; Wisdom et al. 2011). Thus, assumptions about the landscape proportions in this habitat objective have a growing body of evidence that support them.

Alternatively, Knick and Hanser (2011) in an analysis of population and habitat connectivity suggest that minor changes to habitat as a result of fire (22,000 ac of fire in a 2.2 million ac landscape) can have significant impacts to population persistence. These findings are contrary to the current mosaic of habitat disturbance and population persistence of sage-grouse in Oregon.

The 70/30 objective provides a conservation focus for multiple species associated with sagebrush communities. Understanding that there are natural fluctuations in sagebrush cover types, the 70/30 goal serves as an adaptive management strategy for sage-grouse habitat. Flexibility is needed in managing sagebrush habitats as a dynamic landscape where short-term losses of sagebrush (e.g., thinning through brush-beating) can yield long-term benefits to sagebrush steppe communities (Dahlgren et al. 2006). However, for such "losses" to benefit sage-grouse in the long-term, treatments should be conducted such that the integrity and ability of sagebrush and native vegetation to flourish is maximized (Dahlgren et al. 2006).

The current range of sage-grouse habitat in Oregon primarily includes sagebrush communities within the Great Basin. Thus, sagebrush or potential habitats in the Columbia Basin should not be considered a rehabilitation or management priority, because the vast majority of potential habitat is privately owned land, and the funding required to restore these habitats is not available and logistically practical at the present time. The 70/30 goal is consistent with *The Wildlife Policy* (ORS 496.012[7]) which directs ODFW, "to make decisions that affect wildlife resources of the state for the benefit of the wildlife resources and to make decisions that allow for the best social, economic, and recreational utilization of wildlife resources by all user groups."

It is recommended that all Oregon BLM districts and Resource Management Plans (RMPs; it has already been adopted by the South East Oregon RMP) and other public land management agencies adopt habitat goals that support the 70/30 framework as a comprehensive tool for maintaining and conserving sage-grouse habitat. Not only does this approach establish habitat goals, it also provides a comprehensive set of tools for inventory to ensure that goals are being met at both local and regional scales. The 70% level is based on currently available habitat and represents an attainable target of acres supporting later structural stages of sagebrush at any point in time. Retaining the 70% level provides a conservation focus for sagebrush vegetation across the sage-grouse range. To achieve the statewide goal of >70% sagebrush and ~30% disturbance, regional heterogeneity and proportions of habitat must be managed for no net loss in a region.

However, maintaining these proportions does not mean no action. To the contrary, this Plan seeks to improve conditions of existing sagebrush (e.g., understory enhancement, fire break development) and enhance or restore potential habitats (e.g., juniper removal, invasive weed eradication). Improvement of potential habitats will contribute to the conservation goal and provide a buffer (acre for acre) for sagebrush habitat that is lost or fragmented through land use actions, wildfires, or invasion of annual grasses. Statewide and regional objectives are recommended as follows:

STATEWIDE HABITAT BASELINE 2005

(1) Habitat goals:
(a) maintain or enhance the distribution of sagebrush habitats within greater sage-grouse range in Oregon; and
(b) manage those habitats in a variety of structural stages to benefit greater sage-grouse.

(2) Policy: Manage a minimum of 70% of greater sage-grouse range for sagebrush habitat in advanced structural stages, sagebrush class 3, 4 or 5, with an emphasis on classes 4 and 5. The remaining approximately 30% includes areas of juniper encroachment, non-sagebrush shrubland, and grassland and should be managed to increase available habitat within greater sage-grouse range.

(3) Objective: To maintain and enhance existing sagebrush habitats and enhance potential habitats that have been disturbed such that there is no net loss of sagebrush habitat in the following regions:

(a) Baker Resource Area BLM: 82% sagebrush and 18% disturbed habitats.

(b) Vale District BLM (excluding Baker Resource Area): 70% sagebrush and 30% disturbed habitats.
(c) Burns District BLM: 68% sagebrush and 32% disturbed habitats.
(d) Lakeview District BLM: 72% sagebrush and 28% disturbed habitats.
(e) Prineville District BLM: 47% sagebrush and 53% disturbed habitats.

Assumptions and Rationale

Because statewide the sagebrush disturbance proportion is currently near objective (70/30) and most sage-grouse populations have persisted under this proportion since approximately 1980, it is assumed that maintaining or enhancing the current level of habitat will sustain similar populations over the next 50 years.

Sagebrush classes 3, 4 and 5 provide the best habitat for sage-grouse as identified in the WAFWA guidelines (Connelly et al. 2000b, Hagen et al. 2007). The range of canopy cover values in these classes encompasses the range of site potential for sagebrush communities in Oregon (Bates et al. 2004).

These objectives are meant to be advisory for private land holdings. As willing private landowners become involved in sage-grouse conservation and actively add conservation actions on their land to the 70/30 objective. These actions will allow for greater flexibility in public land management.

The 70/30 objective will need to be evaluated to determine if this ratio provides sustainable habitat over time for sage-grouse, particularly with the current projections of climate change.

As a mid-scale objective, 70% of an area in sagebrush does not describe the condition or quality of sagebrush communities (i.e., vegetation composition and structure). Ideally the majority of the 70% should be of high quality habitat; however, defining the appropriate proportion of quality habitat in a region is difficult at this time.

This adaptive management strategy for sagebrush habitat will benefit sage-grouse and other species associated with sagebrush.

Best management practices should facilitate sagebrush recruitment (e.g., juniper removal, seeding of sagebrush, specific livestock grazing treatments) and will likely exceed the 70% sagebrush objective. This will provide a buffer for unplanned disturbances that result in grassland type communities, and flexibility for other land use objectives.

Thinning of shrub canopy can still be implemented, but the timing and location of such treatments must be carefully considered to maintain the long-term 70% sagebrush goal. Most importantly, when thinning occurs, it should be done in a manner that the sagebrush system is in proper functioning condition. Thus, as a general rule most of the treatment area will retain the later seral stages of sagebrush canopy cover.

Proportions recommended for Vale District were adapted from SEORMP, because that objective is covered by the Final Environmental Impact Statement. This objective differs slightly from the proportions reported in Tables 19 & 20 and is likely a result of different mapping techniques.

Actions
Land Management

1.1. Advise, consult and cooperate with public land management agencies to manage landscapes to support the 70/30 framework as a comprehensive tool for maintaining and conserving sage-grouse habitat.

1.2. If the total area of potential habitat statewide approaches the 30% maximum, additional land treatments that would decrease sagebrush would require substantial justification and should be scrutinized carefully.

1.2a An exception might be a project where the objective of a treatment is to retain the overall sagebrush component, but enhance the understory of forbs and perennial grasses.

1.3. If the 30% maximum potential habitat is exceeded, then land management will transition from maintaining to rehabilitation of sagebrush communities.

1.4. If 70% sagebrush objective is exceeded, this will provide a buffer for unplanned disturbances or thinning of shrub canopy can still be implemented, but the timing and location of such treatments must be carefully considered so that long-term declines are not below 70%.

Monitoring

1.5. There is a need to adapt the long-term objective of 70/30 to account for habitat quality (e.g., patch size, vegetation structure and composition within different sagebrush communities). Initially this will require an inventory of vegetative communities within allotments and pastures. At the pasture level quality can be assessed under Rangeland Health Standard #5 on BLM lands.

1.6. Similar standards for rangeland health should be adopted by other land management entities for consistency in monitoring and assessing habitat. This could be conducted through a series of MOUs between BLM and other land management agencies.

1.6a. Inventories of pasture level sagebrush structure and herbaceous understory can be effective in evaluating allotments for habitat related to Rangeland Health Standard #5.

1.6b. Pasture and allotment assessments should contribute to an inventory of sagebrush habitat by recording the presence or absence of sagebrush and if present quantify its class value (1-5).

1.7. Broad- and mid-scale assessments should be updated every 3-5 years to monitor the progress towards maintaining the long-term goal of 70/30 sagebrush/potential habitat mix.

1.8. Determine the ecological relevance of the 70/30 objective from monitoring and inventories, and adjust if necessary.

1.9 Consider using more detailed habitat data on a regional basis.

1.10. Where possible, conduct spatially explicit inventory habitat projects. Using GPS and GIS map the locations of habitat projects so habitat objectives can be quantitatively evaluated.

Partnerships

1.11. Opportunities must be sought to include private and tribal lands into this planning framework of maintaining and enhancing 70% sagebrush habitat in a landscape context over the long term. The voluntary participation of tribes and private landowners will be sought through cost-share projects to add to this long-term goal.

1.12. Private lands may contain some of the higher quality habitats. Adding these higher quality habitat to the overall goal should be encouraged.

SAGE-GROUSE CORE-AREA HABITAT CATEGORIZATION AND CONSERVATION RECOMMENDATIONS USING ODFW's FISH AND WILDILIFE HABITAT MITIGATION POLICY

The purpose of this section is to provide policy direction, consistent recommendations and supporting rationale to guide ODFW habitat mitigation recommendations associated with impacts to sage-grouse habitat from energy development, its associated infrastructure, or other industrial-commercial development. This section updates and replaces guidance provided by ODFW's 7 August 2009, whitepaper (hereafter; ODFW 2009).

This section establishes conservation recommendations for sage-grouse habitat using the Fish and Wildlife Habitat Mitigation Policy (OAR 635-415-0000) (Mitigation Policy).

The goal of these recommendations is to address greater sage-grouse management from a conservation biology perspective which protects the most productive populations and habitats that meets all life history needs, and assists in meeting habitat and population objectives identified in this Plan. The objective of these recommendations is to avoid, minimize, or mitigate for impacts on sage-grouse habitats from energy development, and its associated infrastructure or other large scale industrial-commercial developments.

This Plan recognizes that livestock ranching operations which manage for ecologically sustainable native rangelands are compatible with sage-grouse conservation, and necessary management activities to maintain a sustainable ranching operation are not considered "development actions" under the application of the Mitigation Policy to sage-grouse habitat. From a habitat fragmentation standpoint, ranching was the most environmentally benign land use and accumulated fewer human features than landscapes that also contained tillage agriculture, energy development, or both in Wyoming and Montana (Naugle et al 2011). Ranching as a land use generally supported greater biodiversity as measured by native plant species and shrub/grassland nesting birds than exurban developments or reserves (Stohlgren et al. 1999, Maestas et al. 2002; 2003). Per the Mitigation Policy "development" is defined as a "development action" with some additional clarifying modifications.

"Development action" means any activity subject to regulation by local, state, or federal agencies that could result in the loss of fish and wildlife habitat. Development actions may include, but are not limited to the planning and construction and operational activities of local, state and federal agencies. Development actions also include subsequent re-permitting for activities with new impacts or continued impacts that have not been mitigated consistent with current standards. Development action does not include activities associated with the continued maintenance and operation of livestock ranching operations which manage for sustainable native rangelands, as determined by BLMs Rangeland Health Assessment or other recognized monitoring techniques appropriate for shrub steppe habitats in Oregon.

Framework

The rapid increase in energy development across the West in recent years has required a landscape approach to wildlife conservation, referred to as "*core areas*" (Doherty et al. 2011). The Doherty et al. landscape approach prioritizes habitats based on measures that assess sage-grouse population and habitat relative abundance, and provides protection for a minimum of 75% of the population. The remaining 25% of the population area would be available for development with some level of stipulations and regulations, but likely at a reduced level.

The strength of this approach is that it uses biological information to identify Core Areas with the objective of protecting the most important breeding areas. It also enables managers, at the landscape scale, to map and analyze the risks and necessary conservation measures for each Core Area. The limitation of this approach is that it focuses only on breeding density. For sage-grouse the relative abundance data is drawn from spring lek counts of males. Thus, habitat conservation measures may be biased towards breeding and nesting populations. Lek data have limitations including: variable sampling effort both spatially and temporally, and detection probabilities have not been estimated for ground or aerial counts. Notwithstanding, these are the best data available for mapping sage-grouse distributions.

Because the method outlined by Doherty et al. (2011) focuses on breeding habitats and ODFW's lek data is prone to variable sampling, an additional and complementary method was used to approximate seasonal use ranges, referred to as *connectivity corridors*. Using a home range estimator, local and seasonal connectivity corridors were estimated. Thus, it is important to clarify some definitions about the mapping approach in Oregon. This document refers to Doherty's "core areas" (i.e., 25, 50, 75, 100%) as lek density strata. Lek density of 25-75% polygons and the intersection of 100% strata and local connectivity polygons collectively define a "core area." These definitions and methods are further defined below.

Methods

Data.—Using the Doherty et al. (2011) approach, average maximum counts of lekking male sage-grouse were used to identify areas of high abundance. Additionally, a modification of Doherty et al. (2011) was used to delineate connectivity corridors between core regions (see discussion on connectivity areas below). Lek count data (1980–2010) and the associated spatial coordinates provided the baseline information to map relative abundance of sage-grouse breeding areas. A total of 1,054 leks were analyzed to delineate lek density strata and connectivity corridors (Figure 22). Because sampling effort across leks is variable, two criteria were used to determine whether or not a lek was included in the mapping.

First, if a lek had ≥1 male counted and recorded as the maximum male count over the last 8-yrs (2003-2010) that lek was included in the analysis. Second, for those leks not counted during the 8-yr period, but had males present at the last survey, the percent change in males from the year of last count compared to 2010 was used to estimate lek size in 2010. For example, a maximum count for a lek was 60 in 1987. Based on 88 leks (866 males) counted in 1987, 58 of those were counted again in 2010 (536 males), resulting in a 38% decrease in the number of males counted at all 58 leks surveyed in both years. Thus, the 2010 estimate for the lek would be 37 males ($60 \times \{1+[-0.38]\}$). Otherwise the average maximum male count from 2003 to 2010 was used to estimate minimum male abundance.

Core Area Mapping.—Kernel density functions are often used in wildlife conservation to estimate home ranges of individual animals or to delineate concentrated use areas by populations (Worton 1989). A kernel is a mathematical density function that groups cells of concentrated use by attributing a grid placed over top of a study site with animal use or count data (Worton 1989). A 1-km^2 grid of cells was populated with counts of sage-grouse males at leks across the range of the species in Oregon. This grid was used to select individual leks for Core Area strata designations. The kernel function was modified because choice of smoothing bandwidth is known to drastically affect area estimates and outer boundaries of concentrated use areas by populations (Horne and Garton 2006). Known distributions of nesting females around leks were used to delineate the outer boundaries of core regions and alleviated the choice of bandwidth issue (Holloran and Anderson 2005, ODFW 2009).

The value of each grid cell is a function of the number and proximity of leks in the surrounding landscape. Each cell was attributed with counts of males at leks within a radius of 6.4 km (4.0 mi). This distance was used because nesting females distribute their nests spatially in relation to the location of leks with >80% of nests (n = 495) located within a 6.4 km (4.0 mi) radius of lek sites in Oregon (ODFW 2009). Once the grid was attributed, leks were classified relative to their abundance values and placed into 1 of 4 lek density groups, of which each strata contained 25 (very high density), 50 (high density), 75 (moderate density) and 100% (low density) of the known breeding population. These strata were then delineated by habitat areas within a radius of 6.4-km (highest densities 25, and 50%) or 8.5-km (lower densities 75 and 100%) to delineate potential nesting areas.

The larger radius was used (5.3 mi; Holloran and Anderson 2005) to delineate lower lek density strata (75 and 100%), because Doherty et al. (2011) reported that increasing the radius in these strata provided more realistic estimates of the area needed to support breeding populations in low abundance or fragmented landscapes. Mapping output included a grouping of leks shaded by 4 colors that represent the smallest area necessary to contain 25, 50, 75, and 100% of nesting sage-grouse populations.

Connectivity mapping.— There is a need to support implementation of core areas with studies that document seasonal habitat use and migration patterns to ensure that the priority landscapes meet all seasonal habitat needs (Doherty et al. 2011). Because lek surveys in Oregon are not uniformly distributed across the region nor have they been uniformly distributed over time, inferences about population density are limited. Additionally, the migratory status of many of Oregon's populations is unknown, and lek density strata designations alone may not provide adequate habitat protection. As a result, areas of habitat connectivity were mapped to account for some of this uncertainty. Using a modified approach of the Core Area designations, connectivity corridors were mapped to link lek density strata and provide additional categorization of habitats.

As with the mapping of lek density, a kernel density function was used to delineate connectivity corridors. However, the search radius was increased to 16 km, because such an approach places greater emphasis on lek density and distances between them. Using radiotelemetry data from Oregon, the center of seasonal use areas was estimated for 368 bird use seasons across 5 study areas. On average, sage-grouse moved 10.4, 10.5, and 9.4 km between breeding and summer, summer and winter, and breeding and winter ranges, respectively (Table 1; Sec III). Regionally, sage-grouse monitored in the Baker County study area moved an average of 15.9 km between breeding and summer ranges. Thus, 16 km was used to delineate the average maximum extent of connectivity between breeding and surrounding seasonal use areas. Two levels of connectivity were mapped: a 75% utilization distribution to delineate "local corridors," and a 90% utilization distribution to delineate "seasonal corridors." Polygons of both local and seasonal corridors were "clipped" to an occupied habitat data layer to approximate potential corridors as closely as possible. The clipped edges were smoothed out to 2 km to account for habitats difficult to map at the ecotone of juniper woodlands and forested types.

Winter habitat.— Previous analyses indicated that critical winter range occurred outside of lek density strata delineations, thus methods to include these important habitats are described here. Winter habitat use has been monitored with radiotelemetry (n = 1,659) near Jordan Valley, Baker City, Jack Creek, Hart Mountain, Beatys Butte, and GI Ranch (Eastern Crook County). Winter utilization distributions (90% use) were estimated for each study area. The resulting polygons were overlaid with lek density strata and connectivity layers and those areas of overlap were used to further define habitat categories.

Fragmentation.— Habitat loss and fragmentation are recognized as primary factors limiting sage-grouse populations (USFWS 2010). Where kernel density polygons resulted in slivers (or "donut holes") of non-core or corridors that were needed to minimize fragmentation of the core, those slivers of habitat were connected to increase the likelihood that core would be retained.

Habitat Categorization.— A synthesis of the lek density strata and winter habitat use, and connectivity corridors provides a framework for categorizing sagebrush habitat under the mitigation policy.

(1) Core Area Goal: The goal of establishing Core Areas is to address greater sage-grouse management from a conservation biology perspective that identifies the most productive populations and habitat that meets all life history needs.

(a) Policy 1. The Department shall develop and maintain maps that identify Core Area habitats necessary to conserve 90% of Oregon's greater sage-grouse population with emphasis on highest density and important use areas which provide for breeding, wintering and connectivity corridors.

Objective 1. Consistent with Policy 1, the Department shall use the following criteria to define Core Area habitat. All sagebrush types or other habitats that support greater sage-grouse that are encompassed by areas:

(A) of very high, high and moderate lek density strata;

(B) where low lek density strata overlap local connectivity corridors; or

(C) where winter habitat-use polygons overlap with either low lek density strata, connectivity corridors, or occupied habitat.

(b) Policy 2. The Department shall develop and maintain maps that identify Low Density Habitat which provide breeding, summer and migratory habitats of the Oregon statewide greater sage-grouse population.

Objective 2. Consistent with Policy 2, the Department shall use the following criteria to define Low Density Habitat. All sagebrush types or other habitats that support greater sage-grouse that are encompassed by areas where:

(A) low density strata overlapped with seasonal connectivity corridors;
(B) local corridors occurred outside of all lek density strata;
(C) low lek density strata occur outside of connectivity corridors;
(D) seasonal connectivity corridors occur outside of all lek density strata.

(c) When developing and maintaining the maps referred to in paragraphs (a) and (b) the Department will use:

(A) Local Sage-Grouse Implementation Teams to evaluate the maps and refine exterior boundaries by use of aerial imagery and local knowledge of sage-grouse and sage-grouse habitat; and

(B) Best available science to further understanding of greater sage-grouse life history and conservation needs.

(2) Application of Sage-Grouse Core Area and Low Density Habitat Categorizations and Conservation Recommendations.

(a) Policy 1. The Department shall follow the Fish and Wildlife Mitigation Policy (OAR 635-416-000) when defining habitat categories and providing recommendations to address potential site-level impacts to greater sage-grouse and their habitats (see below).

Rationale for criteria leading to habitat categorization within Core Area
Category-1 Habitat- Criteria-1: The 75% core strata identifies the highest priority and most productive breeding areas for sage-grouse in Oregon and occupies only 28% of the species distribution. While both lek habitat (open areas in sagebrush) and nesting habitat can potentially be reclaimed, the biological dynamic that occurs between female nest site selection and their movement patterns that drive males to establish a lek in these areas of female use (Bradbury et al. 1989), has yet to be restored by human actions. Given the uncertainty and risk involved in trying to mitigate for the loss (i.e., reclaim/restore) of these habitats and biological dynamics, protection of these areas is paramount.

Category-1 Habitat - Criteria-2: Because some low density breeding bird areas may be important for connectivity between populations, where low density and high connectivity overlapped those areas were elevated to Core Area habitat for the reason described under criteria 1.

Category-1 Habitat - Criteria-3: Winter habitat is critical to the persistence of the species, and currently there are no studies or methods for restoring or creating winter habitat if it is lost (Doherty et al. 2008, Carpenter et al. 2010).

Category-2 Habitat - Criteria: All sagebrush habitats and vegetation communities important to sage-grouse that occur within a low density strata or connectivity corridor are identified as Category 2 habitats, because these sites are identified as essential and limited. However, the low productivity of these sites for sage-grouse suggest that mitigating for net increases elsewhere may be possible. It is important to note that native sagebrush communities are generally classified as Category 2 habitats, but in the context of sage-grouse Core Areas it invokes specific recommendations for habitat conservation for the species.

Outcomes of Habitat Categorization

Lek density strata.—A total of 672 occupied leks representing approximately 8,682 males were used to delineate lek density and connectivity corridors (Table 19 & Figure 23). Combined, these strata encompass 61% (11.4 million acres) of the species distribution in Oregon, most of which (72%) was under federal government administration for all strata. The 3 highest density strata only occupied 29% of the species distribution in Oregon, which assists in prioritizing protections in these regions (Table 20 & Figure 24). Only 15% of the high density strata areas are currently protected by special land status, but 38% of the very high lek density strata are protected by special land status (Table 20).

Table 19. Summary statistics for four lek density strata of greater sage-grouse in Oregon, 2010.

Lek Density Strata	No. of Leks	No. of Males	Avg Males	SD	% of Population	Acres
Very high	99	2,208	22.30	23.04	25%	873,443
High	140	2,259	16.14	15.88	26%	1,319,063
Moderate	169	2,166	12.81	10.32	25%	3,237,565
Low	264	2,049	7.76	6.48	24%	5,981,150
Total	672	8,682				11,411,221

Connectivity.—Local and seasonal connectivity corridors covered 8.3 and 5.6 million acres, respectively (Figure 25). The areas of highest density strata and local connectivity were highly complementary in their overlap (Figure 26). Clipping the local and seasonal corridors provided a more realistic set of pathways for movement between lek density strata (Figure 27).

Winter habitat.— Inclusion of winter telemetry data added 43,000 acres of sagebrush habitat outside of lek density strata and connectivity corridors (Figure 28).

Habitat Categories.— The synthesis of the lek density strata and connectivity corridors resulted in objectively defined Core Areas, opportunities for mitigation in Low Density Areas, and important linkage habitats areas between Core Areas (Figure 29). Sage-grouse Core Area habitat protects most of the sage-grouse population (90%) representing over 550 lek sites in Oregon (Table 21). Approximately 18% of the Core Area habitats and 20% of the Low Density habitats are currently protected by special land status designations (Table 21).

One test of effectiveness for the Core Area approach is to compare the coverage of Core Areas and utilization corridors relative to known distributions of radio-telemetry locations of sage-grouse in Oregon. Ninety-five percent of breeding season locations (n = 3,397), 89% of summer locations (n = 663) and 99% of winter locations (n = 1,659) occurred within Core Areas. Locations were more variable with respect to Low Density areas with 5%, 5%, and 1% of breeding, summer, and winter locations, respectively, occurring in these areas. Finally, 1%, and 6% of breeding and summer locations were outside of Core and Low Density areas, respectively.

Table 20.Acres of habitat occurring within greater sage-grouse lek density strata in Oregon, 2010.

Lek Density Strata	Acres in Stratum	% [a]	Sagebrush Habitat[b]	% [c]	Special status[d]	% Protected[e]
Very high	873,443	5%	732,227	6%	333,503	38%
High	1,319,063	7%	1,080,999	9%	194,669	15%
Moderate	3,237,565	17%	2,317,976	19%	490,904	15%
Low	5,981,150	32%	4,182,256	33%	1,075,607	18%
Total	11,411,221	61%	8,313,458	66%	2,136,135	18%
State-wide[a]	18,583,339		12,507,065		3,322,999	

[a] Percent area of a given stratum and total area encompassed by all strata occurring within the current distribution of sage-grouse in Oregon as defined by Schroeder et al. (2004).
[b] Sagebrush habitat as designated from BLM National Science and Technology Center in Denver, CO, circa 2007 Occupied Habitat Mapping product.
[c] Percent area of a occupied habitat occurring within given stratum compared to that totally available.
[d]Acres of designated wilderness, wilderness study area, and National Wildlife Refuges within each stratum.
[e] Percentage of each stratum with protection status.

Table 21. Summary statistics for two cagtegories of habitat areas for greater sage-grouse in Oregon, 2010.

	Habitat Area				
Population/habitat	Core	%	Low Density	%	Total
No. of Leks	550	82 [a]	122	18	672
No. of Males	7,850	91	832	9	8,682
Avg Males	14.27 (SD =15)		6.81 (SD = 6)		
Sagebrush Acres	5,615,870	78[b]	4,246,916	68	9,862,786
Special Status Acres	1,320,969	18[b]	1,229,578	20	2,550,547
Acres of Core	7,214,621		6,261,051		13,475,672

[a] Percentage calculated as proportion of “Total” in last column.
[b] Percentage of sagebrush and special status calculated as proportion of “Acres in Core” in last row.

Recommendations

General. Core Area maps will be updated as new information is obtained on winter habitat use, lek distribution, disturbance thresholds from various types of development, and success of mitigation measures. It is anticipated that such maps will be reviewed and potentially updated as new and substantial biological information is acquired or concomitant with updates to this Plan.

The intent of this landscape approach is to first, at a broad-scale identify landscapes important to sage-grouse. Then, within those landscapes, map areas for which protection from habitat loss and fragmentation (Core Areas), and areas for which such losses may be of less consequence to the statewide population (Low Density Areas).

The purpose of the Core Area maps is to provide a broad-scale filter to assist planners, county, state, and federal agencies to identify areas of likely high and low resource conflict.

These map units provide guidance in the siting of large-scale industrial developments, recognizing that siting such developments in Core Areas will likely be more of a challenge in avoiding impacts to sage-grouse habitats. Alternatively, Low Density Areas provide guidance as to locations where such developments can be located in sage-grouse habitats with the appropriate level of habitat mitigation.

Habitat Category-1: essential for greater sage-grouse populations and is limited by the inability to mitigate for habitat loss in these areas in a reasonable time frame, and is irreplaceable,.

(i) The mitigation goal for Category 1 is no loss of either habitat quality or quantity.

(ii) The Department shall act to protect Category 1 habitats described here by recommending or requiring:

(A) Avoidance of impacts through alternatives to the proposed development action; or

(B) No authorization of the proposed development action if impacts cannot be avoided

Habitat Category- 2: is essential habitat for greater sage-grouse populations and is limited physiographically as migration or movement corridors between Habitat Category 1 areas

(i) The mitigation goal if impacts are unavoidable is no net loss of either habitat quality or quantity and to provide a net benefit of habitat quality and quantity.

(ii) The Department shall act to achieve the mitigation goal for Category 2 habitat by recommending:

a) Micro-site developments and associated infrastructure to minimize impacts to sage-grouse habitat use and population dynamics (see Guidelines section).

b) Conduct construction and maintenance associated with development activities outside of the period from 1 March to 30 June in sage-grouse habitat. If the developer determines that this time period can not be avoided and the authorizing entity in consultation with ODFW agrees, then restrict the activity from 1 hour after sunset to 2 hrs after sunrise.

c) Because all critical winter range and leks for sage-grouse in Oregon have not been identified: recommend pre-construction surveys or monitoring to identify any areas important to sage-grouse.

d) Conduct monitoring and evaluation to determine if project mitigation measures are adequate to maintain sustainability of sage-grouse in the project area. If mitigation measures are determined to be inadequate either in restoring habitat or populations conservation actions should be adapted to address the issues.

Implementation of Core Area Approach
Consistent with the USFWS Wind Turbine Guidelines (USFWS 2010b) and the mitigation hierarchy of Council of Environmental Quality (2000), the Core Area framework in this Plan seeks to maintain large resilient landscapes to support sustainable sage-grouse populations and habitats, and multiple uses of the sagebrush biome (Kiesecker et al. 2010). Such an approach that synthesizes the mitigation hierarchy and conservation planning offers three advantages over a "project by project approach": 1) it takes into account the cumulative impacts of current and projected development, 2) provides regional context for effectively identifying which level of the mitigation hierarchy should be applied, whether its avoidance or offsets, and 3) offers increased flexibility in choosing offsets that maximize conservation efforts by strategically locating where mitigation actions occur (Kiesecker et al. 2010).

Regardless of the location of an industrial development with respect to sage-grouse Core Areas, ODFW staff will conduct local analyses (may include using information from industry consultants) to verify that habitats within Core or Low Density are in fact sage-grouse habitat. ODFW will provide appropriate recommendations as to whether or not avoidance is necessary and what type of mitigation may be necessary. Generally, ODFW staff will recommend:

1) avoidance of impacts to sage-grouse habitat that occur in Core Areas, and mitigation at no net loss with net benefit for impacts to sage-grouse habitat that occur in Low Density Areas

Per ODFW's Mitigation Policy Categories 1 and 2 are strikingly similar to USFWS definitions except ODFW seeks mitigation with a "net benefit" in Category 2. Thus, Core and Low Density Areas assist in identifying the most productive habitat areas for sage-grouse and those areas should be protected from habitat loss and fragmentation. When that goal cannot be realized then actions should be identified and implemented to minimize the impacts to sage-grouse and their habitats consistent with ODFW's Mitigation Policy.

Map refinement.–Consistent with the Population and Habitat Goals of Oregon's Greater Sage-Grouse Conservation Strategy the following guidelines are intended to refine the boundaries of Core Area Maps. Specifically, the inherent goals of reducing the loss and fragmentation of habitat should be in the forefront of this process.

It is proposed to use regionally scaled (1:50,000 to 1:100,000 images) NAIP imagery (National Agriculture Inventory Program, USDA) and other local information overlaid with Core Area maps to refine the outer boundaries. Each Local Sage-Grouse Implementation Team will evaluate Core Area maps and refine boundaries within the following framework:

1. Adjustments should be made ONLY to boundaries of Core Areas.

2. A 0.5 mile area outside of Core Areas should be considered the standard area for adjustments to the perimeters. *(Clarification: these are the outlined areas on the maps where potential habitat within core extends beyond the current Core Area boundary and leks are <0.5 miles to*

these boundaries. These areas can be considered for core status if suitable habitat is present and activities described in #3-7 below are not present.)

3. Exclude areas of existing industrial activity or permitted at greater levels than those recommended in the Plan (see Conservation Guidelines). This includes mining, wind, solar, geothermal energy development and other uses.

4. Exclude existing municipalities and subdivisions.

5. Exclude existing tilled agriculture.

6. Exclude areas where habitat is inconsistent with greater sage-grouse life-history (e.g., woodlands, badlands, "roughness" areas where terrain is unusable, etc.).

7. Exclude other areas where local information indicates there is no reason to be in core.

Core Area Summary

Core Areas represent a proactive attempt to identify a set of conservation targets to maintain a viable and connected set of populations before the opportunity to do so is lost (Doherty et al 2011). If conservation recommendations are fully implemented in Core Areas they would protect approximately 90% of the breeding populations of sage-grouse in Oregon, but only 38% of the species' range. Thus, this approach identifies the most productive landscapes for sage-grouse that occupy only a fraction of the sagebrush biome in which they occur. The Core Area approach and associated maps provide guidance to land use planners, land managers and the public as to the areas of greatest biological importance to the persistence sage-grouse populations. These areas should be targeted for conservation actions or protections when large scale disturbances are proposed. Alternatively, the Low Density habitats may assist in identifying areas where impacts to sage-grouse populations may be less of a risk, or for opportunities to mitigate for lost habitat.

Table 22. Acres by habitat category occurring within jurisdiction of different land management agencies and private lands in Oregon, 2010.

Jurisdiction	Core Areas	%	Low Density	%
BLM	4,752,365	67%	4,205,349	68%
Private	1,729,556	24%	1,373,323	22%
State Land	191,273	3%	241,709	4%
Forest Service	98,670	1%	229,632	4%
USFWS	244,493	3%	66,407	1%
Other	56,321	1%	48,462	1%
Total[a]	7,072,678		6,164,881	

[a] Note slight differences in acres between Table 21 and 22 are a result of some Core Areas extending outside of the Oregon state boundary.

HABITAT SECTION SUMMARY

Maintaining and enhancing habitat throughout their range will ensure the sustainability of Oregon sage-grouse populations. It is important for land-use practices and habitat projects to be conducted to provide balance between the goal of the project and biological needs of sage-grouse and other species associated with sagebrush. Implementation of the Core Area approach will aid in the strategic prioritization of sage-grouse habitats ensuring that the best available habitats are protected from development and those habitats that are developed are appropriately mitigated. Appropriate and successful mitigation for habitat lost to development is critical in order to achieve the habitat objectives identified in this Plan. Following the guidelines provided in Section V of the Plan will assist Implementation Teams in achieving regional habitat and population goals for sage-grouse.

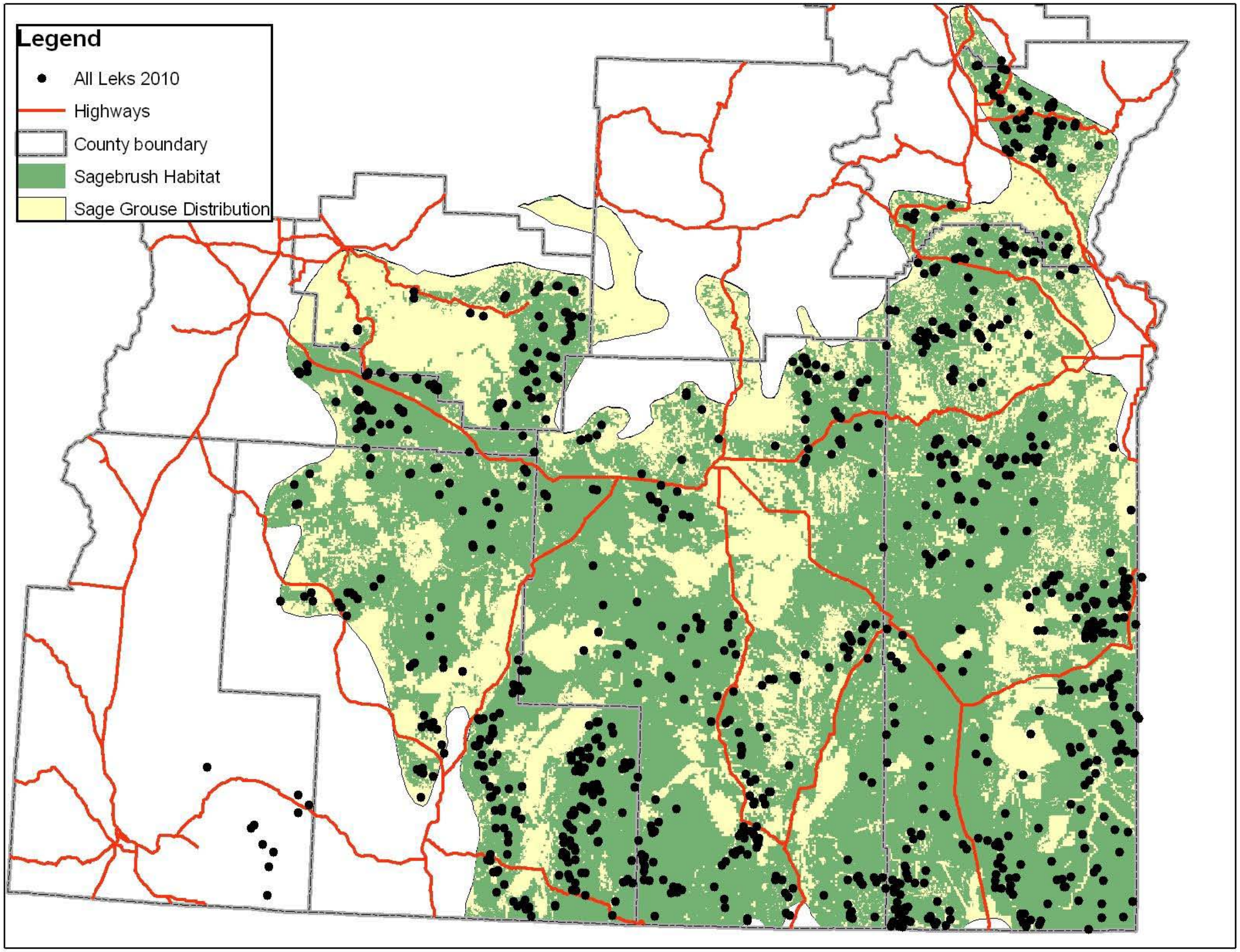

Figure 22. Greater sage-grouse distribution, habitat, and all known leks used in developing lek density strata and connectivity corridors for southeast Oregon, 2010.

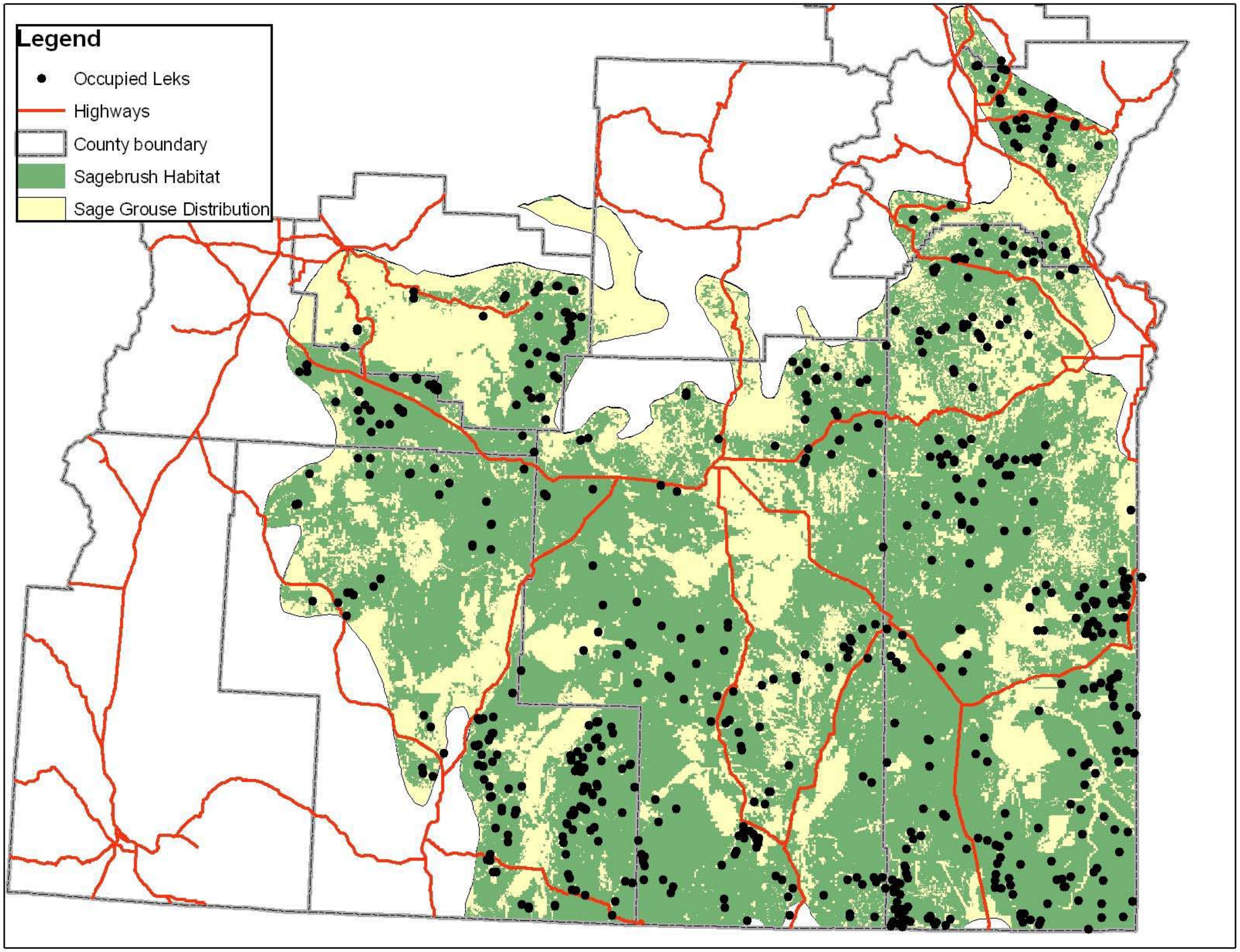

Figure 23. Greater sage-grouse distribution, habitat, and all known occupied leks used in developing lek density strata and connectivity corridors for southeast Oregon, 2010.

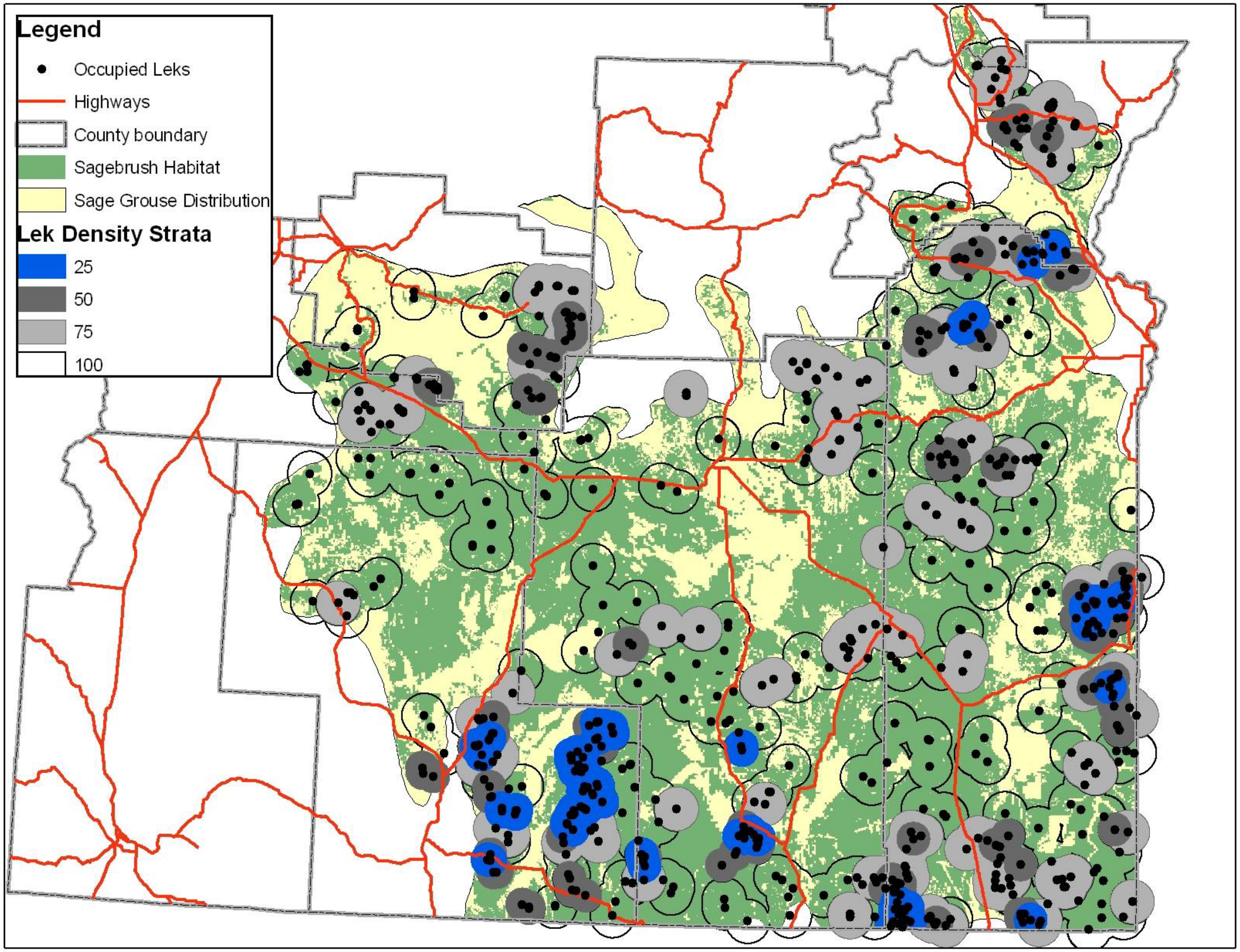

Figure 24. Greater sage-grouse distribution, habitat, and lek density strata for southeast Oregon, 2010. The low density strata are transparent to illustrate the overlap with available habitat.

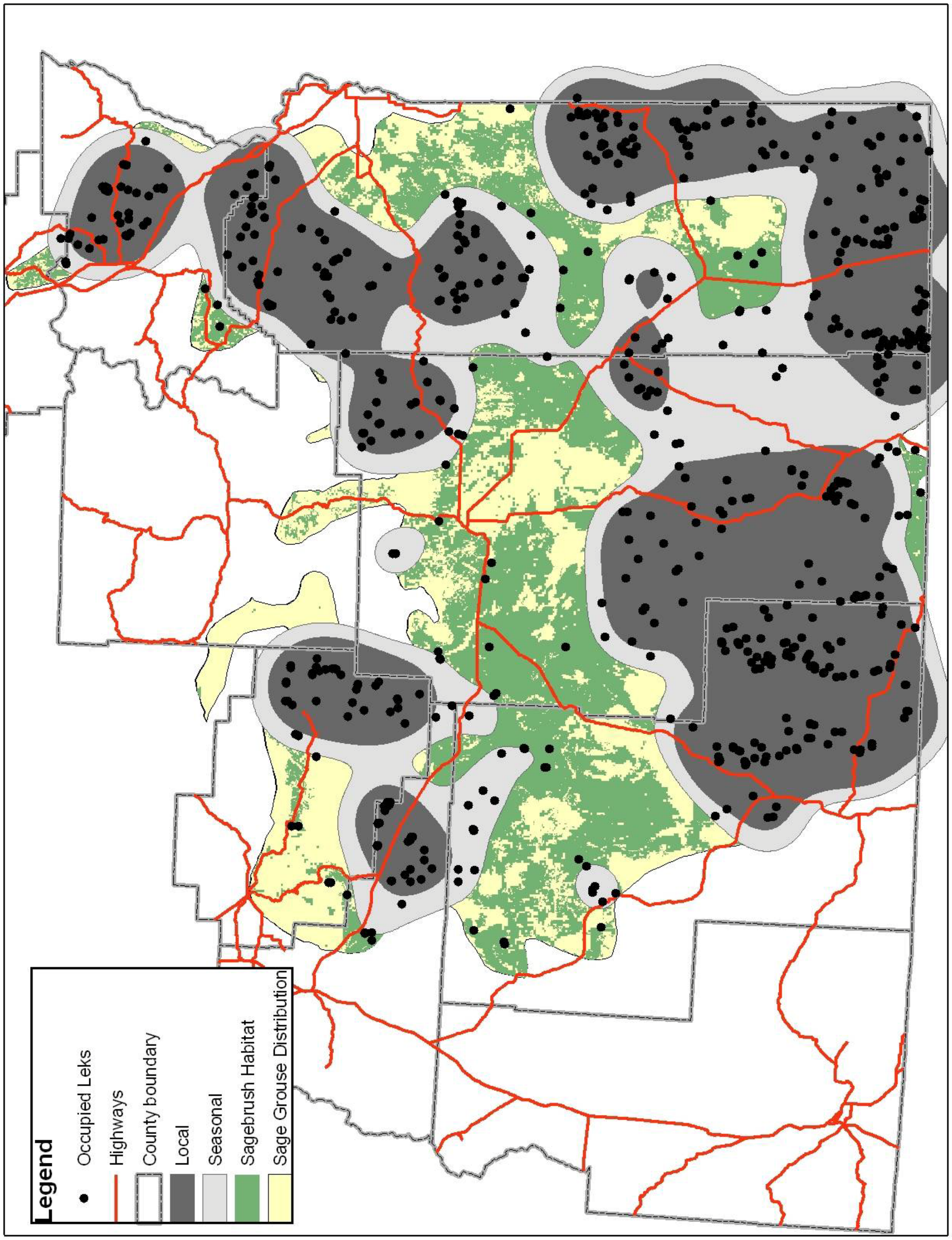

Figure 25. Greater sage-grouse distribution, leks and connectivity corridors for southeast Oregon, 2010.

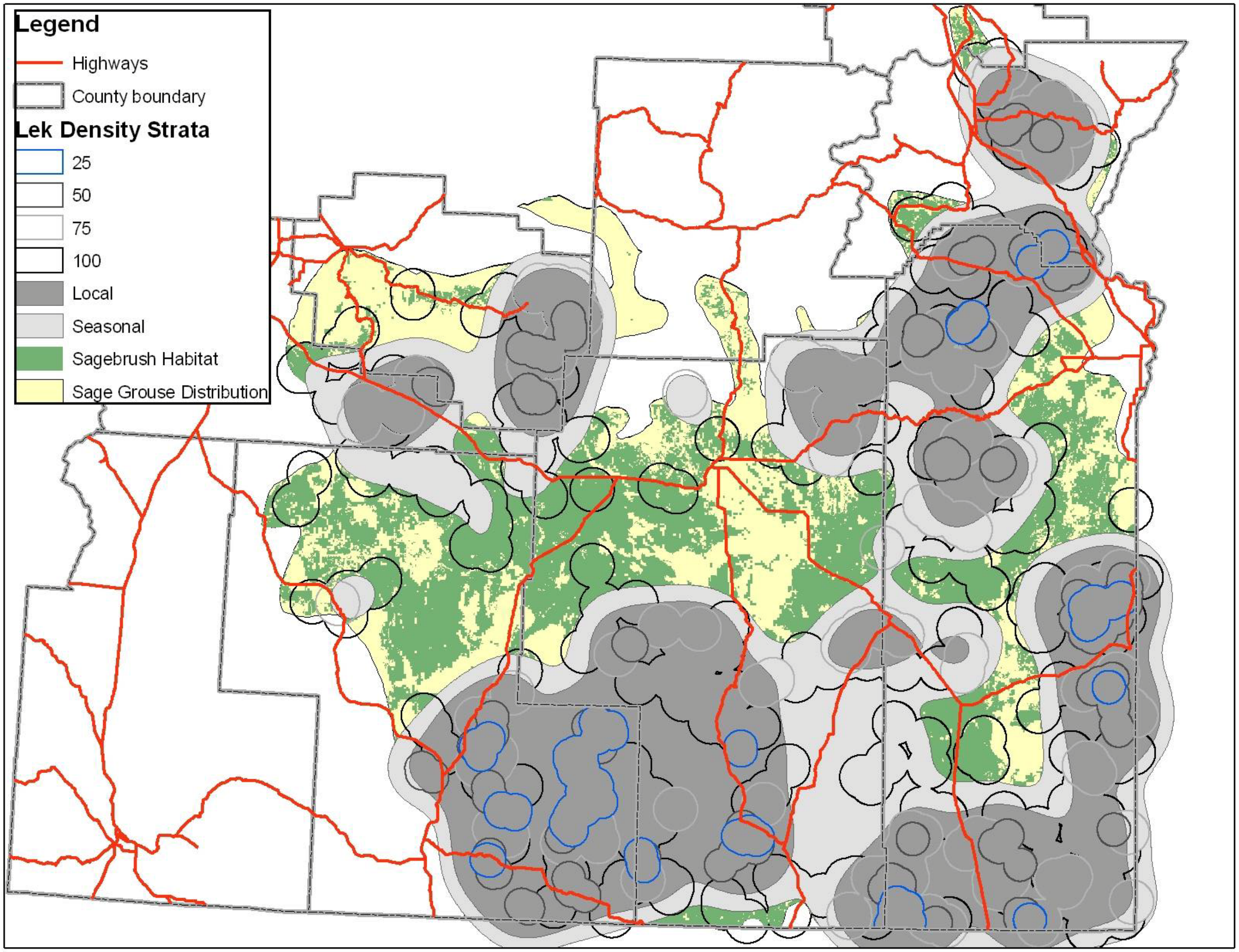

Figure 26. Greater sage-grouse distribution, available habitat and connectivity corridors, and lek density for southeast Oregon, 2010.

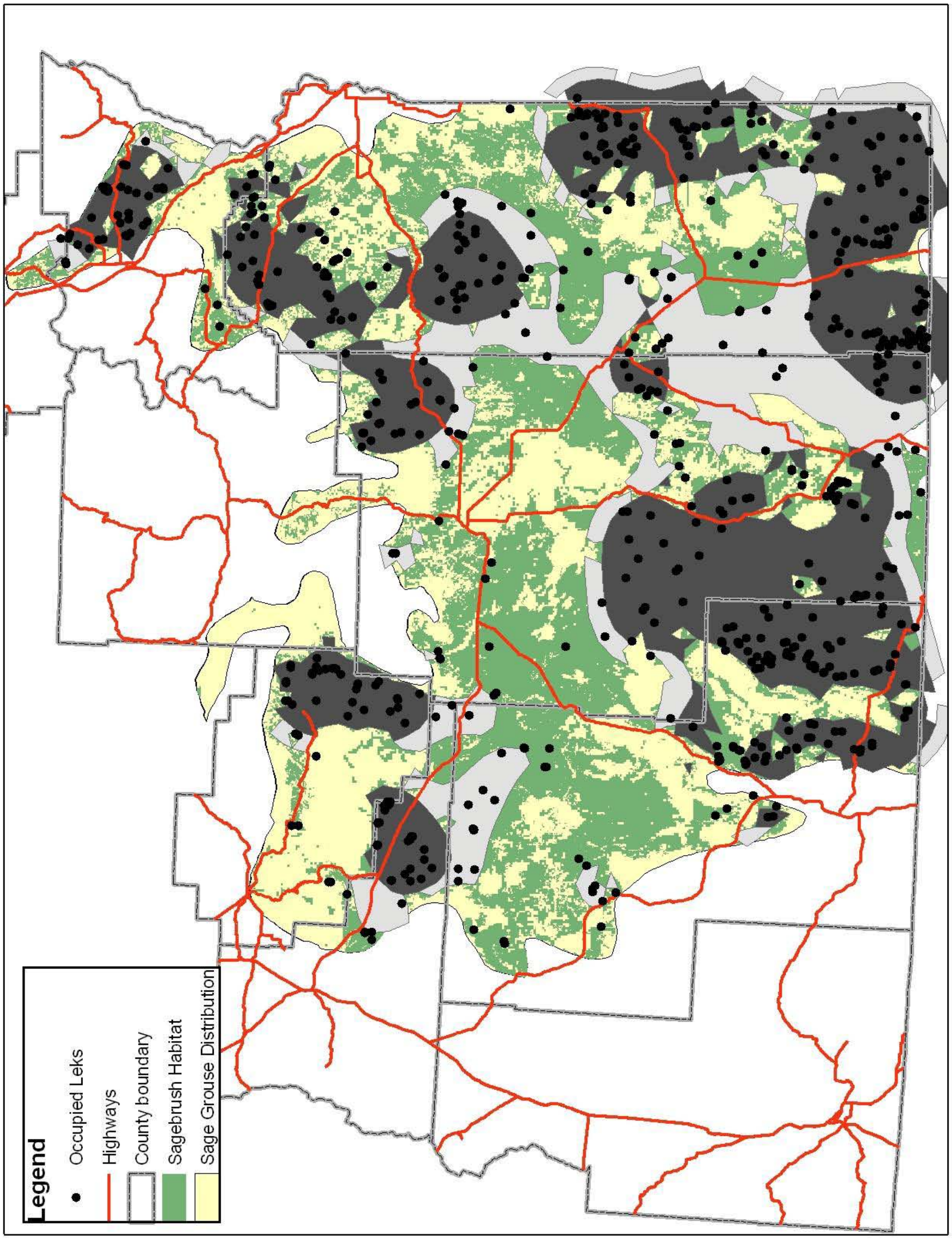

Figure 27. Greater sage-grouse distribution, available habitat and connectivity corridors for southeast Oregon, 2009. Connectivity corridors after they have been clipped to occupied habitat.

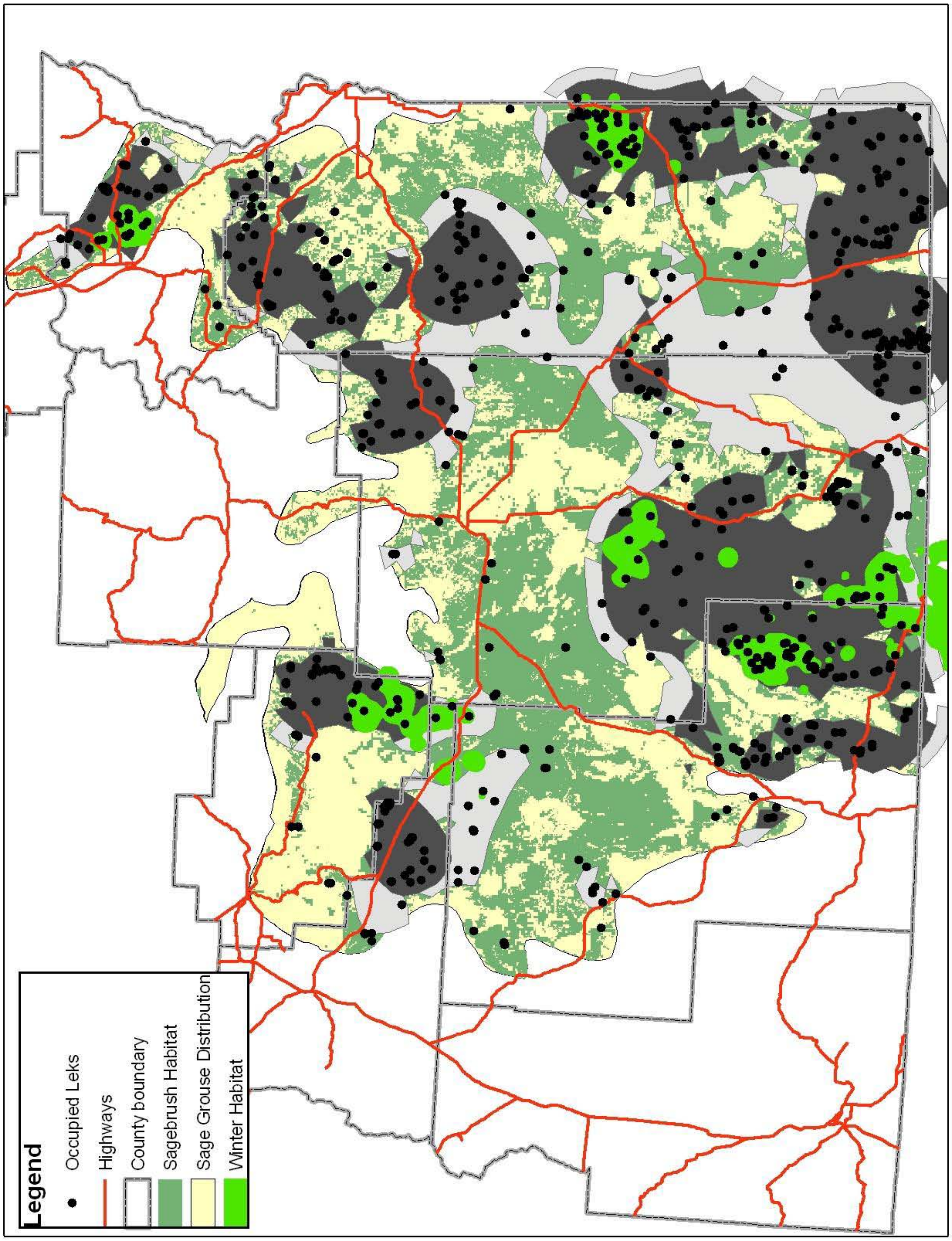

Figure 28. Greater sage-grouse distribution, available habitat, winter habitat use, and clipped connectivity corridors for southeast Oregon, 2010.

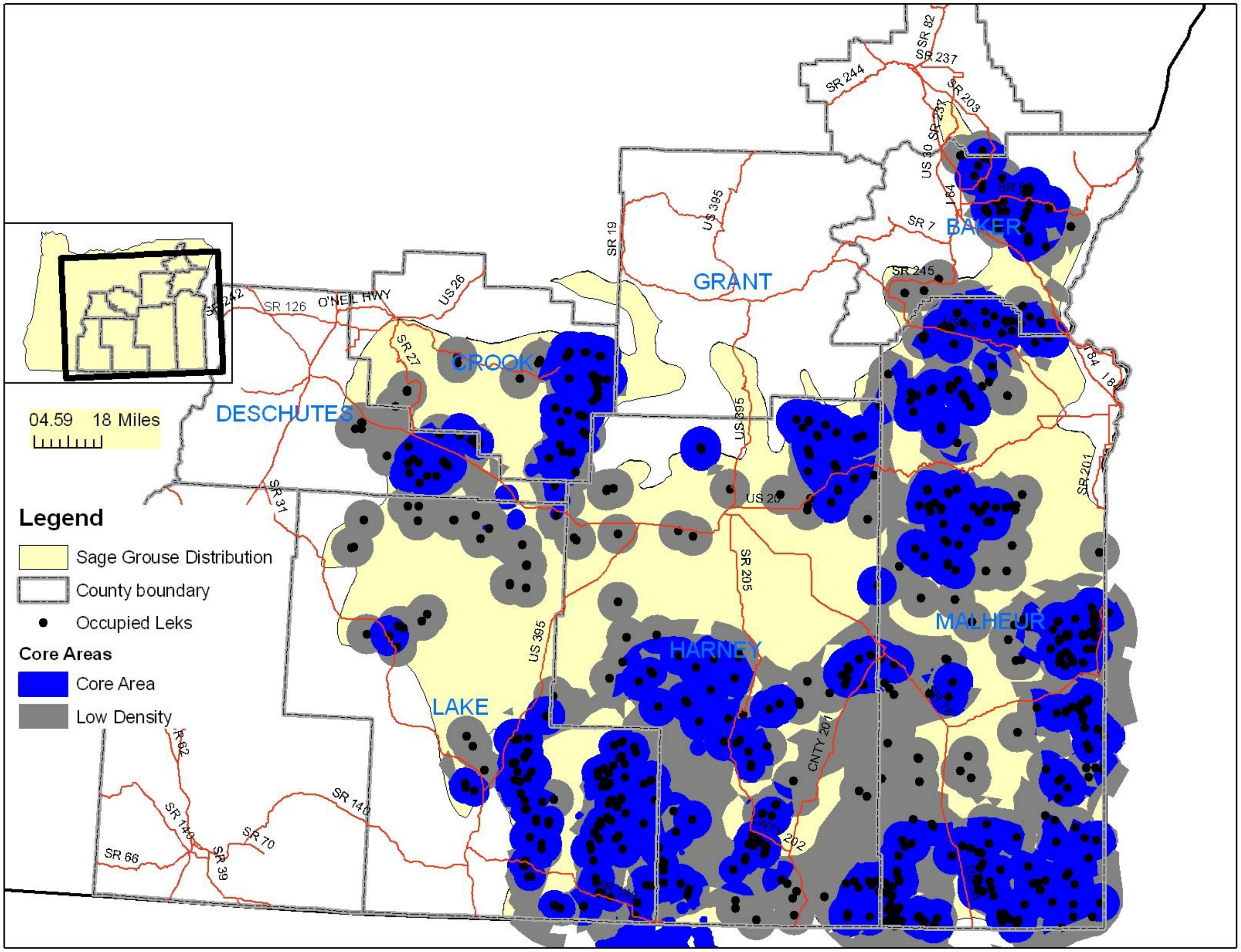

Figure 29. Greater sage-grouse distribution, available habitat, Core Areas and Low Density Areas as defined by lek density strata, connectivity corridors, and winter use areas for southeast Oregon, 2010.

Section V. SAGE-GROUSE CONSERVATION GUIDELINES

These voluntary guidelines are designed to maintain (at a minimum) or enhance the quality (optimum) of current habitats, and will assist resource managers in achieving population and habitat objectives of this Plan. Because populations and habitats have been maintained over a relatively consistent set of conditions for 30 years, maintaining and enhancing the current habitat conditions through these guidelines should assist in providing sustainable populations into the future. The guidelines should be implemented as tools, as needed regionally, because not all issues identified in the guidelines (e.g., juniper encroachment) are relevant to all regions of the state.

Implementation of these conservation guidelines will be guided by local Implementation Teams comprised of land managers, county governments, ODFW, and land owners. These groups include a mix of public and private entities, and because BLM is the primary land manager, local groups are based on BLM District boundaries. Part of the local Implementation Teams' responsibility is to identify the appropriate tools to meet the objectives in their region.

STATEWIDE MANAGEMENT GUIDELINES

The Oregon State Office of the BLM has directed BLM Districts (via Instructive Memorandum OR-2007-8129) in Oregon to use the Management Guidelines outlined in the 2005 version of the Plan to supplant the "*Greater Sage-Grouse and Sagebrush Steppe Management Guidelines"* (2000). It is anticipated that the updated Management Guidelines in this Plan will serve as future guidance to BLM management decisions. Other federal and state land management agencies also adopted the applicable conservation guidelines as signatories to this Plan. This document recognizes the limitation of "one size fits all" management. However, these guidelines were derived from a baseline of knowledge that should be evaluated and compared to regional or local conditions. Moreover, they promote a management focus for the conservation of sage-grouse and sagebrush habitats in Oregon.

The 2010 finding by USFWS that sage-grouse is "warranted but precluded" from listing under the Endangered Species Act identified 2 of 5 possible listing factors (A and D) as significant threats for the rangewide persistence of the species. The five listing factors are as follows.

Factor A: *The Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range*
Factor B: *Overutilization for Commercial, Recreational, Scientific, or Educational Purposes*
Factor C: *Disease and Predation*
Factor D: *Inadequacy of Existing Regulatory Mechanisms*
Factor E: *Other Natural or Manmade Factors Affecting the Species' Continued Existence*

Full protection for sage-grouse under ESA would have serious economic, social, and cultural consequences across the Western United States (Stiver et al. 2008). The remainder of this section will describe various risk factors for sage-grouse as they relate to the 5 factors considered by the USFWS, and provide recommendations to minimize or alleviate these risks. Additionally, regional recommendations for management actions are identified.

Listing Factor A: WILDFIRE

Management of both wild and prescribed fires is considered one of the key issues in maintaining sagebrush systems (Crawford et al. 2004). Sage-grouse have co-evolved in this ecosystem where fire was a primary disturbance process, albeit at infrequent intervals and at seemingly small scales (Miller and Eddleman 2001, Baker 2008). Impacts of fire on sagebrush communities are described with respect to elevational gradients because elevation is an important environmental factor impacting post-fire succession of vegetation. The length of the fire cycle has changed with anthropogenic manipulations to the landscape; it has often shortened in the case of low elevation sites and increased at high elevation sites (Miller et al. 2005). The importance of fire in the sagebrush habitat is often generalized. However, fire regimes are temporally and spatially complex across the sagebrush region due to factors such as site potential, plant community type, and season, size and pattern of each fire (Crawford et al. 2004).

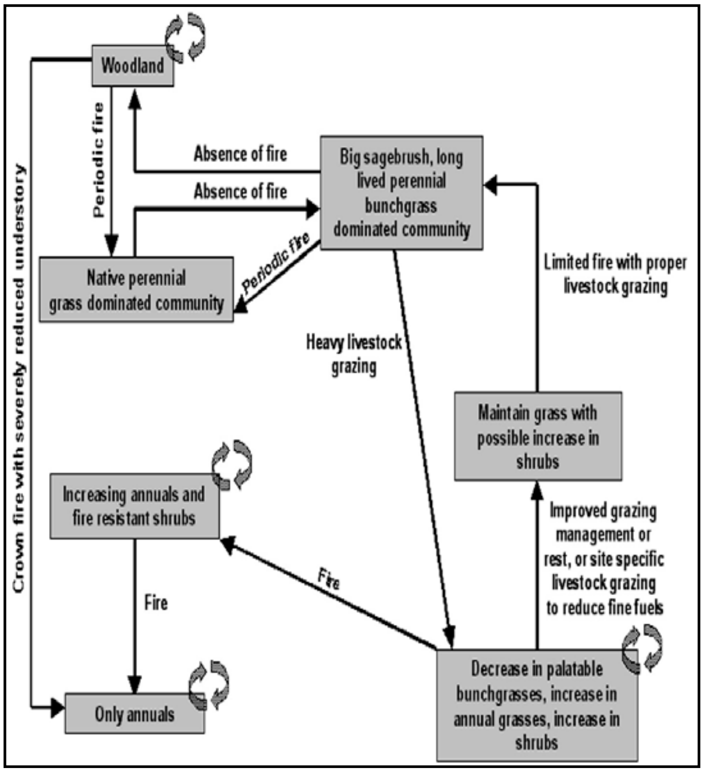

Figure 30. Hypothesized relationship of grazing and fire to successional dynamics in sagebrush communities. Curved arrows indicate "steady states" that will require significant management action to change the community type to a desired habitat condition for sage-grouse. In some cases it may not be economically or logistically feasible to manipulate areas that have become steady states. Movement towards annual plant dominated communities tends to occur in Wyoming big sagebrush communities and at elevations below 1500 m, but this will vary regionally (Adapted from Crawford et al. 2004).

High elevation communities

Post-fire basin and mountain big sagebrush communities generally restock with sagebrush more quickly than Wyoming big sagebrush sites because these subspecies tend to occupy deeper soils and wetter sites. The absence of fire at higher elevations typically results in juniper expansion into sagebrush dominated communities (Figure 30). If fire is absent from a site long enough for juniper abundance to reach or approach stand closure, reduced fine fuel abundance may inhibit fires and necessitate mechanical cutting to restore degraded habitat.

Low elevation communities

Wildfires in low elevation sagebrush habitats may burn nearly all vegetation leaving the area unsuitable for sagebrush dependent species for a number of years. This is particularly true in Wyoming big sagebrush types, especially where there is an abundance of annual grasses in the understory. Repeated wildfires and the disturbance by historic livestock grazing have favored invasion by cheatgrass and other exotic species (Valentine 1990, Pellant 1990). Conversion to cheatgrass alters the fire frequency from the historic 32-70 years in low elevation sagebrush communities to 1-5 years or less (Wright et al. 1979). This scenario is referred to as the cheatgrass-wildfire cycle (Pellant 1996), and is considered a steady state (Figure 30). Cheatgrass monocultures do not provide usable sage-grouse habitat. Wildfires in cheatgrass areas increase the threat in adjacent areas not yet dominated by cheatgrass. If there is an abundance of cheatgrass in the understory of a shrub community, this should alert managers to refrain from the use of prescribed fire in that and adjacent areas. Alternatively, understory cheatgrass provides a good indicator of a high priority protection area during wildfire. There are many more acres of non-cheatgrass communities than areas dominated by cheatgrass; therefore, preventing invasion should be the management priority, as opposed to restoring invaded sites.

Action: Reduce negative impacts of wildfire on sage-grouse through efficient fire suppression techniques	
Issue	**Conservation guidelines**
Fire management plans should identify sage-grouse habitat as a high priority for protection. *During multiple fire events prompt access to local resource specialists, and subsequently to their knowledge concerning areas with critical habitat may be limited.*	1) The act of fire fighting has little impact on sage-grouse as compared to the loss of habitat from a fire. Retain unburned areas (including interior islands and patches between roads and the fire perimeter) of sage-grouse habitat unless there is a compelling safety, resource protection, or control objectives at risk. This may require additional suppression and resources for holding and mop-up. Fire managers should proactively plan for and anticipate these needs early in the incident. 2) Fire specialists and wildlife biologists should review District Fire Management Plans (Phase I) annually to incorporate new sage-grouse information (e.g., lek and habitat viability maps) in setting wildfire suppression priorities. Updates to Phase-I Fire Plans should be distributed to dispatchers for initial attack planning. 3) Train and use resource advisors to assist with prioritizing fires during suppression activities and work with Incident Commanders and Incident Management Teams as appropriate. 4) Give wildfire suppression priority to known sage-grouse habitat within the framework of the Federal Wildland Fire Policy (human life and safety as the first priority, with property and natural resources as second priorities, USDI and USDA 1995). 5) Use direct attack tactics when it is safe and effective at reducing amount of burned habitat. 6) Within 5 km (3 miles) of a lek as well as identified winter range, should be given top priority in fire suppression. Judiciously use heavy equipment and limit brush removal to only the level necessary to expeditiously extinguish the fire. 7) Consider establishing fire breaks or green-stripping along existing roadways to provide a fuel break and safe zone from which to fight fire. a) Establishing strips no larger than 15 m (50 ft) on either side of the road will provide foraging habitat for grouse and provide >30 m (100 ft) of fuel breaks.

	b) Consider planting crested wheat in fuel breaks where annual grasses are prevalent (see guideline on fire restoration for seeding rate). 8) Given the scale of the cheatgrass problem, and its ramifications to sage-grouse habitat it is important to re-iterate that preventing fire from entering at risk communities – e.g., cheatgrass in understory/overstory sagebrush – should be a high priority for protecting sage-grouse habitat.

Action: Reduce negative impacts of wildfire on sage-grouse through prompt and appropriate habitat reclamation or rehabilitation	
Issue	**Conservation guidelines**
The lack of prompt and appropriate rehabilitation following a wildfire can present additional threats to sage-grouse habitat.	1) Wildfires burning >10 acres of sage-grouse habitat should be evaluated to determine if seeding is necessary to recover ecological processes and achieve habitat objectives. a) If seeding is necessary, managers should use appropriate mixtures of sagebrush, native grasses and forbs and appropriate non-native perennials, that will increase the probability of recovering ecological processes and habitat features of the site. b) Wyoming big sagebrush sites should be re-seeded or planted with seedlings of Wyoming big sagebrush when available. c) Wildfires burning >10 acres of habitat that is at high risk of annual grass invasions should be seeded with an appropriate mixture to reduce the probability of cheatgrass establishment. 2) Although planting shrub species is more common now than in the past, sagebrush should be included in fire rehabilitation seeding mixtures or as seedlings as often as possible. 3) The seed supply of native species is generally limited when large acreages burn. Land managers should encourage development of native seed banks (both in the private and government sectors). 4) If native plant and sagebrush seed is unavailable crested wheatgrass can be planted in lieu of native species or as a mixture with native species, because it is readily available, can successfully compete with cheatgrass, and establishes itself more readily than natives. a) If crested wheatgrass is planted initially specific efforts or plans are needed to interseed native grasses, forbs and shrubs in the rehabilitation area. This might include an initial seed-mix of 1 to 2 lbs per acre of crested wheatgrass mixed with natives. 5) If cheatgrass or other exotic plant species are present before a fire occurs, they are likely to become more dominant post-fire if the area is not properly rehabilitated (but see suppression activities above). Rehabilitation techniques that decrease the probability of cheatgrass invasion are needed. 6) Drought can impact the success of a rehabilitation project. Post-treatment monitoring will be needed to determine if rehabilitation efforts need to be repeated if initial attempts fail.

Listing Factor A: PRESCRIBED FIRE

The *Federal Wildland Fire Management Policy and Program Review* (U.S. Department of Interior and U.S. Department of Agriculture 1995) indicates that, consistent with land and resource management plans, fire must be reintroduced into the ecosystem to rehabilitate and maintain ecosystem health and reduce wildfire risk. Recent budget increases in fuels management has allowed increased use of prescribed fire and other fuels management treatments. However, prescribed fire has contributed to the decrease in sage-grouse habitat (Connelly et al. 1994, Fischer et al. 1996a, Nelle et al. 2001). This decrease may be associated with temporary loss of sagebrush cover, or long-term loss due to post-fire dominance of invasive plants.

Action: Reduce negative impacts of prescribed fire on sage-grouse through appropriate strategic planning and field techniques	
Issue	**Conservation guidelines**
If conducted correctly prescribed fires may be beneficial to sage-grouse habitat.	1) Burns should be conducted in such a way that there is a mosaic of sagebrush and burned areas. This "patchiness" will provide a seed source for sagebrush regeneration. These treatments should occur at higher elevations (in the absence of cheatgrass) near juniper encroachment areas. a) Remove juniper encroaching from mountain big sagebrush communities through cutting of juniper and burning piled trees and limbs ("jack-pot burning"). b) Prescribed fires at lower elevations generally should be avoided as a management tool. This tool should be used **<u>only</u>** when i) No other options are available ii) A pre-burn evaluation has determined that the risk of cheatgrass or other invasive weeds is minimal iii) There is a low risk of reducing critical features of sage-grouse habitat

Listing Factor A: LIVESTOCK GRAZING

Moderate levels of livestock use are generally considered compatible with maintenance of perennial bunchgrass, however level of sustainable use varies with a number of environmental factors. Generally cool season bunchgrasses present across much of the sage-grouse range are most vulnerable to the effects of defoliation by grazing in late spring and early summer. Grazing during this time can reduce cover and vigor of perennial grasses and increase opportunity for invasion of undesirable species (Crawford et al. 2004). Optimum sage-grouse nesting habitat consists of a healthy sagebrush ecosystem complete with an herbaceous understory composed of native perennial grasses and forbs. Nesting and early brood-rearing periods are critical for sage-grouse.

<table>
<tr><td colspan="2">Action: Promote vegetation that supports nesting, brood-rearing and winter habitats including maintenance or recovery of shrub and herbaceous (native grasses and forbs) cover. Retain residual cover adequate to conceal sage-grouse nests and broods from predation, and plant communities that provide a diversity of plant and insect food sources.</td></tr>
<tr><td>Issue</td><td>Conservation guidelines</td></tr>
<tr><td>Appropriate livestock grazing regimes can be compatible with sage-grouse habitat needs.</td><td>1) Where livestock grazing management results in a level of forage use (use levels) that is consistent with Resource Management Plans, Allotment Management Plans, Terms and Conditions of Grazing Permits or Leases, other allotment specific direction, and regulations, no changes to use or management are recommended if habitat quality meets Rangeland Health Standard and Guidelines.

2) Where livestock grazing management results in a forage use level detrimental to habitat quality, it is recommended changes in grazing management be made as soon as possible to recover habitat quality.. Adjustments to grazing management should be conducted in accordance with regulations of responsible land management agency.

a) Adaptive management that should be considered include:

i) changes in salting and/or watering locations,

ii) change in the season, fencing, duration or intensity of use,

iii) reducing grazing use levels,

iv) temporary livestock non-use (rest), or

v) extended livestock non-use until specific local objectives are met as identified by implementation group.

3) The timing and location of livestock turnout and trailing should not contribute to livestock concentrations on leks during the sage-grouse breeding season.

4) Measurement of grazing levels should be conducted on that portion of the pasture which is known to be sage-grouse habitat and will not be based on “average use” throughout the entire pasture.

5) Reduce physical disturbance to sage-grouse leks from livestock through managing locations of salt or mineral supplements by placing them greater than 1 km (0.6 mi) from lek locations.

6) Avoid supplemental winter feeding of livestock in known/occupied</td></tr>
</table>

	habitat unless it is part of a plan to improve ecological health or to create mosaics in dense sagebrush stands that are needed for optimum grouse habitat. Although ecologically winter grazing may have a minimum ecological impact on the plant community, the impacts to residual cover for sage-grouse nesting can be detrimental.
Livestock management infrastructure can promote balanced grazing distributions and compatibility with sage-grouse habitat needs.	1) Locate new and/or relocate livestock water developments within sage-grouse habitat to maintain or enhance habitat quality. 2) Spring developments both new and old should be constructed and/or modified to maintain their free-flowing natural and wet meadow characteristics. 3) Ensure wildlife accessibility to water and install escape ramps in all new and existing water troughs. 4) Construct new livestock facilities (livestock troughs, fences, corrals, handling facilities, "dusting bags," etc.) at least 1 km (0.6 mi.) from leks to avoid concentration of livestock, reduce collision hazards to flying birds, or eliminate avian predator perches. a) Fences can be detrimental to local sage-grouse populations. Those fences identified as such or within 1.6 km (1 mile) of an active lek or known seasonal use area should be marked with anti-strike markers. 5) For playas, wetlands, and springs that have been hydrologically modified for livestock watering, local working groups should identify water improvements that have population limiting implications. These should be rehabilitated and off-site livestock watering facilities developed; new water should be available before existing water is eliminated.
Wild Horses--*The management goals for wild horses are to manage them as components of the public lands in a manner that preserves and maintains a thriving natural ecological balance in a multiple use relationship. Wild horses are managed in twenty Herd Management Areas (HMAs) that involve 2.8 million acres of public land, primarily in southeastern OR.*	1) The cumulative Appropriate Management Level (AML) for horse numbers should be kept within current AML (1,351 to 2,650**)** in herd management areas. a) Management agencies are strongly encouraged to prioritize funding for wild horse round-ups in sage-grouse areas that are over AML b) Evaluate the AMLs for impacts on sagebrush habitat c) Further measures may be warranted to conserve sage-grouse habitat even if horses are at, above, or below the appropriate AML for a herd management area.

Listing Factor A: JUNIPER EXPANSION

Before settlement by Euro-Americans, western juniper (*Juniperus occidentalis*) existed on fuel limited sites including open, savannah-like woodlands in low sagebrush (Miller and Rose 1995), rocky surfaces or ridges (Barney and Frishknecht 1974, Cottam and Stewart 1940, Miller and Rose 1995) and pumice influenced soils. These woodlands had an understory that included various sagebrush species. Since the 1880s, western juniper has increased in density and distribution in the northern Great Basin (Miller and Rose 1995, 1999; Miller and Tausch 2001). Western juniper has expanded into mountain big sagebrush, low sagebrush, quaking aspen (*Populus tremuloides*) and riparian communities. The extent of the juniper expansion has increased 10 fold (Miller and Tausch 2001). Increased livestock grazing in the late 1800s and early 1900s contributed to a reduction in fuels that could carry fire, thereby decreasing fire frequency (Miller and Rose 1999, Miller and Tausch 2001). In addition, fire suppression policies have generally lengthened fire-return intervals in juniper-dominated areas. The Natural Resource Conservation Service (NRCS) has developed a National Sage-Grouse Initiative to focus Farm Bill Funding to improve sage-grouse habitat on private land. In Oregon, this effort will focus on early phase juniper removal. Miller et al. (2005) recognize three stages of juniper succession:

- **Phase I**, trees are present but shrubs and herbs are the dominant vegetation that influence ecological processes (hydrologic, nutrient, and energy cycles) on the site;
- **Phase II**, trees are co-dominant with shrubs and herbs and all three vegetation layers influence ecological processes on the site;
- **Phase III**, trees are the dominant vegetation and the primary plant layer influencing ecological processes on the site.

Action: Juniper removal methods should promote the return sagebrush, native grasses, and forbs.	
Issue	**Conservation guidelines**[a]
Funding needed to remove early phase juniper	Promote education and outreach through SWCD and local Implementation Teams to encourage participation in the NRCS's Sage-Grouse Initiative
If conducted correctly juniper removal can restore native vegetation communities to proper functioning condition	1) Mechanical: Chainsaw *Advantages*: selective (trees removed); control of the treated area; broad time period when treatment can be applied; minimal liability; friendly near urban interface, which may negate high costs; maintains shrubs with proper planning; little soil disturbance; not fuel limited; slash may be beneficial in restoring the site; broadcast seed beneath slash. *Disadvantages*: high cost/acre; limited amount of area treated; large amounts of woody debris remains following treatment in dense woodlands; potential liability in fire protection zones adjacent to pine forests. 2) Mechanical: Heavy machinery *Advantages*: control of the treated area; broad time period when treatment can be applied; minimal liability; friendly near urban interface, which negate high costs; maintains shrubs with proper planning; not fuel limited;

	slash may be beneficial in restoring the site; broadcast seed beneath slash; soil surface disturbance may enhance germination of seed broadcast prior to treatment. *Disadvantages*: high cost/acre; limited amount of area treated; some mechanical equipment are limited by steepness of slope and rockiness; large amounts of woody debris remain following treatment in dense woodlands; possible increase in non-native annual grasses; soil disturbance or compaction. 3) Chemical *Advantages*: Can treat areas quickly; not limited by topography; effective on trees less than 2 m (6 ft) in height. *Disadvantages*: Use is highly restricted on Federal lands in Oregon; effectiveness of control often limited; few effective products are currently labeled for this use. 4) Prescribed fire *Advantages*: To minimize the spread of invasive weeds, please refer to cautions about this tool described above. *Disadvantages*: risk; liability; weed threat in some locations; reduction of shrubs (e.g., sagebrush, bitterbrush, mountain mahogany); tree selectivity limited; must have adequate fuels; potential nutrient losses with high intensity fires; limited climatic conditions under which prescribed fire can be used; smoke issues; urban interface.
Slash from mechanical or chemical removals may continue to compromise habitat use.	1) For Phase I juniper <2 m (6 ft) felling and leaving may be effective. a) Consider limbing any branches >1.5 m (4 ft) in height on a felled tree. 2) For Phase I and Phase II where jackpot burning is the most appropriate method of slash removal consider a spring burn (Mar-Apr) when soils tend to be frozen but the moisture content of the felled trees is low. 3) Broadcast burns of juniper invaded sagebrush should be conducted judiciously and such that only one-third of the treatment area is burned (i.e., not to exceed 160 acres). Once sagebrush has begun to recruit a broadcast burn can be conducted for another one-third of the treatment area, and so on for the final third of the area.

[a] These guidelines were adapted from Miller et al. (2005)

Recognizing the transitory phase of a juniper encroachment identified for removal is critical to understanding methods required for removal as well as site rehabilitation to sagebrush steppe. While rehabilitation of lands dominated by western juniper may be beneficial to sage-grouse, lack of proper post-treatment management of these lands may limit rehabilitation towards native shrubs and deep-rooted perennial grasses.

Action: Post-treatment management of juniper removal areas should promote the return of native grasses and forbs to the treatment area.	
Issue	**Conservation guidelines**
If conducted correctly post-treatment management can return areas to native vegetation communities and reduce the risks of invasion of noxious weeds.	1) Seeding prior to treatment should be considered when current perennial grass community is in poor condition (<2 plants /10ft^2,<1 plant/10ft^2 on dry and wet sites) or if exotic annual grasses are present. a) Broadcast seeding prior to soil disturbance or under slash may increase the chances of establishment. 2) Length of rest from grazing following treatment will depend on understory composition at time of treatment and response of desirable vegetation following treatment. This typically varies from less than 1 to more than 3 years. 3) Juniper succession stage (Phase I, II, or III) and site conditions should be considered when selecting removal and post-treatment methods.

Listing Factor A: INVASIVE VEGETATION

Nonnative Invasive Plants

While cheatgrass proliferation has been widespread, increases in other exotic species such as medusahead (*Taeniatherum caput-medusae*), knapweed (*Centaurea* spp.) and yellow starthistle (*Centaurea solstitialis*) and other noxious weeds are also adversely impacting sagebrush-steppe habitat (Quigley and Arbelbide 1997). Many exotic plants are adapted to the Great Basin climate (Trewartha 1981 *in* Mack 1986, Young et al. 1972 *in* Mack 1986), and have the greatest potential for impact on the warmer, lower elevation sagebrush communities. They alter the structure and function of ecosystems they invade and threaten biological diversity (Randall 1996, Vitousek et al. 1996, Olson 1999). Invasive weeds have increased soil erosion, reduced infiltration (Lacey et al. 1989), and displaced native plant species (Belcher and Wilson 1989, Miller et al. 1994). The rapid rate of expansion is partly attributable to the life history of exotic plants. Exotic plants are often opportunists, and many are pioneering, colonizing species. They are frequently one of the first species to arrive and colonize areas that have experienced soil-surface disturbance or areas that lack plant cover. Their establishment and spread are aided by disturbance to the soil surface (Baker 1986, Bazzaz 1986). Spotted knapweed (*C. maculosa*), yellow starthistle, and leafy spurge (*Euphorbia esula*) have exhibited the ability to invade relatively undisturbed sites, including wilderness areas (Asher 1994, Tyser and Key 1988).

Limitations on the Treatment of Invasive Plants

In 1984, the BLM and U.S. Forest Service completed the *Western Oregon Program Management of Competing Vegetation Environmental Impact Statement*. Legal action was taken on this EIS and the result was a court-ordered injunction that prohibited the use of herbicides on all federally-administered lands in Oregon. The injunction was modified in 1987 and allowed federal land management agencies to use 4 herbicides to control noxious weeds only. Those four herbicides are glyphosate, 2,4-D, picloram, and dicamba, and are the only herbicides that can be used on BLM-administered lands. In September 2007, the BLM's Vegetation Treatments Using Herbicides Final Programmatic EIS Record of Decision was published. The EIS will enable the Oregon BLM to implement various herbicides to address this issue. However, the injunction has not been rescinded and it is unclear how quickly the use of herbicides will occur.

Action: Minimize the impact of invasive noxious weeds on sage-grouse habitat.	
Issue	**Conservation guidelines**
Prevention of invasive plants moving into new areas underemphasized.	The most successful and efficient method for managing weeds is prevention of invasion. Weed Prevention Areas (WPA's) should be established in areas with limited infestation. Spread vector analysis should be used to determine the highest probability spread mechanisms. "Invasive Plant Prevention Guidelines" developed by the Center for Invasive Plant Management should be followed to reduce the risk of spreading invasive noxious weeds into sagebrush communities.
Newly arriving satellite weed patches are not detected before they become major infestations.	Systematic and strategic detection surveys should be developed and conducted in a manner maximizing the likelihood of finding new patches before they expand. Once patches are located, seed production should be stopped and the weeds should be eradicated. The most effective tools for eradication of many weeds are herbicides and possibly bio-controls.
Invasive weeds continue to expand from borders of large infestations	Containment programs for large infestations should be maintained. Border spraying infestations, planting aggressive (even appropriate non-native species) plants as a barrier, establishing seed feeding biological control agents, and grazing weeds to minimize seed production are all methods that could help contain large infestations.
Repeated periodic largescale herbicide applications are not sustainable.	The goal of weed management should be to establish and maintain a healthy, functioning sagebrush plant community that has some degree of invasion resistance by maximizing ecological site occupation by native plants.
Many sagebrush steppe communities have not crossed a threshold after which they are no longer recoverable by weed control.	Areas with an adequate understory (> 20% composition) of desired vegetation should be identified and prioritized as high for control since they have higher likelihood of successful rehabilitation that areas where to desired species are completely displaced.
Many sagebrush steppe communities have crossed a threshold after which they are no longer recoverable by control.	A rehabilitation and/or restoration plan should be developed and implemented for areas with inadequate understory (< 20% composition) of desired vegetation. The species of choice should include these with similar niche as the invasive weeds. The goal should be to maximize niche occupation with desired species.
Herbicide injunction on public land limits land managers ability to treat various exotic weeds.	Work with various agencies and the courts to remove the injunction.

Listing Factor A: VEGETATION TREATMENTS

Large-scale sagebrush eradication programs of the mid-1900s resulted in the direct loss of sage-grouse habitat. There is a need (on a case by case basis) to reinvigorate some sagebrush communities that have transitioned into late seral stages. The use of such treatments need to be conducted judiciously, so that the needs of sagebrush associated species are not jeopardized. This section overlaps to some extent with juniper and prescribed fire, but focuses on sagebrush treatments.

Use of Crested Wheatgrass

This Plan recognizes the importance of native vegetation in functioning sagebrush systems; however, currently there is a limited supply of native seed, and current technologies and protocols for establishing native species following disturbance have had only limited success. This Plan encourages the development of native seed sources and the use of native seed by land management entities. However, until that market is fully realized and technologies for establishing native species improve, this Plan supports the use of crested wheatgrass (seeded at low rates [1 to 2 lbs per acre]) in conjunction with native plants as an intermediate step in rehabilitating disturbances to sagebrush habitats. In the recent past, monocultures of crested wheatgrass were used in lieu of native vegetation as livestock forage at the expense of thousands of acres of sagebrush habitat. Despite past use of this plant species it has potential to stabilize an area that has been recently disturbed. It is competitive with cheatgrass and if planted at low rates it is compatible with native grass and forb species (Monsen et al. 2004).

Action: Maximize benefits of vegetation treatments for sage-grouse through best management practices	
Issue	**Conservation guidelines**
Vegetation manipulations should benefit the long-term health of sagebrush habitat.	1) Use brush beating (or other appropriate treatment) in strips (or a mosaic pattern) 4 to 16 meters (12 to 50 ft.) wide (with untreated interspaces 3 times the width of the treated strips) in areas and with relatively high shrub cover (>25%) to improve herbaceous understory for brood rearing habitats, where such habitats may be limiting. Such treatments should not be conducted in known winter habitat (Dahlgren et al. 2006). 2) Avoid vegetation treatments in sage-grouse habitat in areas that are highly susceptible to cheatgrass or other exotic species invasion. Any vegetation treatments conducted in cheatgrass-dominated communities will be accompanied by rehabilitation, and if necessary, reseeding to achieve re-establishment of native vegetation. 3) Minimize disturbance to sage-grouse populations and do not conduct any vegetation treatments during nesting and early-brood rearing periods when sage-grouse are present. 4) Aggressively treat noxious weeds and other invasive plants where they threaten quality of sage-grouse habitat, and apply best management practices to prevent infestations from occurring. 5) Crested wheatgrass can be planted (1 to 2 lbs per acre) but preferably in a mixture with native species, because it is readily available, can successfully compete with cheatgrass, and establishes itself more readily

	than natives. 6) The use of herbicides (primarily tebuthiuron) at low (0.1–0.3 kg ai/ha) application rates may effectively thin sagebrush cover while increasing herbaceous plant production (Olson and Whitson 2002). These treatments should be applied in strips or mosaic patterns. a) Site conditions must be critically evaluated prior to treatment (including fire rehabilitation, new seedings and seeding renovations) to increase likelihood of the desired vegetation response.

Listing Factor A: REALTY

Various human activities and structures decrease quality of sage-grouse habitat, and some can result in habitat loss. This sub-section provides recommendations for a variety of land-use issues and methods of minimizing their impacts on sagebrush habitats. Because direct effects of these risks (disturbances) have not been demonstrated in all cases, it is critical that land management agencies err on the side of sage-grouse needs, rather than assume no effect. Thus, many of the set-back distances are based on the known habitat needs of sage-grouse relative to the distance from lek sites and serves as minimum area that should be protected from development. However, the size, duration, and intensity of a development should be considered when assessing potential impacts and determining the set-back distance for a project. Also, see Core Areas discussion in Section IV for mitigation recommendations related to industrial or commercial development.

Action: Minimize impacts of land-exchanges and the construction of anthropogenic features on sage-grouse habitat.	
Issue	**Conservation guidelines**
Land Exchanges/Disposals	1) Evaluate sage-grouse habitat values when federal or state lands are being considered for sale or exchange. This should apply to the quality of the habitat as well as the quantity (i.e., should not be swapping high quality sagebrush for low quality sagebrush). 2) Maintain existing sage-grouse habitats, with particular attention to areas of intact habitat.
Communication/Emitter Sites	Use existing communication/emitter sites to consolidate activities of new construction, except where topographically impossible, and install new communication sites in forested landscapes. However, off-site mitigation should be considered if the area of impact from new construction is $\leq$640 acres; disturbance of larger areas for communication sites should be critically evaluated.
Road Rights-of-Ways	Disturbance from high volume roads can lead to avoidance of otherwise suitable habitat or direct mortality of birds. Minimize the construction of new roads through occupied sage-grouse habitat, especially lek, nesting and brood-rearing areas.
Agricultural Conversion	Sagebrush conversion on public lands (e.g., crested wheatgrass seedings) should be avoided if the sole purpose is to increase livestock forage. Alfalfa may provide foraging habitats for sage-grouse, but typically this occurs at the edge of extensive agricultural areas. A small number of alfalfa fields in an expanse of sagebrush may provide late-season brood habitat. Typically conversion to alfalfa is at the discretion of private landowner.
Insect outbreaks and insecticides	There is potential for sage-grouse mortality if organophosphorus insecticides are applied to agricultural fields to limit insect damage. Recently similar treatments have been applied to rangelands for grasshopper outbreaks.Such treatments could lead to direct mortality or have indirect effects by removing important foods for chicks. 1) Evaluate necessity of insecticide application

	2) Avoid use of any insecticide in brood-rearing habitats 3) Avoid use of non-specific insecticides in sage-grouse habitats. a) Use instar specific insecticides to limit the impacts to other invertebrate species
Urban Development	Urban developments should be clustered to limit the extent of disturbance to sage-grouse habitats. If clustering is not possible off-site mitigation should be considered (i.e., funding or cost-sharing a habitat project elsewhere). Typically these developments will occur on private land and such stipulations would need to be addressed through county planning.
Habitat Fragmentation	Habitat loss and fragmentation are probably the 2 leading causes for the long-term decline in sage-grouse. Current and future land management will need to examine landscape patterns of sagebrush habitat and seek strategies to ensure that large connected patches of sagebrush are present. The implementation of the connectivity model and habitat monitoring techniques suggested in the Plan will help minimize the impacts of habitat loss and fragmentation.

Listing Factor A: ENERGY DEVELOPMENT AND TRANSMISSION

Commercial or industrial developments (i.e., energy development and transmission) have had varied but generally negative impacts on sage-grouse demography and habitat use (Naugle et al. 2011). Currently, there is a paucity of specific information about the effects of renewable energy development (e.g., solar, wind, geothermal) on sage-grouse ecology. Generally, oil and gas developments within 2-4 miles of leks and/or nesting areas had deleterious effects on populations (Lyon and Anderson 2003, Holloran 2005, Walker et al. 2007). Oil and gas fields may differ in the overall vertical structure and vehicle traffic relative to renewable energy developments, but they are similar from the standpoint that roads and infrastructure fragment native habitat (Becker et al. 2009). Recent work on coal-bed methane development indicates 3 wells per 4 km^2 (~988 acres) diminishes the use of otherwise suitable sage-grouse winter habitat by 10% and with 22 wells use is diminished by 47% (Doherty et al. 2008). The latter figure (22 wells / 4 km^2) is likely similar to some of the densities observed for wind turbine placement (BLM 2010). Wyoming has identified impacts of >1 well per section (640 acres) as an unacceptable threshold for oil/gas developments in sage-grouse Core Areas (Doherty et al. 2008). Specific thresholds for other energy developments have not been quantified or documented in scientific literature.

Increased abundance of raptors and corvids within occupied sage-grouse habitats may result in predation rates outside the range of natural variation (Coates 2007). Transmission structures may also provide nesting sites for corvids and raptors in habitats with low vegetation and relatively flat terrain. Thus, raptors and corvids may preferentially seek out transmission structures in areas where natural perches and nesting sites are limited.

Implementing the Core Area approach to siting of industrial developments and related mitigation provides recommendations about where development should or should not occur. The following recommendations are provided for those areas where micro-siting of infrastructure is going to occur.

Action: Reduce risk of (avoid, minimize and mitigate) impacts from energy development, transmission lines and associated infrastructure on sage-grouse habitat in accordance with habitat mitigation policy.	
Issue	**Conservation guidelines**
Core Areas (Guidance for habitat classification within core areas)	As a broad-scale filter, aim to avoid impacts from energy development in Core Areas. Determine site-specific habitat classifications by answering the following questions: 1) Are the habitats those upon which sage-grouse depend (see Core Area section for details)? 2) Is the site-specific habitat both essential and irreplaceable? a) If the answer is yes to both questions, the appropriate classification is likely Habitat Category 1 under OAR 635-415-0025. Determine whether project will impact habitat and, if impacts are unavoidable, recommend alternative actions. b) If the answer is yes to the first, but not to the second, the appropriate classification is likely Habitat Category 2 or lower and

	habitat mitigation alternatives should be recommended consistent with the Fish and Wildlife Habitat Mitigation Policy.
Low Density Habitat (Guidance for habitat classification in low density habitat)	Determine site-specific habitat classifications by answering the following questions: 1) Are the habitats essential to the species and those upon which sage-grouse depend (see Core Area section for details)? a) If the answer is yes, the appropriate classification is likely Habitat Category 2. Determine whether project will impact habitat and, if impacts are unavoidable, recommend habitat mitigation alternatives consistent with the Fish and Wildlife Habitat Mitigation Policy. Low density habitat will not be classified as Habitat Category 1. 2) Appropriate set-back distances (thresholds) regarding density (# of units per area), size (total area disturbed), and noise levels of energy developments need examination to determine what the effects are on sage-grouse. Until better information is available, managers should err on the side of the birds' biology and use the greatest set-back distance where feasible and necessary. 3) Use existing utility corridors and rights-of-ways to consolidate activities to reduce habitat loss, degradation, and fragmentation by new construction. Where topographically possible, install new power lines within existing powerline corridors or highway rights-of-way. 4) In some cases power lines should be buried to minimize the disturbance. 5) MET towers should be constructed without guy wires, if guy wires are necessary then should be marked with anti-strike devices
Habitat Mitigation	1) Use Core Area designations to Mitigate (avoid, minimize and mitigate) for impacts sage-grouse habitats. 2) Update and revise Core Area and Low Density maps as new information is acquired on winter habitat use, lek distribution, disturbance thresholds to various types of development, and success of mitigation measures.

Listing Factor A: CLIMATE CHANGE

Some climate change projection models indicate significant changes to the sagebrush biome in the next 20-30 years (Miller et al. 2011). Efforts in energy conservation and non-fossil fuel energy developments may assist in reducing greenhouse gases that contribute to global change, and could slow this process. However, if current climate change projections are realized, such changes may impact ODFW's ability to meet or maintain the goals of this Plan. Thus, achieving the 70% sagebrush and 30% disturbance habitat goal may be difficult. It is likely that habitat changes would occur first and population loss would follow. Most climate change studies indicated that higher elevation and more northerly latitude sagebrush communities would be among the most resilient to the projected changes (Miller et al 2011). The sagebrush biome occurring in Oregon is included in the more northerly latitudes and several of the mountain ranges therein (e.g., Steens, Pueblos, Hart, Trout Creeks) would be included in the higher elevation communities. Schrag et al. (2010:13) recommend an increased emphasis on conservation and protection of sagebrush communities with greater likelihood of resilience to climate change, and stated "We recommend increased emphasis on conservation and protection of areas with a high probability of suitable sagebrush habitat in the future, including both core and low density areas."

Action: Minimize the effects of climate change on sage-grouse populations and habitats.	
Issue	**Conservation guidelines**
Non-fossil fuel energy generation in sage-grouse habitat	1) Use guidance provided by Core Areas to site energy development projects 2) Use ODFW Mitigation Policy to avoid, minimize, and mitigate impacts to sage-grouse habitat
Resilient sagebrush habitats need to be identified and protected	1) Use Core Area maps and climate change models to identify those Core Areas that are likely to persist as sagebrush into the future. a) Identify opportunities to conserve and protect those resilient habitats.

Listing Factors B&E: RECREATION

Human uses of the sagebrush steppe for recreational activity vary widely. The direct effects of these activities are unknown, but there are negative correlations with sage-grouse populations and increased human activity (Connelly et al. 2004). There is no commercial use of sage-grouse in Oregon.

Action: Minimize the impact of recreational activities on sage-grouse habitats while ensuring continued enjoyment of the sagebrush steppe ecosystem.	
Issue	**Conservation guidelines**
Viewing	1) Protect existing leks and provide secure sage-grouse breeding habitat with minimal disturbance and harassment through seasonal closures of roads and areas. 2) Provide sage-grouse habitats secure from direct human disturbance during the winter and breeding seasons (when birds are concentrated and susceptible to harassment). 3) If alternative measures have not been successful in reducing disturbances initiate seasonal or area closures as necessary to protect sage-grouse habitats. 4) Assist with developing public viewing areas of sage-grouse leks with oversight from ODFW and land management agencies to minimize disturbance.
Off-Highway-Vehicles (*e.g., includes ATVs, motorcycles, four-wheel-drive jeeps, pick-up trucks, or sport-utility vehicles*).	1) Off-highway-vehicle (OHV) use should be restricted to areas >3.2 km (2 mi) from leks during the breeding season. 2) OHVs should be restricted to on-trail or on-road use during the nesting season in areas known to be occupied by sage-grouse. Some playas serve as breeding display sites and could be impacted by off-road use. 3) The extent and intensity of OHV use should be monitored. Quantifying OHV use (e.g., daily and seasonal use) will assist in mitigating potential conflicts with sage-grouse habitat needs and recreational pursuits.
Developed or Improved Recreation Sites	1) Facilities (i.e., kiosks, toilets, signs, etc.) should be constructed at least 3.2 km (2 mi.) from leks to minimize disturbance during the breeding season. 2) Facilities (kiosks, toilets, signs, etc.) should be constructed to minimize disturbance in known/occupied sage-grouse nesting and early brood-rearing habitat. Avoid construction of facilities that provide avian predator perches unless they include mitigating features such as perch guards.
Hunting	1) Methods further clarified since 2005 for establishing harvest permits (Appendix I). Continue to evaluate and adaptively adjust permit numbers annually. 2) Maintain biological data collection from hunter harvests for estimating productivity, gender ratios, hatch dates, and nesting success, and surveying the prevalence of WNv. 3) Regulations will be re-evaluated every 5-years consistent with ODFW Upland Game Bird Framework.

Listing Factor C: PREDATION

Sage-grouse have many predators, but there is little published information indicating that predation is a major limiting factor for the species (Hagen 2011). Few studies have examined the effects of predator control on sage-grouse populations (Batterson and Morse 1948, Slater 2003, Coates and Delehanty 2004). Batterson and Morse (1948) and Coates and Delehanty (2004) removed ravens from their study areas and indicated increased nest success, however neither study had an appropriate control in their experiment. Slater (2003) examined the effects of coyote removal on nest and brood survival and found no measurable effects between the removal and non-removal area. However, there may be instances where small isolated populations are declining or are at risk of extirpation because of predation. Human-induced increase in abundance of red fox (*Vulpes vulpes*), raccoon (*Procyon lotor*), or other predators may negatively impact local populations. Similarly translocated birds may be unfamiliar with their new habitat and more susceptible to predation. In such instances, where populations are at a critical level the feasibility of short-term predator control program should be evaluated. Long-term intensive predator control programs are not cost-effective or socially acceptable. Proper habitat management is the best long-term strategy to ensure predation does not threaten viability of populations (Schroeder and Baydack 2001, Hagen 2011).

Action: Minimize the effects of predation on isolated, translocated, or declining populations where predation has been identified as a limiting factor	
Issue	**Conservation guidelines**
Predator populations have reached a level outside the range of natural variation *Translocated populations have naïve birds and may be more susceptible to predation.* *Isolated populations may be at increased risk level due to marginal or fragmented habitat* *Populations have reached critically low numbers*	1) Evaluate feasibility of short-term predator management programs. 2) Consider predator management program only when identified as a limiting factor and other management tools have not stabilized declining population. a) Predator management includes both lethal and non-lethal methods. Examples of non-lethal methods are: using perch deterrents on power poles or fence posts, modifications to power poles or other human-made structures that are used by corvids or raptors for nesting

Listing Factor C: WEST NILE VIRUS

The emergence of West Nile Virus (WNv) in the western U.S. and the lack of resistance in the sage-grouse immune system is a serious management concern (Naugle et al. 2004, Clark et al. 2006). Outbreaks of the virus have been localized but sage-grouse have been documented with the disease in Alberta, California, Colorado, Idaho, Montana, Nevada, North Dakota, Oregon, and Wyoming. At this point in time, monitoring for outbreaks is priority and development of response strategies is needed. Oregon Department of Human Services (ODHS) has added sage-grouse to the species watch list for monitoring the spread of WNv. ODHS has provided funding for testing of specimens and information and education. ODFW provides each successful applicant for a sage-grouse hunting permit with 2 Nobuto strips to collect blood samples from each harvested grouse to be assayed for WNv. From 2006-2009, 1,503 samples have been collected, 1,097 have been assayed (2009 samples still pending) with 1 positive (from a juvenile male) being detected in the Beulah Unit from the 2008 harvest.

Action: Minimize the effects of WNv (or other pathogens) on populations.	
Issue	**Conservation guidelines**
The effect of WNv to the statewide population is unknown	1) Investigate and record deaths that could be attributed to disease or parasites. 2) Develop and implement strategies to deal with disease outbreaks where appropriate. 3) Continue to educate public about WNv and sage-grouse. 4) Monitor radiomarked populations during WNv season (July – September) where applicable. 5) Continue to collect blood samples from hunter harvested sage-grouse to monitor the presence of the disease over a broad area.
Areas of WNv outbreak in sage-grouse populations	1) Evaluate feasibility of mosquito control including: a) Mitigate water sources that provide breeding habitat for mosquitoes. i) Change irrigation techniques from flood to sprinkler systems. ii) Control water overflow. b) Use larvicides in areas where mosquito habitat cannot be reduced. c) Evaluate the effectiveness of spraying for adult mosquitoes. i) Consider using mosquito specific insecticides.

Listing Factor D: REGULATORY MECHANISMS

The USFWS 2010 "warranted but precluded" finding determined that current regulatory mechanisms, including those administered through local (County) governments, state, and federal land management agencies, were insufficient to conserve sage-grouse populations, primarily with regard to habitat loss and fragmentation. Regulatory mechanisms have little control of wildfire, invasive weeds, and juniper encroachment. However, all of these regulatory entities can direct or guide location of commercial or industrial development that may result in large scale habitat loss or fragmentation, one of the primary causes contributing to a positive finding on Factor A. Thus, increasing regulatory mechanisms designed to maintain or enhance sage-grouse habitat by local, state and federal regulatory and land management agencies will increase the certainty of a conservation focus for these regions.

Action: Increase certainty that local, state, and federal agencies can fully implement regulatory mechanisms available to conserve sage-grouse habitats and populations.	
Issue	**Conservation guidelines**
State and federal regulatory agencies lack regulations to adequately address the impact of industrial and commercial developments	1) Adopt Core Area habitat categories and mitigation recommendations as part of Resource Management Plans, State Asset Planning, and Forest Planning.
Current local regulations may not adequately address the impact of industrial and commercial developments.	1) Adopt sage-grouse habitat as a Goal 5 resource in County Comprehensive Plans. a) Adopt Core Area habitat categories and mitigation recommendations as part of the Goal 5 resource planning.
Candidate Conservation Agreements (CCAs) and Candidate Conservation Agreements with Assurances (CCAAs) are underutilized tools to foster conservation of sage-grouse habitats	1) Advocate proactive, cooperative approaches to protecting sage-grouse habitat by using CCA or CCAA processes to provide "safe harbor" for participating landowners or permitees and incentives for maintaining or improving habitat and sage-grouse populations. 2) Advocate for regional or local conservation plans that meet the criteria of the USFWS Policy for Evaluating Conservation Efforts (PECE).

REGIONAL CONSERVATION MEASURES

Baker Resource Area

Baker County has substantial human activity. Thus, there is a need to be cautious and evaluate recreational activities as they pertain to sage-grouse habitat use. In particular, the area near Virtue Flat contains several leks (Batterson and Morse 1948), and is under increasing pressure for OHV trail use. The preponderance of private land in this region will require additional efforts to identify willing landowners for participation in sage-grouse conservation. NRCS in Oregon (and throughout the west) has provided funding specifically for sage-grouse, and has identified this region as a priority for projects. Also, given the relatively small and isolated area of sagebrush habitat east of Baker City it is important for land managers to carefully consider the benefits/detriments to sage-grouse, as the population likely will be more sensitive to fragmentation or other disturbance.

Burns District

While there are large areas currently under special status in this region, the multi-scale approach to rangeland assessment has not been adopted in the Andrews Resource Management Plan (RMP). The 3 Rivers RMP will be updated in the near future and the multi-scale approach should be included in the new document.

Management practices should maintain connectivity of core sagebrush areas between Burns, Lakeview and Prineville Districts to the west and Vale to the east. Several areas along Highway 20 corridor between Hines and Hampton are in need of juniper removal to maintain connectivity of this core area. There are at least 200,000 ha (500,000 acres) of juniper that need to be evaluated for potential treatment throughout the district. Fire has altered at least 54,000 ha (133,000 acres) within which opportunities for habitat rehabilitation and restoration need to be identified (Table 23). Similarly acreages of grassland, seedings, and non-sagebrush shrublands need to be evaluated for conservation projects. Specific opportunities will be identified by Implementation Teams, but most of this work will need to be addressed by BLM.

Lakeview District

The 2003 Lakeview RMP provided significant consideration for sage-grouse in resource use and activities. There is a need to adopt the multi-scale rangeland and habitat assessment proposed in this document. Habitat management at Hart Mountain National Antelope Refuge also should include the multi-scale approach; this will assist in providing a more complete profile of habitat configuration with respect to the long-term landscape scale objectives for sagebrush cover.

At least 76,000 ha (190,000 acres) of juniper need to be evaluated for potential treatment (especially the area west of Warner Valley). Rehabilitation projects need to be identified for areas planted to crested wheatgrass, and trying to bring portions of those stands into sagebrush classes 3, 4, or 5. Most of these plantings occurred in the northern portion of the district. Rehabilitation of at least 40,000 ha (100,000 acres) in transition from fire needs to be assessed.

Sage-grouse have been absent from the Klamath Falls Resource Area since 1993. Habitat improvement projects continue in this region with respect to juniper encroachment treatments (T. Collom, ODFW personal communication). A reintroduction of sage-grouse to Klamath Falls region may have potential both from the stand point of habitat and population restoration. Such a project would need careful consideration and habitat evaluation to judge the likelihood of success. Additionally, sage-grouse and sagebrush management in California should be considered when evaluating the potential translocation to this region.

Prineville District

Prineville RMPs are beginning the process of updates and renewal; it is recommended that the adoption and integration of the multi-scale approach described herein should be included in each new RMP. Because Prineville District includes a larger human population than most others in Oregon’s sage-grouse range, there is an array of issues that likely will need action in the near future.

Table 23. Acres lost to wildfire in each of the Sage-grouse Implementation Team regions, 2004-2009, in Oregon.

Habitat viability	Baker	Burns	Lakeview	Prineville	Vale	Total
High	3,517	134,488	1,059	1,191	154,376	294,989
Moderate	9,144	32,854	2,236	2,588	149,673	196,495
Low	0	16,799	1,073	0	891	18,763
Negligible	1,818	22,938	38	0	23,953	48,747
Sage-juniper	325	14,767	358	937	12,651	28,680
Total	14,804	221,846	4,764	4,716	341,544	587,674

Juniper encroachment (130,000 ha [320,000 acres]) is a significant issue for this region as it may marginalize 30% of the habitat remaining in the district (Table 17). Disturbances due to fire need to be clarified through more thorough inventories. Maintaining the connectivity of habitat between this region and Burns and Lakeview districts is critical to ensuring the long-term sustainability of the current population. Identifying partnerships to best maintain or rehabilitate these areas will be critical in this region where private land comprises a slight majority of sage-grouse habitat. Similar to Baker County because of the preponderance of private land, this region will be a priority for NRCS projects. Because of declining sage-grouse population trends in this region aggressive management is needed to identify limiting factors and halt the decline.

Human impact is the greatest in this region, whether it is anthropogenic structures (power lines, OHV trails, residential developments) or activities (mountain biking, bird watching, horseback riding). These all occur in greater frequency on a relatively smaller area in comparison to the remainder of sage-grouse range in the state. Thus, management and mitigation of such activities will be necessary to reduce the impacts on sage-grouse. Managing the human activity may be the primary conservation action to assist in stabilizing populations. Habitat improvements should be pursued in concert with managing human activity.

Given the continued negative trends in sage-grouse populations in Prineville District, it may be necessary to augment populations in the future through intrastate translocations. It is recommended that such efforts should be pursued in conjunction with aggressive habitat management strategies to increase the likelihood that augmentations will succeed. Loss of the Prineville District population would not only reduce the range of the bird but, in effect, create a new peripheral range and the population susceptibility that often corresponds with populations at the fringe of the range. Several sagebrush areas > 1,000 ha (2,500 acre) were identified near Warm Springs Indian Reservation and further north into Wasco and Jefferson counties. These areas should be evaluated for their potential to support sage-grouse and future re-introductions considered if long-term sustainability is feasible. Thus an evaluation should consider the ability of birds from these isolated patches to disperse or interchange with populations further south in the district.

Vale District

The Southeast Oregon RMP is the most recent in Oregon, but does not include the Baker Resource Area. The Baker RMP is due for renewal and it is recommended that the multi-scale approach used in the other 2 resource areas should be adopted. Similar to Prineville, Baker City and the surrounding public land is another urban interface that has potential for conflicts between human recreation and sage-grouse habitat.

Fire has altered > 62,000 ha (154,000 acres) of sagebrush in the Vale District in recent years (Table 23) and thousands of sagebrush hectares were converted to crested wheatgrass in the 1960s-70s. This has produced significant grasslands throughout the southern portion of the District. Some of these areas have been recolonized by sagebrush. It is recommended that experimental work to rehabilitate those areas not in sagebrush should be conducted. Similarly much work is needed to identify the best methods for rehabilitating areas lost to fire, so that cheatgrass invasions are minimized. Contrary to other districts, juniper does not pose as great a threat as fire and invasion of cheatgrass. Higher elevation sites especially in the Malheur watershed should be evaluated for areas of juniper (235,000 acres) which threaten the connectivity of sagebrush habitat. Much of this area is administered by BLM and these actions will need to be facilitated through that agency.

Table 24. Estimates (in acres) of gross and net changes in available sagebrush habitat offset by juniper treatments conducted from 2005-2009 within occupied range of sage-grouse in Oregon. Rangeland improvement project and annual grassland treatment acres are also reported, but are not considered in the calculations of net change.

Habitat type / treatment	Baker	Burns	Lakeview	Prineville	Vale	Total
Sagebrush[a]	435,979	3,055,778	2,229,673	926,869	4,094,486	10,742,785
BLM Juniper[b]	0	81,483	10,788	3,042	380	95,693
NRCS Juniper[c]	3,573	931	2,040	4,787	3,507	14,838
Other Juniper	1,000	130	2,734	455	1,158	5,477
Total juniper	4,573	82,544	15,562	8,284	5,045	116,008
Loss to fire	3,517	134,488	1,059	1,191	154,376	294,631
Gross change	-0.81%	-4.40%	-0.05%	-0.13%	-3.77%	-2.74%
Net change	**0.24%**	**-1.70%**	**0.65%**	**0.77%**	**-3.65%**	**-1.66%**
Annual grass treatment[d]	0	130,352	903	0	27,623	131,255
Range health NRCS[c,e]	29,153	16,890	5,594	51,033	36,755	139,425

[a] Sagebrush acres are from Table 20 in section IV on Habitat.
[b] Juniper treatment refers to hand-felling and removal of juniper trees, slash removal was generally conducted via "lop and scatter" or "jackpot" burning.
[c] NRCS statistics did not separate specific treatments: used proportion of juniper (30%) to other treatments (70%) conducted on BLM land to estimate acres of juniper and rangeland enhancement acres.
[d]Annual grass treatment refers to techniques used to eradicate invasive annual grasses: generally the application of herbicides and potential reseeding after spraying.
[e] Range health are projects that sought to improve quality of existing sagebrush habitat through grazing management, and associated practices of water placement, spring protection and restoration, fencing, and brush thinning.

SECTION VI. IMPLEMENTATION AND MONITORING

IMPLEMENTATION

Framework and Background

Community-based conservation has been evolving during a period when wildlife conservation and natural resource management have been in the midst of three conceptual shifts: from reductionism to a holistic or systems view, to include humans in the ecosystem, and from expert-based to participatory conservation and management (Berkes 2004). The implementation goal of this Plan is to use community-based conservation to achieve the population and habitat objectives herein (Berkes 2004, Peterson et al. 2004).

Some of the conservation issues facing sage-grouse (e.g, grazing and fire) are spatially and temporally complex and will require adaptive management frameworks to reduce the level of uncertainty and achieve success (Boyd and Svejcar 2009). Alternatively, juniper encroachment is a relatively simple conservation issue but complex from the spatial extent (Miller et al. 2005, Boyd and Svejcar 2009). In either case, the cooperation of federal, state and private partners is necessary to be successful in addressing these conservation issues. Similarly, both well-founded science and local ecological knowledge can contribute to solving some of these complex problems. It is in the spirit of community-based conservation that this Plan seeks to implement conservation actions for sage-grouse populations and their habitats in Oregon.

The specific framework to implement community-based sage-grouse conservation is through adaptive co-management (Berkes 2004, Armitage et al. 2009) which explicitly integrates traditional or local ecological knowledge (Berkes et al. 2000) into the decision making process for local conservation actions. Such an approach is critical to acknowledging the ongoing sustainable conservation practices for healthy rangelands and provides a framework to monitor and evaluate them in the context of adaptive management (Bellamy et al. 2001, Armitage et al. 2009).

As several case studies have demonstrated (Bellamy et al. 2001, Peterson et al. 2004), the more transparent and inclusive a natural resource management process is with local communities the more likely there is to be support for the final plan, greater compliance, and greater community satisfaction (Peterson et al. 2004). In short, such a process yields significant "social capital," which reduces overhead costs by empowering the collective action of the local community. Adaptive co-management requires a shift away from "command and control" planning and decision making to more collaborative management of natural resources that incorporates local knowledge (Berkes 2004, Armitage et al. 2009).

Public Land Management

The guidance provided in the Plan in regards to habitat management and/or protection recommends BLM determine if the guidance conforms to existing RMPs. It is recommended that current science within the Plan that may exceed RMP guidance should be applied at the project scale until such time the RMP is amended to incorporate this guidance. A schedule of RMP renewal is needed so that BLM Districts can decide whether or not to amend current plans if needed or to include these recommendations as policy in forthcoming updated plans.

This Plan provides biological recommendations for long-term conservation of sage-grouse in Oregon based on the best available science. However, ODFW recognizes that land use planners and managers may need to consider these recommendations within the context of social-economic issues and decisions that are the responsibility of the respective governmental bodies. Thus, the intent of this plan is to inform decision-makers regarding the biological consequences of various actions on sage-grouse, but not to dictate land management decision.

Integrating the State's Strategies and Local Conservation

This Plan provides specific non-regulatory guidance for public land management agencies to consider when adopting conservation practices so that compliance can be measured and regulatory mechanisms will exist for management of sagebrush habitats. The Plan also provides private landowners with recommended conservation actions and monitoring tools to measure the outcome of those actions. The Plan identifies most of the issues surrounding sage-grouse in Oregon. As local projects and working groups evolve to address them, other issues may arise and some may not apply to a specific region. It is the intent of this Plan to provide private landowners with recommended options for land management. Voluntary conservation projects need to be identified that are mutually beneficial and can be funded with the assistance of ODFW, NRCS, BLM, SWCDs, or USFWS. The goal of the Plan is to provide a foundation for conservation agencies and individuals to work cooperatively in sage-grouse and sagebrush management, and identify or define landscape mosaics that support stable populations of sage-grouse.

Berkes (2004:629) outlines 4 important aspects of adaptive co-management that should be in the forefront of sage-grouse conservation at the local level:

1) Matching the scale of management to the scale of the system to be managed and implementing solutions at the local level are both important principles to follow.

2) Two key elements of adaptive co-management for making community-based conservation work: a) sharing of management power and responsibility, and creating a context that encourages learning and stewardship and builds mutual trust.

3) Incentives are multifaceted. Equity and empowerment may be more important than monetary incentives. A workable conservation project helps implement decision making processes that are legitimate, accountable, and inclusive.

4) Knowledge is power, and the use of local ecological knowledge is a mechanism for co-management and empowerment.

Plan Implementation

The Oregon Sage-grouse Conservation Plan will be implemented at the state and local level. Although there may be policies and conservation actions that occur at the state level, it is the intent of this Plan that most of the conservation actions occur under the guidance of the local Implementation Teams.

Local Implementation Teams
Implementation of conservation guidelines outlined in this Plan will be guided by local Implementation Teams comprised of ODFW, land managers and land owners. Because these groups are not mutually exclusive and include a mix of public and private entities, BLM is the primary land manager; local groups are based on BLM District boundaries (and in some cases Resource Areas).

This Plan identifies five local Implementation Teams: one in each BLM district boundary and one in the Baker Resource Area within the Vale District boundary. Membership of local Implementation Teams will include at a minimum: ODFW, DSL (where applicable), SWCD (two private land owners), BLM (one biologist and one rangeland conservationist), USFS (where applicable; one biologist and one rangeland conservationist), County Government Representative (there will be two county government representatives on the Prineville Team, Deschutes and Crook counties, and the Baker Team, Baker and Union counties) and USFWS Refuge (where applicable). Additional private landowners may be appointed by the SWCD Board of Directors as existing elected Directors or as Associate Directors as recommended. There may be existing groups in counties or BLM districts that may serve as the implementation team, provided they include the representation from appropriate action agencies. The local Implementation Teams, and/or individuals (public and private) represent entities that are directly responsible for implementing on the ground actions identified in the Oregon Sage-Grouse Conservation Plan. The local implementation team may appoint additional members as needed. Technical experts/advisors may be consulted through Oregon State University, USDA Agricultural Research Service, USFWS (Ecological Services), or NRCS, as needed.

Role of Local Teams
The primary directive for Implementation Teams is to ensure that sage-grouse and sagebrush habitat conservation decisions (at a minimum those actions identified in the Plan) occur at the local level. These groups facilitate and identify management priorities and actions to address them to achieve population and habitat objectives (See Appendix V for risks and projects identified by local implementation teams). This process occurs at the interface of public and private lands. Priorities and projects should first be identified based on the biological needs of sage-grouse or habitat rehabilitation. Ownership or administrative jurisdiction should be secondary in identifying priorities, but are critical in identifying partners to implement a conservation action. As a result, implementation of projects requires two parallel processes; one for public and the other for private lands. Plan implementation on private lands occurs primarily through the local SWCD offices or Watershed Councils. The public lands process includes extensive public involvement via the NEPA process through integration of plans of other federal land management agencies in the designated area. Regardless of ownership, local implementation groups are responsible for establishing: appropriate timelines, parties conducting treatments and monitoring, and identifying funding sources for projects. It is the expectation that decisions will be made through consensus. Conflicts arising regarding projects or management actions could be elevated to the state conservation team for discussion and consultation.

Local teams will implement conservation within the scope of existing policies. Such groups may influence agency policy, but they do not set policy, and cannot change policies, many of which are mandated by state and federal law.

Incentives.—Working with local Implementation Teams ODFW and USFWS will seek to promote incentives for sage-grouse conservation on private lands through development of USFWS Candidate Conservation Agreements with Assurances (CCAA), ODFW Private land Habitat programs (e.g., Access and Habitat), and incentives on public lands through development of Candidate Conservation Agreements (CCA). A regional or local conservation plan for sage-grouse could be developed to meet the requirements of the Policy for Evaluating Conservation Efforts (PECE), and may include both public and private land management. Additionally, ODFW and NRCS expect to continue promoting juniper removal in important sage-grouse habitats across the state through cost-share programs and the NRCS's National Sage-Grouse Initiative.

The Oregon Sage-grouse and Sagebrush Habitat Conservation Planning Team will provide oversight and guidance by providing workshops and training to regional teams.

Mission and Guidance

The following principles provide a framework to guide local efforts. Each team may find a need to develop additional principles or ground rules that meet local needs and improve its efficiency.

1) Conservation actions for sage-grouse are intended to promote intact and functioning sagebrush steppe communities.

2) Conservation strategies identified in the Plan and additionally by local efforts will integrate local, regional, and national needs for sage-grouse and sagebrush habitat conservation.

3) Wildlife professionals, land managers, private landowners, and all others who have a vested interest in sagebrush communities will be tolerant, understanding and respectful of other perspectives and focus on areas of common interest.

4) The Plan is not intended to exclude any users or activities or infringe on legally defined private property rights; but serves to provide solutions to problems and issues that affect sage-grouse and the functionality of sagebrush communities.

Effectiveness and Validation of Conservation Measures

Sagebrush systems respond slowly to treatments and it may take several years of monitoring before effects are observable. Thus, when evaluating the impacts on sage-grouse populations or their habitats there needs to be a long-term commitment by all involved in the project in order to measure the outcome.

The criteria by which a management action is considered successful will vary by project. The crux will be to decide: how big of an effect is needed and can it be accurately measured? The conservation measures suggested will need to be evaluated in terms of population or vegetation response. Other response variables may warrant exploration depending upon the resource that may be impacted.

ACCOMPLISHMENTS AND EFFECTIVENESS

Since 2005, Implementation Teams further refined conservation opportunities and knowledge gaps for sage-grouse in their respective regions (Appendix V). The following accomplishments of conservation actions are summarized by actions for each implementation region, and to assess overall effectiveness at the state level. Notably, NRCS reported conservation projects by County, not Implementation Team boundary, those statistics will not be directly comparable, but generally follow similar geographic distributions.

Baker

Habitat.—Priority conservation opportunities in the Baker Implementation Area included: juniper removal, annual weed removal, and management of human activities (i.e., recreation and industrial development). Since 2005, nearly 14,000 acres of juniper have been removed from sage-grouse habitat. Another 30,000 acres of habitat has been managed to improve habitat quality (Table 24). The Virtue Flat OHV staging area was moved to the north side of the road and fenced to reduce potential disturbance to the lek area.

Populations.— Biological questions included understanding potential biological isolation of the Baker populations north and east of Interstate-84, and understanding the distribution and trends of other leks. In 2006, aerial surveys of sagebrush habitat with "unknown" sage-grouse populations west of I-84 between the Lookout and Sumpter Wildlife Management Units (WMUs) were completed with no new breeding populations detected. Additional aerial surveys were conducted in 2009 to determine status of all leks in the region, no new leks were identified in 2009, but four new leks were identified in 2010.

ODFW requested data from USGS Conservation Genetics Lab in Denver Colorado for mitochondrial DNA (maternally inherited DNA) information on Lookout Mountain and Beulah WMUs. Haplotypes in these areas were compared to the frequency of the five most common haplotypes found rangewide and their percentage prevalence in Oregon.

Summary of haplotypes found in Lookout and Beulah units of Oregon compared to rangewide..

Lookout			Beulah			Most common	
Haplotypes	N	%	Haplotypes	N	%	Haplotypes	%
A	3	38	**A**	2	20	**A**	30
B	2	25	F	2	20	**B**	5
F	1	13	Q	1	10	C	0
DG	1	13	V	1	10	**X**	20
DD	1	13	**X**	2	20	EJ	0
			AG	1	10		
			CE	1	10		
Total	8			10			

Because there were no unique haplotypes identified, there appears to be reasonable connectivity between birds in Northern and Southern portions of Baker County (as well as rest of the state), albeit relatively small sample sizes. A radio-telemetry study is underway (spring 2009 to present) that may enhance the understanding of geographical linkages between these two regions.

Burns District

Habitat.—Priority conservation opportunities in the Burns Implementation Area included: juniper removal, annual weed removal, and wildfire prevention. Since 2005, nearly 90,000 acres of juniper have been removed from sagebrush habitats. More than 100,000 acres of sagebrush habitat with an annual grass component have been treated to improve habitat quality (Table 24). Over 400 miles of fuel breaks have been established along existing roads primarily in the Wagontire (northeastern corner) and Juniper units.

Populations.— Biological questions included understanding the distribution of populations in the North Steens region prior to the extensive juniper treatments. Helicopter surveys in 2007 documented the location of 1 new lek and confirmed the status of 16 leks in the region. Additional helicopter surveys were conducted in the Pueblo Mountains in 2009 to provide a baseline on lek distribution in the event the proposed wind farm proceeds to full development.

Lakeview District

Habitat.—Priority conservation opportunities in the Lakeview Implementation Area included: juniper removal, annual weed removal, and wildfire prevention. Since 2005, nearly 16,000 acres of juniper have been treated and 1,000 acres of annual grasses have been treated in sage-grouse habitat (Table 24). A total of 435 miles of fuel breaks have been brush beat along existing roads to alleviate the risk of large scale fires.

Populations.— Biological questions included understanding the potential distribution of sage-grouse in historic areas that have sustained considerable sagebrush type conversion and understory depletion (Wagontire Unit), and monitoring for the presence of WNv at Hart Mountain National Antelope Refuge. Currently >500 live samples have been collected with no positives for the virus or antibody. Surveys in 2008 did not detect any breeding populations in marginal habitats of Lakeview Implementation area. Currently a baseline telemetry study is underway to better understand winter habitat use in the Warner Mountains. These data will also serve as a baseline for demography and spatial use relative to large scale juniper removal and potentially wind energy development.

Prineville District

Habitat.—Priority conservation opportunities in the Prineville Implementation Area included: juniper removal, human activities (i.e., recreation and industrial development), and improving understory conditions. Additionally, this group decided that more background information was needed and baseline habitat condition data were needed prior to proceeding with management actions. Since 2005, 25,000 acres of juniper have been removed from sagebrush habitats most of which occurred on private land (Table 24). Four playas have been experimentally restored by backfilling “dugouts” cutting juniper in the vicinity and excluding half of the playa from grazing. The results of these treatments will take a few years to determine their success. Two ranches are in various stages of developing “whole ranch” (including public and private lands) grazing plans that contain sage-grouse specific habitat objectives. The goal being to provide habitat for the life-history needs of sage-grouse while maintaining a sustainable ranching operation.

Populations.—Biological questions included understanding movement of populations between GI Ranch and Glass Butte areas. As well as identifying possible breeding populations in the upper reaches South Fork of the John Day River watershed. A telemetry study (2006-2008) on the GI Ranch (Silvies and Maury Units) focused on mapping seasonal habitats with an emphasis on winter habitat use. Several birds moved considerable distances between summer and winter use areas with a few birds moving south of Hwy 20 near Canary Lake west of Glass Butte. Aerial surveys in 2008 detected 2 new leks in the Devil's Garden Area.

Vale District

Habitat.—Priority conservation opportunities in the Vale Implementation Area included: annual weed removal, and wildfire prevention in the southern portion of the region; and juniper removal, and invasive weed management in the northern portion of the region. Since 2005, nearly 18,000 acres of juniper have been removed from sagebrush habitats most of which occurred on private land in the north half of the area (Table 24). Nearly 30,000 acres of invasive weeds have been treated to enhance habitat quality.

Populations.— Biological questions included a greater understanding of population trends in the remote areas of the District. Since 2006, an average of 60 additional leks have been monitored through Oregon's Adopt-a-lek program. On average 30 volunteers per year count sage-grouse leks using ODFWs protocol in Malheur County. The data collected by volunteers appears to be comparable to the trend data collected by ODFW staff. In 2006, West Nile virus was confirmed in three sage-grouse recovered from an irrigated hay field near Burns Junction (along with the remains of 60 other grouse). Since that outbreak live samples have been collected from the region with no positive results for disease or anti-bodies. However, a female grouse that died within hours of being collected from the Cow Lakes area tested positive for the disease. West Nile virus was detected from the blood sample of a harvested juvenile male from the Beulah Unit in the 2008 season.

Statewide

Habitat.— Since 2005, there has been a gross decrease of nearly 3% in sagebrush due primarily to wildfire (Table 23). However, the net loss when offset by the acres of juniper removal is approximately 1% (Table 24), regardless the total acres lost is noteworthy. Thus, statewide the habitat goal is being maintained or at least within a margin of measurement error. Notably, habitat losses were greatest in Burns and Vale and it is recommended that both of those regions should seek opportunities to increase the availability of sagebrush where possible. These acre estimates need to be explicitly linked spatially such that responses of specific populations can be correlated (positively or negatively) to the treatments on the landscape.   The current estimates fall short of this type of assessment.

In 2009, ODFW and NRCS embarked on a strategic plan to effectively spend Farm Bill Program funding (Environmental Quality Incentives Program [EQIP], Wildlife Habitat Improvement Program [WHIP]). This effort was assimilated by the NRCS's National Sage-grouse Initiative and will receive over $2 million for fiscal year 2010. Specifically, this funding will target treating

Phase I and II juniper within 3 miles of known lek sites or other known seasonal use areas of high importance. Currently (June 2010), over 50 landowners have signed up under the SGI in Oregon.

Populations.—Since 2003, spring populations increased through 2006 and declined through 2008. In 2009, populations rebounded modestly, and a 20-30% increase in 2010. Despite the declines, none of the population thresholds have been reached that would initiate additional actions as outlined in the 2005 plan.

Research.—Several research projects have been initiated to address the information gaps identified in 2005. Notably, three studies have specifically addressed winter habitat use and seasonal movements that describe sagebrush communities used by grouse and some limited migratory behavior in each population (GI Ranch, Baker County, Beatys Butte, and Hart Mountain). Additionally, work conducted at GI Ranch, Baker County, and in Warner Mountains is adding to the breadth of knowledge on the basic ecology of these populations which was previously unknown.

Broms et al. (2010) have proposed a new technique to potentially estimate fall population size of upland birds. Using sex-and-age kill ratio data and supplementary telemetry data fall populations of sage-grouse were estimated from 1993-2005. Using age and gender ratios from wings of harvested grouse, hunter survey data, and limited telemetry data, population estimates were generated for Oregon sage-grouse populations. Unfortunately, the variance around these estimates is large enough that it is difficult to implement the method. However, the point estimates are well within the range of values generated from lek data alone, which provides some level of verification.

A retrospective analysis of nest sites at Hart Mountain provided some insights to nest site selection at the landscape scale (Yost et al. 2008). Yost et al. (2008) identified that patchy habitat was preferred by females over a more contiguous monotypic stand of Wyoming big sagebrush.

INFORMATION AND EDUCATION

It is recommended that agencies adopting this Plan provide public outreach that extends beyond public hearings and meetings. Such outreach might include opportunities to collaborate with various publics to provide sage-grouse workshops for observations of displaying birds, or community volunteers to assist with habitat enhancement projects (e.g., removal of old fences, planting seedlings). The goal is to provide the public with a basic understanding of sage-grouse and sagebrush steppe and the significance of these natural resources.

INVENTORY, MONITORING, AND RESEARCH NEEDS

Inventory and Monitoring of Sage-Grouse Distribution

ODFW and BLM should continue helicopter surveys to delineate sage-grouse distribution and document status of known leks. Surveys of potential sage-grouse habitat was completed in spring 2006. Once the distribution project is complete, helicopter surveys could be used to estimate the number of active leks in a regions where ground access in spring is limited in most years. ODFW is developing a statistically valid sampling scheme for examining lek activity. Additionally, sampling schemes for evaluating trend and estimating population size are being considered for districts in which not all leks can be counted in a breeding season.

Inventory and Monitoring of Sage-Grouse Habitat Conditions

One primary criterion for sage-grouse conservation is inventorying the quantity and quality of habitat in a region (Connelly et al. 2000b). From that baseline, conservation actions can be identified, prioritized, and implemented. One of the cruxes to land management is developing a comprehensive framework in which habitats can be inventoried and management objectives defined. The multi-scale approach of Karl and Sadowski (2005) provides such a framework that is currently integrated into the Southeastern Oregon RMP. Strengths of this approach enable rangeland assessments and inventories to occur at the pasture or ecological site level. When completed over a watershed or planning area these (pasture by pasture) assessments cumulatively provide an inventory of sagebrush habitat in various successional stages (Figure 23). The potential for this framework to unify sampling and management across various scales, may assist in Oregon's modification and implementation of the Western Association of Fish and Wildlife Agencies guidelines (Connelly et al. 2000b). Scales pertinent to this process and management include: state level (**broad**); geographic areas which might range from a BLM district, planning area, or watershed (**mid**); allotments or pastures (**fine**); and ecological sites (**site/local**). Much of what is discussed below is taken or modified from Karl and Sadowski (2005).

Sagebrush Desired Conditions

Mid-scale.— The presence of shrub cover that supports the life history of sage-grouse and other wildlife species should occur at multiple scales, over a large area, and in a variety of spatial arrangements (Karl and Sadowski 2005). The focus for sage-grouse should be the presence of large contiguous areas of viable habitat. However, the spatial arrangement might include some islands, corridors, and mosaic patterns (Figure 14).

Wildlife objectives for sagebrush communities in individual pastures, allotments, or management areas (identified by the connectivity model) will consider factors such as: (1) presence of sage-grouse and their life history needs, (2) existing native shrub cover patterns and characteristics, (3) frequency and reasonable likelihood of fire, (4) locations of seedings and their shrub canopy cover conditions, and (5) locations of invasive juniper stands and their shrub understory.

Mixed age-class sagebrush stands (i.e., various structural characteristics) should occur throughout a geographic area with an emphasis on communities in classes 3, 4 and 5.

Fine-scale.— The presence of sagebrush cover, its configuration and spatial relationships are likely important. There is an opportunity to combine techniques of the mid-scale and site-level, to increase the understanding of sage-grouse ecology. The task is to inventory landscape characteristics of a given block of habitat as well as the shrub, forb, and grass composition of the site. Ideally the "habitat blocks" would be identified as breeding, brood-rearing or winter habitat. Karl and Sadowski (2005) provided the following description of fine scale monitoring: (which excluded landscape statistics, although they should be applied to this inventory).

The multi-scale approach requires integration of GIS and field techniques to identify the extent of sagebrush habitats in a region (Appendix II). At the **broad** and **mid-scale,** habitat quality can be evaluated with landscape statistics that describe, for example, **patch size**, **patch connectivity, patch configuration** (area/perimeter ratios), and **patch isolation**. Ultimately, habitat inventory is most beneficial when conducted in known seasonal habitats. Generally, the larger and more contiguous habitats will have a better quality rating. However, baseline data are lacking to compare these landscape metrics with respect to population trends. The most recent landcover maps may serve as a baseline from which to track changes in these metrics with respect to populations.

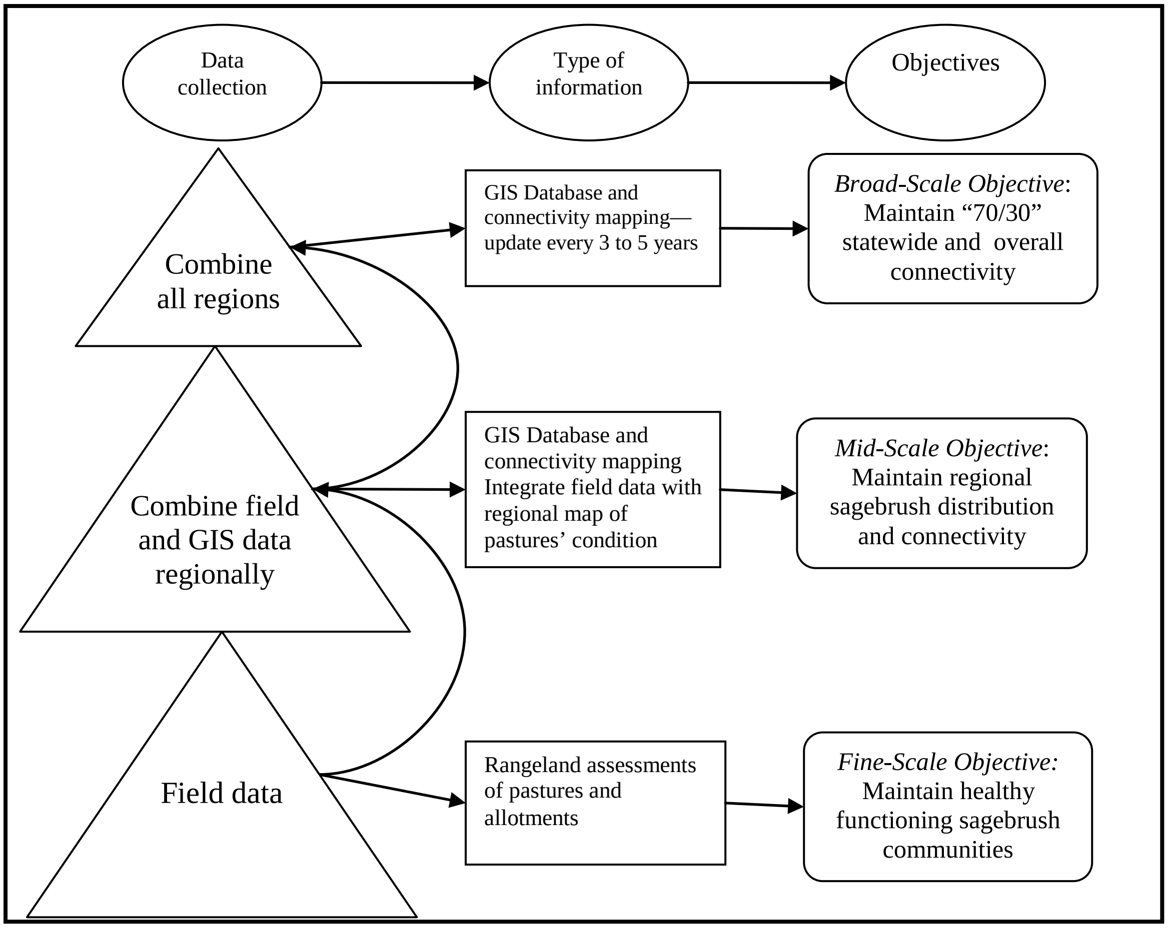

Figure 31. Data collection and information used to evaluate habitat objectives for sage-grouse at fine, mid, and broad scales in Oregon.

At the allotment/pasture level (**fine scale**), line intercept (transects) are used to measure the canopy cover of sagebrush and quadrats (40 x 50 cm frame) for estimating herbaceous cover of understory vegetation across the pasture or at sites within it. As the condition of each pasture is documented, information can be added as a data field in the existing GIS database. Thus, each pasture will be represented in the GIS with an attribute indicating condition, which will include at a minimum sagebrush community type (class 1-5), and a proportional value as to how much of a given polygon is in that type. This will allow for easy quantification and inventory of a particular area, ultimately providing an assessment at the mid- and broad-scale. This assessment technique provides a comprehensive method for assessing rangeland health, while inventorying wildlife habitats.

Research Needs
Rowland and Wisdom (2002) outlined 8 areas of research for Oregon sage-grouse based on current knowledge gaps in the state. Their prioritized list recognized a need to identify spatial structure (i.e., geographic subdivisions) of populations. Furthermore, little work has been done in Oregon to identify if populations are largely sedentary or migratory and the interrelationship between breeding and wintering areas.

Basic research.—Because much of the sage-grouse research in Oregon has focused on Hart Mountain National Antelope Refuge, there is a lack of basic ecology from regions such as Baker County, Trout Creek Mountains, most of Malheur County, and areas north of Burns. A well designed research project can provide basic information and address some of the more complex questions identified below.

Population ecology—Understanding annual survival and seasonal mortality is critical and largely undocumented in Oregon. Similarly, there is still a need to refine methods to estimate population sizes. Similarly, development of a probabilistic sampling scheme for lek counts is paramount to provide some level of rigor to the data collection.

In Oregon with established Wildlife Management Units there is potential to conduct experiments with hunting seasons to better understand the effects of harvest on population dynamics. However, it is likely that the harvest rate would need to be increased above the current rate of 3% to detect a population response, if any.

Benedict et al. (2003) examined the spatial structuring (geographic subdivision) and genetic diversity of sage-grouse populations throughout the southern portion of Oregon. However, it would be beneficial to further investigate potential isolation of Baker and Prineville birds. Generally, a more detailed account of sage-grouse sub-populations would be instrumental in determining mechanisms which may be limiting gene flow in the state.

Data are still lacking that demonstrate the level of connectivity of populations and the sedentary and/or migratory behavior of sage-grouse throughout much of the state. Identifying seasonal movements and migrations are key factors in assessing and monitoring core sage-grouse habitats (seasonal and yearlong) and its management (Connelly et al. 2000b).

Similarly there are no data describing natal dispersal of sage-grouse in Oregon, and how that process impacts the spatial structuring of populations.

Sagebrush ecology—One of the greatest threats facing sage-grouse is loss of habitat to invasive plant species and considerable research is needed to improve current knowledge of habitat maintenance (prevention) and enhancement (rehabilitation). The effectiveness and use of non-native plantings (namely crested wheatgrass) as a stabilizing mechanism for disturbed sagebrush communities, and methods to return those sites to native shrublands and grasslands should be identified.

The influence of community scale structural heterogeneity on habitat selection and reproductive success should be evaluated. For example, one would use two sagebrush communities, both with

15% shrub cover as the observational unit. One of the communities has a few dense patches of shrubs with grass in between patches. The other has homogenous shrub distribution across the entire community. The primary question is: how well do these two communities serve the various habitat needs of sage-grouse (particularly nesting)?

There are few data that directly demonstrate the effects of livestock grazing on sage-grouse populations or habitat structure and composition, and research in the area would be a significant contribution. In particular, examining how timing, duration, intensity, and season of grazing effect sage-grouse productivity and/or the influence on the vegetative community (i.e., changes in species composition, residual cover, and forb production). There is a limited understanding of livestock grazing impacts on vegetation at large time and spatial scales. Given the prevalence of livestock grazing across the range of sage-grouse, it is critical that the knowledge of the impacts of this practice on sage-grouse and other sage-brush obligate species be increased.

Local ecological knowledge can be viewed as an "informal" corollary of adaptive resource management where management of resources is conducted in a "learning by doing" framework. Local ecological knowledge is informal in the sense that rigorous scientific monitoring is often lacking, but impacts to productivity and/or economics provide indicators as to the success or failure of a management action. Thus, it is in the context of adaptive management that local knowledge of sage-grouse conservation and management can be tested in a more rigorous framework. For example, there may be particular grazing practices that through years of experience appear to have yielded greater abundances of forbs and insects and sage-grouse brood-use. This would become a hypothesis to test with some formalized monitoring and evaluation.

SOCIO-ECONOMIC FACTORS AND SAGE-GROUSE CONSERVATION

Sage-grouse are a valued game bird species to hunters in Oregon and abroad. Similarly, birdwatchers are drawn to the elaborate breeding displays and make concerted efforts to observe sage-grouse each spring. In 2006, all wildlife viewing generated $776.4 million and 16,185 jobs statewide (Leonard 2008). All hunting activity generated $879.6 million and 8,279 jobs. Upland bird hunting contributed $39 million and 767 jobs to these totals (IAFWA 2002). State and local tax revenues generated from wildlife viewing were estimated at $123.6 million. The direct economic impact of these activities as they relate to sage-grouse and to local communities is unknown, but it is clear that in general wildlife related activities have both societal and economic values (Table 25). For detailed social-economic profile of counties where sage-grouse occur see Appendix VI.

A recent analysis of wildlife related recreation for Oregon counties indicated that more than $161 million of revenue are generated in sage-grouse counties and $78 million was from viewing alone (Dean Runyan Associates 2009; Table 25).

The habitats on which sage-grouse depend are highly valued for other recreation as well: trails for OHV, horseback riding, rock hunting and other recreational pursuits (e.g., camping, hiking, bird and big game hunting). The economic impacts of these activities contribute seasonally to local economies. Thus, ensuring sage-grouse remain under state regulatory authority and that these activities are compatible with maintaining sage-grouse populations is vital to eastern Oregon communities.

Table 25. Summary of travel generated and local recreation expenditures by Eastern Oregon Counties, 2008 (reported in thousands), adapted from Runyan and Associates 2009.

County	Fishing	Hunting	Wildlife Viewing	Total
Baker	6,310	5,015	8,576	19,901
Crook	4,009	3,267	6,987	14,263
Deschutes	25,731	8,480	44,291	78,502
Harney	3,142	4,826	7,953	15,921
Lake	2,899	2,773	4,940	10,612
Malheur	5,058	2,617	1,512	9,187
Union	2,429	6,031	4,488	12,948
Total	49,578	33,009	78,747	161,334

Currently, livestock use of sagebrush habitat for forage is the largest economic activity in Oregon sage-grouse range. While there are significant economic issues with regards to livestock grazing (Torell et al. 2002), there is an important social value associated with a ranching lifestyle as well.

Economic impacts of sage-grouse conservation on other activities will vary regionally, but are currently unknown except for one modeling study on the economics of grazing. Modeling the removal (under the premise of an ESA listing) of early-spring grazing from public lands indicated substantial economic impacts for ranches in Oregon, Idaho, and Nevada (Torell et al. 2002).

OTHER SPECIES ASSOCIATED WITH SAGEBRUSH STEPPE HABITATS

Managing sagebrush communities as dynamic systems in various stages of succession will provide habitat for the maximum number of species. Considering other species in the Plan is important because conservation efforts for individual species will be time-consuming and costly, and a species-by-species approach is not likely to include all structural components and functional relationships of sagebrush communities. Despite the potential problems with single-species management, many species like sage-grouse require individual attention, particularly where conservation efforts will require considerable effort. In addition, some species warrant management emphasis because their conservation will provide benefits to other species. In many situations, management is most efficient when focused directly on the community or the assemblage of interacting species. Our main focus in this effort was on vertebrate animals that occur in Oregon, because this was the group for which most published information was available.

Several articles have been published that provide descriptions of species associated with shrub steppe communities (Paige and Ritter 1999, Wisdom et al. 2000, Vander Haegen et al. 2001, Rowland and Wisdom 2002, Dobkin and Sauder 2004). These references provided the major source of information for this section, and their lists of species differ because of differing objectives and geographic emphasis. For example, Dobkin and Sauder (2004) list 37 and 24 species of birds and mammals, respectively, that are closely associated with shrub steppe communities in the Intermountain West. Wisdom et al. (2000) list 16 species of birds, 10 mammals, and 5 reptiles that are associated with shrub steppe in the Interior Columbia Basin. More specific to this effort, Vander Haegen et al. (2001) identified 103 species of birds, mammals, reptiles, and amphibians that are generally associated with shrub-steppe communities and 49 species that are closely associated with sagebrush communities in Oregon and Washington (Table 26). In addition, they identified 41 species that depend on shrubs, primarily sagebrush, as key elements in their life history where shrubs are used either for nesting, foraging, or key winter habitat (i.e., sagebrush obligates). Therefore removal of shrub habitats due to fire, mechanical conversion, or invasion of exotic species may result in reduced population sustainability of these species, and can cause dramatic changes in the wildlife community. Many of these species are considered sagebrush obligates (see below) like sage-grouse.

Birds
Vander Haegen et al. (2001) list 44 species of birds that are generally associated with sagebrush communities in Oregon and Washington (Table 26). Twenty-two of these species use shrubs as a key element in their life history requirements. Most breeding birds in shrub steppe are migrants that winter south of the United States and are therefore called Neotropical Migrants. The winter bird community is supplemented by species that breed in higher elevations or more northern latitudes but spend part of the winter in shrub steppe, including rough-legged hawks, northern shrikes, and Townsend's solitaires. Although most of these species are songbirds, two native gallinaceous birds (sage-grouse, Columbian sharp-tailed grouse) and several predatory birds (burrowing owls, short-eared owls, ferruginous hawks, Swainson's hawks, and long-eared owls) occur regionally. The list of species that are considered obligates or near-obligates usually includes sage-grouse, sage sparrow, Brewer's sparrow, vesper sparrow, black-throated sparrow, lark sparrow, lark bunting (not common in Oregon), loggerhead shrike, green-tailed towhee, and sage thrasher.

Population trends of birds associated with shrub steppe in the Intermountain West indicate that 16 to 25 upland birds species are declining in one or more regions of their geographic range (Dobkin and Sauder 2004). Five of 12 riparian species exhibited significant long-term or short-term declines, and only four of 37 species exhibited significant long-term increases. Consequently, there is concern for the population status of breeding birds in shrub steppe communities in the Intermountain West, and some of these species are considered candidates for federal listing in the future.

Mammals
Vander Haegen et al. (2001) list 27 species of mammals that are closely associated with shrub steppe communities in Oregon and Washington. Of these species, 12 are dependent on shrubs as a key element in their life history. Species richness is typically related to the structural complexity of the dominant vegetation. The list of species includes a variety of small to medium-sized mammals, carnivores, and ungulates. Small mammal communities include deer mouse, Great Basin pocket mouse, northern grasshopper mouse, sagebrush vole, and vagrant shrew. Medium-sized mammals of the shrub steppe include several lagomorphs, such as white-

Table 26. Numbers of species associated with shrubsteppe habitat and shrubs as a key element in Oregon and Washington (from Vander Haegen et al. 2001)

	Shrubsteppe habitat		
Species Group	Generally Associated	Closely Associated	Shrubs as a key element
Birds	44	22	22
Mammals	26	27	12
Reptiles	20	0	6
Amphibians	9	0	1
Total	101	49	41

tailed and black-tailed jackrabbits, mountain cottontails, pygmy rabbits, and species of ground squirrels of the genus *Spermophilus*. Ground squirrels are important prey for many avian and mammalian carnivores in shrub steppe communities. Carnivores of the shrub steppe include badgers, long-tailed weasels, and coyote. In addition, kit fox occur in low densities in extreme southeastern Oregon. The two most prominent large mammals in shrub steppe are mule deer and pronghorn; only pronghorn is a shrub steppe specialist. The list of mammals considered obligate or near obligates species includes the sagebrush vole, pygmy rabbit, Townsend's ground squirrel, kit fox, and pronghorn. For example, pygmy rabbits are uncommon and found primarily in areas dominated by tall, dense stands of sagebrush on deep soils that allow for their burrowing life style. Sagebrush voles have a strong affinity for sagebrush but may occur in areas lacking sagebrush overstory if grass understories are thick enough. Pronghorns are the only large herbivore that have a strong association for sagebrush and are most successful where sagebrush species are available for winter forage.

In contrast to the Breeding Bird Surveys for birds, there are no long-term standardized surveys for mammal populations (Dobkin and Sauder 2004). Consequently, there is little information on the long-term trends in mammal populations in sagebrush communities. Nonetheless, Dobkin and Sauder 2004 found only one species of mammal in more than 70% of sampled localities, and no species was found in more than 62% of potentially suitable locations. Trapping studies showed a negative response of 12 species of small mammals to livestock grazing, and 8 species have been demonstrated to respond negatively to the presence of exotic grasses. Consequently, alteration of sagebrush communities may affect long-term suitability of these habitats for several mammal species (Dobkin and Sauder 2004).

Reptiles and Amphibians

Because of xeric climatic conditions and lack of open water, species richness and density of amphibians in shrub steppe communities are low. Nine species of amphibians are generally associated with shrub steppe habitats, but none are closely associated with these habitats (Table 26). Only two species of salamander occur in shrub steppe communities in Oregon: long-toed salamander, and tiger salamander (Vander Haegen et al. 2001). Seven of 11 species of native toads and frogs occur in shrub steppe habitat; Great Basin spadefoot toads, western toad, and Woodhouse's toad are the species most likely to be found in this habitat. Columbian spotted frogs and northern leopard frogs are found in shrub steppe communities but usually in close association with standing water.

In contrast to amphibians, species richness and density of reptiles is relatively high in shrub steppe communities because of the warm and dry climatic conditions. Twenty species of reptiles are generally associated with shrub steppe habitats in Oregon and Washington (Table 26). Lizards are the group of reptiles most closely associated with shrub steppe. The Mojave black-collared lizard, long-nosed leopard lizard, and desert horned lizard occur only in shrub steppe, dwarf shrub steppe, and desert playa/salt scrub shrublands. Ten of 15 snake species in Oregon and Washington occur in shrub steppe communities or related shrub communities. The ground snake, longnose snake, and striped whipsnake are associated with shrub steppe habitats, and six other species (racer, gopher snake, western rattlesnake, rubber boa, western terrestrial garter snake, and common garter snake) occur in a variety of habitats including shrub steppe. Although species richness of amphibians and reptiles is lower than that of birds and mammals in shrub steppe in Oregon and Washington, they can be important ecologically. Because the long-term conversion efficiencies of energy are many times higher for amphibians and reptiles, they can contribute disproportionately to biomass production and make large amounts of energy available to other trophic levels (Vander Haegen et al. 2001).

Threatened, Endangered, and Species of Concern

As of the year 2000, there were 26 species of birds, mammals, and reptiles associated with shrub steppe communities that were threatened, endangered, or considered sensitive (Table 27, Wisdom et al. 2000, Rowland and Wisdom 2002). However, many of these species are common in Oregon. Of this total, 14 species are birds (including sage-grouse), eight are mammals, and four are reptiles. This list provides examples of other species that are currently listed as threatened or endangered or are of concern and may be proposed for listing in the future. Consequently, it is important for this Plan to identify opportunities to benefit these species and not to impact them negatively while managing for sage-grouse.

Summary of Sagebrush Associated Species

In consideration of other species associated with shrub steppe communities, this section emphasizes species that are broadly or closely associated with these habitats plus those listed as threatened, endangered, or of special concern. The list includes approximately 150 species of vertebrates, most of which are birds and mammals. Many of these species should benefit from the Plan for sage-grouse in Oregon. Although the exact habitat associations or local distributions of these species are unknown, large blocks of sagebrush will likely provide habitat for many of them. There is a need for more surveys, research, and monitoring of management activities for many sagebrush associated species. Information about their ecological requirements is needed to develop management strategies to sustain populations of all organisms associated with shrub steppe communities. As adaptive management for sage-grouse proceeds during the next decades, the effects of management on other species will need to be considered so they will not be negatively affected.

Table 27. Terrestrial vertebrate species associated with sagebrush ecosystems and status in Oregon (adapted from Wisdom et al. 2000 and Rowland and Wisdom 2002).[a]

Common Name	Scientific Name	ODFW Status[b]
Birds:		
Ferruginous hawk	*Buteo regalis*	SC
Burrowing owl	*Athene cunicularia*	SV
Short-eared owl	*Asio flammeus*	NL[c]
Vesper sparrow	*Pooecetes gramineus*	SC[d]
Lark sparrow	*Chondestes grammacus*	NL
Brewer's sparrow	*Spizella breweri*	NL
Black-throated sparrow	*Amphispiza bilineata*	SP
Sage sparrow	*Amphispiza belli*	SC[e]
Grasshopper sparrow	*Ammodramus savannarum*	SV
Western meadowlark	*Sturnella neglecta*	SC[e]
Greater sage-grouse	*Centrocercus urophasianus*	SV[f]
Columbian sharp-tailed grouse	*Tympanuchus phasianellus*	SC
Sage thrasher	*Oreoscoptes montanus*	NL
Loggerhead shrike	*Lanius ludovicianus*	NL
Mammals:		
Preble's shrew	*Sorex preblei*	NL
Pygmy rabbit	*Brachylagus idahoensis*	SV
Sagebrush vole	*Lemmiscus curtatus*	NL
Black-tailed Jackrabbit	*Lepus californicus*	SV[e]
White-tailed Jackrabbit	*Lepus townsendii*	SV
Kit fox	*Vulpes macrotis*	LT
Pronghorn	*Antilocapra americana*	NL
Reptiles:		
Northern Sagebrush Lizard	*Sceloporus graciosus graciosus*	SV[e]
Mojave black-collared lizard	*Crotaphytus bicinctores*	NL
Longnose leopard lizard	*Gambelia wislizenii*	NL
Striped whipsnake	*Masticophis taeniatus*	NL
Ground snake	*Sonora semiannulata*	NL

[a]Criteria for identifying species of concern included habitat conditions resulting in increased likelihood of population isolation, a global ranking of 1 or 2 by The Nature Conservancy, and species whose habitats were projected to increase or decrease significantly under a land management alternative as part of the Interior Columbia Basin Ecosystem Management Project. Further details in Volume I, Wisdom et al. (2000).
[b]Status as of 2008. Sensitive species are those defined as "naturally reproducing native vertebrates which are likely to become threatened or endangered throughout all or a significant portion of their range in Oregon." Sensitive species codes begin with "S" and are further defined as follows: SC = critical; SP = peripherally or naturally rare; SU = undetermined status; and SV = vulnerable (Oregon Natural Heritage Program 2001). LE = listed as endangered and LT = listed threatened.
[c]Denotes a species not listed as sensitive by Oregon Department of Fish & Wildlife.
[d]Status reported for Oregon subspecies only (*P. g. affinis*).
[e]Status applies to only 1 ecoregion, in the state, not the species entire range in the state.
[f]Status applies only to populations in the Blue Mountains, Columbia Plateau, and East Cascade Foothills ecoregions.

SYNOPSIS

Sage-grouse are sagebrush obligates requiring large areas with a variety of sagebrush communities to meet life-history needs. The primary objective of this Plan is to maintain large expanses of intact sagebrush habitat for the benefit of sage-grouse and other sagebrush associated species. Based on the assessment of habitat and populations, several large areas of habitat (>100,000 acres) have sustained populations over the last 30 years. Protecting large expanses of sagebrush communities from fragmentation and habitat degradation should ensure sustainable populations into the future. The conservation guidelines provided in this Plan will assist local Implementation Teams and land managers maintain and enhance sagebrush communities throughout Oregon; and ultimately enable Oregon to achieve population and habitat objectives provided.

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GLOSSARY

Allotment- An area designated for the use of a prescribed number and kind of livestock under an area specific management plan.

Animal Unit- Considered one mature cow (1000 lb), either dry or with calf up to 6 months of age, or the equivalent based on average daily forage consumption of 26 lb dry matter/day.

Animal-Unit-Month (AUM)- The amount of oven-dry forage (forage demand) required by one animal unit for a standardized period of 30 animal-unit-days. Not synonymous with animal month.

BLM-Bureau of Land Management, U.S. Department of Interior, administers significant areas of public land that are sage-grouse habitat in Oregon and western U.S.

Connectivity model- Geographic information system analysis depicting connected sagebrush habitats, it DOES NOT depict understory condition of the sagebrush patch; the output is a map.

Connectivity corridor- Estimated seasonal use and migratory connections between lek density strata as estimated using a kernel density function. **Local corridors** were delineated by 75% utilization and **seasonal corridors** were identified as 90% utilization.

Forb- An herbaceous broad-leafed plant

DSL- Oregon Department of State Lands, administers several thousand acres of state owned rangeland in eastern Oregon which is managed to raise money for Oregon schools

Habitat Viability- Refers to the presence of available sagebrush in a given community, the ranking of viability of high, moderate, low, or negligible is a result of the **connectivity model** inputs.

Lek- An area where male sage-grouse display during the breeding season to attract females (also referred to as strutting-ground).

Lek complex- A collection of lek sites typically with small numbers of males which are associated with a larger lek site in the vicinity (≤ 1 mile). A count of a lek complex generally includes censusing all displaying males in a series of leks where no two lek sites are more than one mile apart.

Lek Status definitions:
Annual status: Lek status based on the following definitions of annual activity.

Active lek: A lek attended by ≥1 male sage-grouse during the breeding season. Acceptable documentation of grouse presence includes observation of birds using the site or recent signs of lek attendance (e.g. fresh droppings, feathers). New leks found during ground counts or surveys are given an annual status of active.

Inactive lek: A lek with sufficient survey data to suggest that there was no male attendance throughout a breeding season. Absence of male grouse during a single visit is insufficient documentation to establish that a lek is inactive. This designation requires documentation of either: 1) an absence of birds on the lek during at least two ground surveys separated by at least seven days. These surveys must be conducted under acceptable weather conditions (clear to partly cloudy and winds <15 kph [<10 mph]) and in the absence of obvious disturbance or, 2) a ground check of the exact known lek site late in the strutting season that fails to find any sign (fresh droppings/feathers) of attendance. Data collected by aerial surveys alone may not be used to designate inactive status.

Unknown lek: Lek status has not been documented during the course of a breeding season. New leks found during aerial surveys in the current year are given an annual status of unknown unless they are confirmed on the ground or observed >1 time by air.

Conservation status: Based on its annual status, a lek is assigned to one of the following categories for conservation or mitigation actions:

Occupied lek: A regularly visited lek that has had ≥ 1 male counted in one or more of the last seven years. Designate and protect surrounding area as Category 1 habitat (see Hagen 2005 for lek count protocols).

Occupied-pending- A lek not counted regularly in the last seven years, but birds were present at last visit. Designate and protect surrounding area as Category 1 habitat. These leks should be resurveyed at a minimum of two additional years to confirm activity.

Unoccupied lek: A lek that has been counted annually and has had ZERO birds for eight or more consecutive years. Mitigation category based on habitat type and condition.

Unoccupied-pending: A lek not counted regularly in a seven year period, but birds were NOT present at last visit. Designate and protect surrounding area as Category 1 habitat. These leks should be resurveyed at a minimum of two additional years to confirm activity.

Historic lek: A lek that has been unoccupied prior to 1980 and remains so. Mitigation category based on habitat type and condition.

a. 1980 serves as the baseline for evaluating population objectives under ODFW's Sage-grouse Conservation Strategy, thus leks unoccupied prior to 1980 are not included in the baseline for population abundance and distribution.

No surface occupancy- Use or occupancy of the land surface for fluid mineral exploration or development is prohibited to protect identified resource values.

No surface use- Use of the land surface for fluid mineral exploration or development is protected during certain time periods to protect identified resource values. This does not apply to on-going production.

NRCS- Natural Resource Conservation Service, U.S. Department of Agriculture, provides technical expertise on conservation practices to private land owners, administers a number of federal conservation programs under the Farm Bill for private lands.

ODFW- Oregon Department of Fish and Wildlife, agency mandated to manage the state's fish and wildlife resources.

Productivity- An estimate of nest success and chick survival in a given year determined from the number of chicks observed per female. These data are obtained either from brood routes or wing-data obtained from hunter harvests.

Residual cover- Remaining dead standing herbaceous cover from previous growing season consider an important feature for sage-grouse nesting habitat.

RMP- Resource management plan, a BLM planning document specific to resource areas there are eight resource areas in Oregon.

Steady state- Vegetation community requiring management intervention to change community type to one more desirable for sage-grouse habitat.

Transitory state-vegetation community in the process of succession moving from early to later seral stages

USFWS- U.S. Fish and Wildlife Service, U.S. Department of Interior, mandated to manage migratory species (birds), national wildlife refuges, and protect and recover endangered or threatened species.

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SAGE-GROUSE LEK MONITORING, POPULATION ESTIMATION, AND HUNTING SEASON PROCEDURES/GUIDELINES

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INTRODUCTION

This protocol will standardize collection of data across the range of sage-grouse in Oregon and allow a better evaluation of sage-grouse population status and trend over time. The methodologies described are designed to help wildlife managers collect adequate data for annual sage-grouse breeding population evaluations where lack of resources (personnel, equipment or funding) precludes conducting research studies, complete inventories, or counts of all known leks (strutting grounds) each year.

Two types of lek situations can be encountered in the field: individual leks or lek complexes. A lek consists of a particular site where 1 or more males are displaying or strutting for the purpose of attracting and mating, two or more times during the breeding season. A lek complex is as an area that includes all closely allied leks within approximately one mile of each other (C.E. Braun pers. commun., 1999), which male grouse attend on different days during the breeding season. Counting either leks or lek complexes can be used for trend comparisons.

Three types of data have been identified which are needed to evaluate and monitor sage-grouse breeding population status. Each is described below:

1. Lek/Lek Complex Searches: Lek searches consist primarily of determining the location of all leks using aircraft. This allows us to identify the breeding distribution of sage-grouse, allows an assessment of the location of nesting habitat, and identifies future population inventory locations.

2. Trend Lek/Lek Complex Counts: Counts of the number of sage-grouse (primarily males) attending designated leks each spring. This survey provides a measure of population trend over time and serves as the basis for making annual minimum population estimates.

3. Lek/Lek Complex Checks: Within Oregon there are nearly 700 active sage-grouse leks, many more than can possibly be counted each year. Many of these leks are remote and difficult to access, especially in the wet, muddy, spring period. Therefore, some leks may not be part of annual trend lek counts. However, in terms of sage-grouse population trend, these leks must be monitored to determine if they remain active, and what level of attendance they have through time. In addition, lek checks allow lek extinction rates to be calculated.

<u>LEK/LEK COMPLEX COUNTING PROCEDURES</u>: The following lek counting procedures are based on the premise that once lek attendance begins, a high proportion of the males that attend any given lek do so each day. Some authors have indicated that each lek should be counted at least three (Jenni and Hartzler 1978) or four (Emmons and Braun 1984) times each season at 7 to 10 day intervals between mid- March and early mid-May to reduce count variability within a given year. The highest of the three/four (lek or lek complex) counts should be used in population estimation/modeling exercises (Emmons and Braun 1984, Autenreith 1981). The following criteria should guide lek counts in Oregon:

1. Counts should be conducted between March 15 and April 30 each year. (Note: There may be local variation between districts that will dictate minor modifications to these dates).

2. Counting ideally should be done within the first 2 hours after daybreak under clear, calm, and dry weather conditions.

3. Each lek/ lek complex should be counted at least 3 times at 7 to 10 day intervals.

4. If a lek complex is counted, all leks in the vicinity of the complex area should be counted on the same day. Count results for each individual lek site should be kept separate for individual lek trend comparisons. Data from all leks within lek complex should be summed, and the count day with the highest count for the entire complex will be reported for population trend analysis.

TREND LEK COUNT PROCEDURES

Individual leks, and/or lek complexes are to be surveyed annually from the ground to determine a breeding population estimate. A minimum of 10 leks or a total of 100 male sage-grouse should be counted in each WMU, where possible.

If possible, all known leks in an area (district or WMU) should be inventoried annually. Currently ODFW is developing a methodology for sub-sampling areas that cannot be censused completely each year.

"Lek Count" survey protocols are tied closely to "Lek Check" protocol, please review the following "lek check" section closely for proper recording procedures.

LEK SEARCH PROCEDURES

In Oregon, lek search surveys are necessary to estimate breeding distribution of sage-grouse, to identify lek establishment, and to identify leks for future inventory and population estimation. A complete systematic survey should be repeated every 10 years.

Location of new leks and status (active or inactive) of known leks, which are not counted regularly can be determined from verification of sighting reports to locating with aircraft. Vehicle searches are limited to areas adjacent to roads, and may not be the most practical method of locating lek sites throughout sage-grouse habitat in Oregon.

1. Lek searches are most successful within two hours after daybreak.

2. If done with aircraft, the search area should be flown in a transect pattern so that the entire area is systematically covered. The distance between transects will vary depending on light conditions (sunny vs. cloudy), ground vegetation structure (extensive sagebrush stands vs. juniper/sagebrush mixes), topography (rolling vs. flat), and type of aircraft (fixed wing vs. helicopter). However, a distance of 1/4 to 1/2 mile between transects is generally recommended.

3. Helicopters work best for aerial searches. If a helicopter is used, a recommended flight level is 23 to 30 feet above ground (Autenrieth 1981) although 50 to 100 feet will increase the margin of safety and may improve sighting distance. Past experience has shown that under optimal flying conditions, approximately one township can be surveyed in a 2 to 3 hour flight with a helicopter. Fixed wing aircraft surveys, preferably with a Super-cub, work well for lek occupancy checks where verification of occupancy is more important than count information.

Note: for aerial lek searches, the following information should be recorded on the provided Aerial Observer Field Data Form.

1. Date, observer name, and county/management unit where survey is being conducted.

2. Time when flying begins and ends, and the time when the survey begins and ends.

3. Lek name and/or designated number. Lek names may be derived from a nearby landmark or geographic feature.

4. Time lek is observed (hh:mm).

5. UTM coordinate of lek (using GPS unit).

6. Sky conditions (i.e. sunny, cloudy, raining or snowing).

7. Ground conditions (i.e. bare ground vs. snow covered).

8. Number of males, females, unclassified birds, and total number observed.

9. Directions to lek – If possible, a detailed description of the location and the best way to access each lek/lek complex should be recorded. This should include mileage from nearest town to junctions or crossroads, and directions to the lek location to the nearest $1/10^{th}$ mile.

10. In addition, at the conclusion of the day's survey efforts, all lek locations should be plotted on USGS topographical maps with an indication of number of birds present for future reference.

LEK CHECK PROCEDURES

Since lek occupancy changes over time, with use of some leks occasionally discontinued and new leks established, monitoring of all known leks and searches for new leks is an important facet of sage-grouse population trend monitoring. Emmons and Braun (1984) indicated that the number of leks increases with increasing sage-grouse populations and decreases with decreasing sage-grouse populations. Annually a random sample of leks should be monitored for activity, and size. For large areas with numerous leks, a sub-sample of all known leks should be checked periodically and at the same time searches for new leks can be conducted. Counts should be done at the same time.

However, if the lek check is done from the air, the accuracy of the count may be poor. Therefore, it is recommended that any total counts be done from the ground. If the count is done from a helicopter, it is advisable to land and survey the lek on foot since some birds will not flush from the helicopter (Autenreith 1981).

Annually at least 10% of the leks in a district should be checked and leks to be checked should be selected randomly. Lek checks should be done from the ground, when at all possible to determine the number of attending males and females. Fixed wing or helicopters may be used when ground counts are not possible. An inactive lek should be denoted as a "0" on the data sheet. Three to four counts per lek are adequate unless the biologist feels that the count wasn't representative of the lek. If this occurs then an additional count should be conducted. If three counts are done on one of these leks then not only does it count as a "lek check", but it can also be used as part of the annual population estimation, if birds are present.

Note: For lek checks, the following information should be recorded on the provided Ground Observer Field Data Form:

1. Date, observer name, and county/management unit where survey is being conducted.
2. Lek name and/or designated number. Lek names may be derived from a nearby landmark or geographic feature.
3. Time lek is observed (hh:mm).
4. UTM coordinate of lek (using GPS unit).
5. Township, Range, and Section number
6. Topographic map quad name
7. Elevation (derived from topo map)
8. Sky conditions (i.e. sunny, cloudy, raining or snowing).
9. Ground conditions (i.e. bare ground vs. snow covered).

10. Number of males, females, unclassified birds, and total number of birds observed.

11. Lek description (size and type). General description of the habitat type (i.e. wet meadow, dry meadow, pasture, low, Wyoming or mountain big sagebrush community, livestock feed or watering site, etc.) at the lek site and approximate size of the lek.

12. Distance to nearest juniper or other tree.

13. Distance to nearest road.

14. Individual photograph identification. A total of 5 photographs of each lek should be taken. These should include one photograph each from the four cardinal compass directions and one from the vantage-point were observations of strutting birds were initially made.

15. Directions to lek – If possible, a detailed description of the location and the best way to access each lek/lek complex should be recorded. This should include mileage from nearest town to junctions or crossroads, and directions to the lek location to the nearest $1/10^{th}$ mile.

LEK REPORTING PROCEDURES AND DATABASE MANAGEMENT

To ensure that information obtained from lek counting procedures is comparable from area to area, and from year to year, the following record keeping system is recommended for each district:

1. Assign all leks a common name that references a local land mark. Spatial data to be included for each lek entry in the database should include UTM coordinates (recorded with a GPS in datum NAD 83), Lat-Long coordinates, USGS quadrangle map name, wildlife management unit name and number, legal description, year the lek was first found. Count data from the data forms will be included as well. The internet-based database can be shared among offices.

2. Developing a folder for each lek would be beneficial for ensuring continuity when volunteers or new staff are needed to conduct counts. Each folder should contain 3 maps (of varying scales) of each lek location on a 7.5’ USGS quadrangle map, and indicated best route into a lek and best observation point. A brief summary of past count data, and year first counted should be included as well.

POPULATION ESTIMATION

Sage-grouse minimum population estimates can be made from lek count information (Garton et al. 2011). Lek counts seldom represent the total attendance by males and females (Emmons and Braun 1984, Walsh et al. 2004), therefore a population estimate based on lek attendance will provide a minimum population estimate. It has been postulated that for every male that attends a lek, approximately 2.0 females:male will also attend the lek (Johnsgard 1973). Analysis of Oregon wing data indicates that prior to winter there are 1.66 adult female (range 1.11 to 2.61 females per male) for every adult male in the population. Each modeled hunt unit should use the 5 year average (from the wing data) number of adult female:adult male ratio. In addition, when conducting three counts per lek, Jenni and Hartzler (1978) estimated the peak count enumerates 90% of the male component of the population. Walsh et al. (2004) and Stiver et al. (2008) found that between 42 and 58% of the adult male population was represented by lek counts. Emmons and Braun (1984) found that 86 and 92% of yearling adult males attended leks during the breeding season. From these data sets, a 75% male lek attendance should be used to adjust male population calculations for undetected males.

While annual counts of trend leks or lek complexes can be used for monitoring population trend, care must be taken in using the information to make a population estimate due to variability in lek size. Selection of larger than average leks would provide an over-estimate of population size, and selection of smaller than average leks would provide an under-estimate of population size. Therefore leks should be stratified by size and a random sample selected for counts that will be used to estimate the adult population.

Count data can then be entered into the following formula to determine minimum breeding population size:

1. Enumerate the number of leks occurring in each of 5 strata for a given area (e.g., working group area, wildlife management unit area): inactive (0 males), small (1-10 males), medium (11-25 males), large (25-50 males), and extra-large (>50 males). In cases where only 1 lek occurs in the XL-strata, that lek will need to be combined with the large strata.

2. Estimate the mean males per lek per strata (nM) and then nM × total number leks in stratum = minimum males in stratum (nST). Sum nST for all strata for a minimum male estimate for management unit of interest (NM). Adjust estimate for attendance rates by NM ÷ 0.75 = NMa.

3. Estimate female population (NF) by multiplying NM by 5 year mean adult F:M ratio from the harvest ratio not to exceed 2.0.

4. Sum NMa and NF to determine total adults in survey area.

5. Sum all survey areas in the sample for Statewide Total Spring Population Estimate.

BROOD PRODUCTION SURVEYS

Brood production surveys are conducted to provide a measure of annual reproductive success and trend in sage-grouse productivity. Thus, surveys should be conducted in various locations in a wildlife management unit that increase the likelihood of encountering broods. Timing of brood surveys may vary depending on annual weather conditions and timing of nesting. Likewise, the general weather conditions that have preceded the count will affect the count results. For example, drought conditions normally cause many ephemeral water sources or meadow sites to dry up and subsequently cause birds to concentrate at remaining water sources or meadow sites. Generally, wet spring and summer periods often cause birds to be more widely dispersed. Both situations will impact count results. When conducting brood surveys, the following criteria should be considered:

1. Routes should be conducted between July 15 and August 10, depending on plant phenology and timing of the hatch. Routes should be counted in the same manner (time of day, method of transportation) each year.

2. Counting should not be done during periods of inclement weather when observations of grouse are difficult to classify according to age and sex.

3. All birds observed will be counted. Birds will be classified as male, female, juvenile, and unknown. Classification information will be used to calculate chicks per brood, chicks per adult, and chicks per female. The following characteristics will be used to help the observer separate chicks from females or other adults during brood classification:

    A. Pronounced stripe through the eye of chicks.

    B. Smaller size of chicks, (usually noted with late hatches, however, if counts are done late, chicks may be as large as adult females).

    C. Lack of black patch on chest of chicks as compared to adults.

    D. Uneven lengths in tail feathers; on younger birds which are early in their molt sequence (adults have an even outer margin resulting in a more “pointed” tail).

MAXIMUM ALLOWED HARVEST

The ODFWs policy has been for sage-grouse harvest to not exceed 5% of the projected fall population. Braun and Beck (1985), determined that a harvest rate of 7 - 11% of the total population did not have an impact on subsequent breeding population size. Connelly et al. (2000b) estimated a 5-10% harvest rate in Idaho with no detectable impact on breeding population size. Sedinger et al. (2010) found that up to 11% of a sage-grouse population could be harvested without measurable affect on population dynamics. Others have documented harvest rates of up to 25% but no evaluation of the impact of hunting on the populations was conducted (Braun and Beck 1985).

Based on the current state of knowledge ≤5% should be a conservative harvest rate that would have low probability of affecting the breeding population the following year (i.e. not additive mortality; see Sedinger et al. 2010). Unless further research suggests otherwise, ODFW should maintain ≤5% harvest limit of projected fall population. However, 5% is not a harvest goal, instead, 5% is a harvest limit that should not be exceeded.

Male attendance at leks is the primary indicator of the breeding population. However, it is well established that not all males attend a lek on a given day, though most adult males will attend a lek during the course of the breeding season (Jenni and Hartzler 1978, Walsh et al. 2004). Research has provided a wide range of attendance rates for males from 42% on a given day to near 100% over the course of the breeding season (Jenni and Hartzler 1978, Emmons and Braun 1984, Walsh et al. 2004, Stiver et al. 2008). For the purpose of setting tag limits and estimating the fall population, an attendance rate of 90% will be used. This rate is likely an over-estimate of the actual attendance rate, but will result in a lower (conservative) estimate of the male breeding population.

The number of females must also be estimated to determine the population. It is well documented that the breeding population is biased toward females, but it is difficult to determine the ratio (Walsh et al. 2004). A generally accepted rule is that there are 2 females for every male, however the support for this assumption is lacking. The bias in sex ratios is due to the differential mortality over time (i.e. male survival has been documented to be lower than female survival). It is reasonable to use adult F:M ratios from previous year(s) wing bees to estimate the proportion of females in the breeding population for the following reasons; 1) over-winter survival is usually high, and 2) during Fall to Spring there is less time to express differential mortality because behavior between genders is more similar (i.e. no nesting or lekking during this time period). The calculator uses a moving 5-yr average for the adult F:M ratio as obtained from the wing bee for each data analysis units. However, the ratio is capped at 2 F per M, which again is a measure to ensure the estimate is conservative. Using ratios from wing data does assume that vulnerability to harvest is similar among adult males and adult females over the 5-year time period by DAU.

Though sage-grouse are relatively long-lived as compared to other upland game birds, the biggest influence on the annual abundance of sage-grouse is productivity. An increase in the number of successful females or chick survival will result in a higher fall population. An estimate of productivity from current year will be an important parameter for predicting that year's fall population. Consequently, it is important to obtain immature:adult female ratios during the summer (late July). Using chick:female ratios from the previous year's wing data or an average over multiple previous years (e.g. as obtained from wing bees) could result in a liberal number of permits for a year with below average production.

The following equation may be helpful in setting harvest quotas:

The following equation is used for calculating the maximum allowed harvest:

Maximum allowed harvest = (Estimated fall population × 0.05)

Fall population size is estimated from the following variables:

Adults males (NM_{WMU}) = Stratified minimum male estimate (nM_{WMU}) ÷ 0.9

Adult females (NF_{WMU}) = NM_{WMU} x previous 5-yr mean adult F:M $ratio_{DAU}$ from harvest data not to exceed 2

Immatures (I_{WMU}) = NF_{WMU} x current year chick:F $ratio_{DAU}$ (obtained from brood production surveys in current year)

Estimated Fall $Population_{WMU}$ = NM_{WMU} + NF_{WMU} + I_{WMU}

Permit numbers per WMU are estimated from the following equation:

Permit numbers per WMU = Maximum Allowed $Harvest_{WMU}$ ÷ (previous 5 year hunter participation $rate_{DAU}$ x hunter success $rate_{DAU}$ [birds/hunter/season]), where hunter participation and hunters success rates are determined from post-season harvest surveys. Response rate to post season harvest surveys is high with over 70% of the successful applicants responding (response rate was 78% for the 2009 season).

HUNTER HARVEST/WING DATA

Although the hunting season for sage-grouse in Oregon is tightly regulated through the controlled hunt process and is primarily designed to collect additional information on sage-grouse population composition, the hunting season remains popular among many hunters in Oregon.

Wings provide information on the proportion of adults/yearlings/juveniles, chicks/females, and the sex ratio in the population prior to winter. Cumulative impacts of annual harvest on the population should be evaluated (prior years' harvest analysis, population estimate, brood production surveys, and wing analysis) before the next years' harvest goals are set. The following rationale must be considered in hunting season design so that the maximum amount of information can be obtained from wing collections:

1. Season should occur in the early to mid-September time frame so that feather replacement and wear patterns are not so advanced to preclude interpretation of wing data for nest success and hatch date purposes.

2. Tag numbers and/or wing collection strategies are designed to allow collection of a minimum of 100 wings from a Data Analysis Unit (DAU) where possible. However, due to the current conservative hunting season framework, collection of 100 wings from each DAU is not possible at this time. DAU's are combinations of existing Hunt Codes (Wildlife Management Units) and will be used to assess sage-grouse populations on a larger scale and assist with conservation planning efforts. Below are the combination of existing Hunt Codes that are combined to create 5 DAU's for the state of Oregon:

   DAU # 1. Juniper – Silvies-Wagontire

   DAU # 2. Beatys Butte- Steens-Warner

DAU # 3. Beulah- Malheur River – Sumpter

DAU # 4. Owyhee-Whitehorse

DAU # 5. Lookout Mountain (Likely included with #3)

No hunting has occurred in the following wildlife management units with sage-grouse since 1982 when harvest was resumed: Interstate, Silver Lake, Fort Rock, Paulina, Maury, Ochoco, Keating, Murderer's Creek and Catherine Creek. Additionally there is no harvest on Hart Mountain National Antelope Refuge.

3. Wing collection bags and a postage paid return envelope will be mailed to all sage-grouse hunters along with a letter requesting assistance in the collection of sage-grouse wings for sage-grouse management purposes.

4. Telephone or postcard harvest surveys of all successful controlled hunt applicants will be conducted to determine hunter effort, total harvest, and wing collection rate.

5. All wings collected will be classified to sex and age (adult, yearling, and juvenile). In addition, hatch dates and percentage of successful females will be calculated.

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APPENDIX II. SAGEBRUSH CLASSIFICATION FOR HABITAT MONITORING AND RANGELAND ASSESSMENTS

The following sub-classifications of sagebrush stand characteristics are taken directly from BLM Technical Manual 417 (2005). These are not meant to be an exhaustive or exclusive classification system there may be additional stand types in Oregon. This list is provided to give managers a starting point for rangeland and sagebrush assessments. The habitat monitoring section is parallel to the draft Sage-Grouse Habitat Assessment Framework proposed by Idaho's conservation strategy and currently being modified for use as a fine scale habitat assessment tool by the BLM .

Class 1 No sagebrush canopy cover

Class 1(A): Plant communities that are dominated by native grasses and forbs which generally provide a portion of habitat needs for sage-grouse and other wildlife that use sagebrush-steppe habitats. These plant communities are typically observed after fire, before sagebrush species recolonize. These plant communities may occur in a patchy, mosaic pattern within the sagebrush-steppe, intermingled with Class 2(A, C), Class 3(A, B, C), Class 4(B), and Class 5(B:25% to near 35% canopy cover) plant communities. However, early structural stages should be a minimal proportion of a given landscape.

Class 1(B): Plant communities that are dominated by introduced annual grasses and forbs such as cheatgrass, medusahead, and tumblemustard, which do not provide habitat needs for sage-grouse and other wildlife that use sagebrush-steppe habitats. These plant communities are not desirable to sustain in their present condition if the sites are capable of supporting a sagebrush plant community(ies). Before converting to annual grasses and annual forbs, these Class 1(B) plant communities were more likely to have been Wyoming big sagebrush or basin big sagebrush plant communities than either low sagebrush or mountain big sagebrush plant communities (Miller and Eddleman 2001). These plant communities are biologically and physically unstable because of high risk for repeated fire. High plant density of these annual plants, combined with great amounts of litter, effectively eliminate biological soil crusts. The combination of these conditions inhibit native plant recovery.

Class 1(C): Plant communities that are dominated by seedings of crested wheatgrass or other exotic perennial grasses which generally do not provide habitat needs for sage-grouse and other wildlife that use sagebrush-steppe habitats. These plant communities are lacking in sagebrush canopy cover either because a sagebrush seed source is lacking, or there has not been sufficient time elapsed for sagebrush species to recolonize the seeding. These plant communities are not desirable to sustain in their present condition if the sites are capable of supporting a sagebrush plant community(ies).

Class 1(D): Plant communities that are closed woodlands dominated by species such as western juniper. Particularly in the mountain big sagebrush and low sagebrush plant communities, western juniper encroachment and increasing density can result in near total loss of sagebrush canopy cover (Miller and Eddleman 2001). These Class 1(D) plant communities do not provide habitat needs for sage-grouse (sage-grouse did not select western juniper communities in central Oregon for nesting or winter habitat [BLM 1994; Miller and Eddleman 2000]) and other wildlife that use sagebrush-steppe habitats. In many of these plant communities, excessive livestock grazing pressure and/or fire suppression have been the main contributors to their formation. These plant communities have depleted herbaceous understories in addition to depleted shrub canopy cover, and could have depleted biological soil crusts if the sites are capable of supporting biological soil crusts. The depletion of the shrub, herbaceous, and biological soil crust cover can result in accelerated erosion on these sites. These plant communities are not desirable to sustain in their present condition if the sites are capable of supporting a sagebrush plant community(ies) and supported a sagebrush plant community(ies) before the western juniper encroached.

Class 2 Sagebrush Cover = Trace to 5%

Class 2(A): Plant communities that are dominated by native grasses and forbs with some recruitment of sagebrush species, which provide a portion of habitat needs for sage-grouse and other wildlife that use sagebrush-steppe habitats. These plant communities are typically observed after fire, when sagebrush species are recolonizing. These plant communities are desirable to achieve in a patchy, mosaic pattern within the sagebrush-steppe, intermingled with Class 1(A), Class 2(C), Class 3(A, B, C), Class 4 (B), and Class 5(B:25% to near 35% canopy cover) plant communities.

Class 2(B): Plant communities that are dominated by introduced annual grasses and forbs such as cheatgrass, medusahead, and tumblemustard, where sagebrush species are generally declining in abundance attributable to too frequent of fire. These plant communities are typically not providing habitat needs for sage-grouse and other wildlife that use sagebrush-steppe habitats. These plant communities are not desirable to sustain in their present condition if the sites are capable of supporting a sagebrush plant community(ies). These plant communities are biologically and physically unstable because of high risk for repeated fire. High plant density of these annual plants, combined with great amounts of litter, effectively eliminate biological soil crusts. The combination of these conditions inhibit native plant recovery.

Class 2(C): Plant communities that are dominated by seedings of crested wheatgrass or other exotic perennial grasses, where sagebrush species are in the early stages of recolonization. These plant communities might not be providing the complex shrub-grass-forb cover and food needs of sage-grouse and other wildlife that use sagebrush-steppe habitat, but if there is active recolonization of sagebrush species, there is high future likelihood for providing habitat needs. These plant communities are desirable to sustain if they are moving successionally to greater abundance of sagebrush species.

Class 2(D): Plant communities that are woodlands dominated by species such as western juniper. Particularly in the mountain big sagebrush and low sagebrush plant communities, western juniper encroachment and increasing density can result in near total loss of sagebrush canopy cover (Miller and Eddleman 2001). These plant communities do not provide habitat needs for sage-grouse (sage-grouse did not select western juniper communities in central Oregon for nesting or winter habitat [BLM 1994; Miller and Eddleman 2001]) and other wildlife that use sagebrush-steppe habitats. In many of these Class 2(D) plant communities, excessive livestock grazing pressure and/or fire suppression have been the main contributors to their formation. These plant communities have depleted herbaceous understories in addition to depleted shrub canopy cover, and could have depleted biological soil crusts if the sites are capable of supporting biological soil crusts. The depletion of the shrub, herbaceous, and biological soil crust cover can result in accelerated erosion on these sites. These plant communities are not desirable to sustain in their present condition if the sites are capable of supporting a sagebrush plant community(ies) and supported a sagebrush plant community(ies) before the western juniper encroached.

Class 3 Sagebrush Cover = Greater than 5%, up to 15%

Class 3(A): Plant communities supporting low sagebrush or Wyoming big sagebrush, with an understory of native grasses and forbs (typically about 10% grass canopy cover and less than 10% forb canopy cover), and intact biological soil crusts in interplant spaces, represent the potential natural vegetation for these plant communities (Miller and Eddleman 2001). Class 3(A) low sagebrush or Wyoming big sagebrush plant communities provide habitat needs for sage-grouse (e.g., winter habitat [Miller and Eddleman 2001]) and other wildlife that use sagebrush-steppe habitat. They are desirable to sustain in a patchy, mosaic pattern within the sagebrush-steppe, intermingled with Class 1(A), Class 2(A, C), Class 3(B, C), Class 4(B), and Class 5(B:25% to near 35% canopy cover) plant communities.

Class 3(B): Plant communities supporting basin big sagebrush or mountain big sagebrush, with an understory of native grasses and forbs, which are typically moving successionally to greater abundance of sagebrush species and are not yet at the potential natural vegetation for these two plant communities. Despite this, Class 3(B) basin big sagebrush or mountain big sagebrush plant communities provide habitat needs for sage-grouse and other wildlife that use sagebrush-steppe habitat. Their presence in a mosaic, intermingled with Class 1(A), Class 2 (A, C), Class 3 (A, C), Class 4 (B), and Class 5 (B:25% to near 35% canopy cover) plant communities, should be considered desirable for sagebrush-steppe habitat. It should be recognized however, that these Class 3 (B) plant communities are probably transitory and should be permitted to move successionally to Class 4 (see Class 4 (B) for more detail).

Class 3(C): Plant communities that are dominated by seedings of crested wheatgrass or other exotic perennial grasses, where sagebrush canopy cover is on the increase attributable to sagebrush colonization. While not providing the quality of habitat that Class 3(A) or Class 3(B) plant communities do, because typically there is not a diverse grass or forb component in these seedings, Class 3(C) plant communities do provide added structure because of the sagebrush, which provides habitat for some wildlife that use sagebrush-steppe habitat.

Class 4 Sagebrush Cover = Greater than 15%, up to 25%

Class 4(A): Plant communities supporting low sagebrush or Wyoming big sagebrush, which typically show a decrease in native grass and forb canopy cover (particularly where sagebrush canopy cover is 20% or greater [Miller and Eddleman 2001]), and biological soil crust development, compared with Class 3(A) low sagebrush or Wyoming big sagebrush plant communities. Disturbances such as excessive livestock grazing pressure are often contributory to development of Class 4(A) plant communities (Miller and Eddleman 2001). Class 4(A) is not the potential natural vegetation, nor a desirable outcome, for these two plant communities when the inherent capabilities of soils, landform, and climate are factored in. However, Class 4(A) plant communities can provide some habitat needs for sage-grouse (e.g., winter habitat [Miller and Eddleman 2001]) and other wildlife that use sagebrush-steppe habitat.

Class 4(B): Plant communities supporting basin big sagebrush or mountain big sagebrush, with an understory of native grasses and forbs, more often than not represent the potential natural vegetation for these plant communities. Class 4(B) plant communities provide habitat needs for sage-grouse (e.g., nesting and brood-rearing habitat [Miller and Eddleman 2001]) and other wildlife that use sagebrush-steppe habitat. Their presence in a mosaic, intermingled with Class 1(A), Class 2(A and C), Class 3(A, B, C), and Class 5(B:25% to near 35% canopy cover) plant communities, should be considered desirable for sagebrush-steppe habitat.

Class 4(C): Plant communities supporting mountain big sagebrush or low sagebrush, with tree seedlings (particularly western juniper) in the understory. Particularly in the mountain big sagebrush and low sagebrush plant communities, western juniper encroachment and increasing density can result in near total loss of sagebrush canopy cover (Miller and Eddleman 2001). These Class 4(C) plant communities currently provide habitat needs for sage-grouse and other wildlife that use sagebrush-steppe habitats. However, with continued growth and increasing density of the western juniper, sagebrush will decline and these plant communities will transition and at some point not provide habitat needs for sage-grouse and other wildlife that use sagebrush-steppe habitats. On many of these Class 4(C) plant communities, excessive livestock grazing pressure and/or fire suppression have been the main contributors to their formation. These plant communities are not desirable to sustain in their present condition if the sites are capable of supporting a sagebrush plant community(ies) and supported a sagebrush plant community(ies) before the western juniper encroached.

Class 5 Sagebrush Cover = Greater than 25%

Class 5(A): Plant communities supporting basin big sagebrush or mountain big sagebrush, with an understory of native grasses and forbs, can represent the potential natural vegetation for these plant communities, particularly for canopy cover that ranges from 25% to less than 35% (Miller and Eddleman 2001). However, as sagebrush canopy cover approaches 35%, the understory of native grasses and forbs decreases. Class 5(B) basin big sagebrush or mountain big sagebrush plant communities can provide habitat needs for sage-grouse (e.g., nesting and brood-rearing habitat [Miller and Eddleman 2001]) and other wildlife that use sagebrush-steppe habitat (e.g., pygmy rabbit). Class 5(B) that has sagebrush canopy cover in the range of 25% to less than 35% is probably within the range of what the soils, landform, and climate would sustain for these two plant communities, whereas canopy cover Class 5(B) that approaches or exceeds 35% in these two plant communities is probably undesirable and a result of excessive livestock grazing pressure and/or fire suppression

Class 5(B): Plant communities supporting low sagebrush or Wyoming big sagebrush, which typically are depauperate in understory native grasses and forbs (Miller and Eddleman 2001) and often have an understory composed of exotic annuals such as cheatgrass and mustards. Understory native grasses, forbs, and biological soil crusts would be primarily restricted to microsites beneath shrub canopies and would rarely be found in interspace microsites. Disturbances such as excessive livestock grazing pressure are often contributory to development of Class 5(A) plant communities (Miller and Eddleman 2001). Although these low sagebrush or Wyoming big sagebrush plant communities can provide some habitat needs for sage-grouse (e.g. winter habitat; Miller and Eddleman 2001) and other wildlife that use sagebrush-steppe habitat, these Class 5(A) plant communities are not the potential natural vegetation, nor a desirable outcome, for these two plant communities when the inherent capabilities of soils, landform, and climate are factored in.

INVENTORY AND MONITORING TECHNIQUES FOR EACH SCALE

Mid-scale.—The multi-scale approach requires integration of GIS and field techniques to determine the extent of sagebrush habitats. Landscape composition of sagebrush to non-sagebrush habitats can be delineated and other landscape level statistics should be considered when inventorying habitat patches and ranking potential quality: fragmentation, patch size, and isolation.

At mid-scale, habitat suitability is defined by patterns of habitat patches on the landscape. Unlike site-specific indicators of productive habitat such as sagebrush canopy cover or sagebrush height, little research has been done to better discern discrete, mid-scale, habitat indicator values for sage-grouse. However, sage-grouse habitat suitability declines as sagebrush shrubland patches decrease in size and become more isolated and surrounded by vegetation communities with undesirable components. Therefore, a mid-scale habitat description should have a trend context including extent and pattern of change. The extent and pattern of change gives the mid-scale habitat description a relevant basis for baseline description.

A mid-scale evaluation should include the following steps (Karl and Sadowski 2005):

Step 1. Clearly define the purpose and objectives associated with the proposed mid-scale baseline assessment of sage-grouse habitat.

Before delineating the assessment area, clearly define the purpose and objectives of the overall project. This will help in the analysis design and help identify which mid-scale habitat indicators to focus on.

Step 2. Delineate the assessment area and map habitat using mid-scale cover types

Clearly delineate the assessment area on a map. Review the purpose and objectives of the project and insure that the assessment area includes components necessary for a mid-scale description.

After the assessment area has been defined on the statewide sage-grouse 1: 100,000 planning maps, it should be refined to coincide with defined cover types important for mid-scale habitat descriptions. These refinements are needed for mid-scale habitat descriptions associated with some of the habitat indicators.

Step 3. If possible, identify a historical reference period and delineate assessment area and map habitat using the mid-scale cover types

For some mid-scale projects, a historical reference point may help document habitat trend (positive, neutral or negative) and the significance of the mid-scale indicators for the assessment area. Detailed historical vegetation data are not necessary. This historical reference point should be selected based on the following factors:

1. General vegetation data for the assessment area are available,

2. Historic sage-grouse distribution data are available or there is reasonable confidence that sage-grouse once occupied currently unoccupied habitat in the assessment area, and

3. The historical reference point allows for a reasonable description of trend for the assessment area. The historic reference period should be relevant to a time period when most of the habitat changes occurred. For some areas like the Big Desert in eastern Idaho the historical reference point may only be a decade ago before the large fires of the 1990's, while for other areas, with a longer history of habitat change, a reference period during the 1970's may be more appropriate.

Step 4. Describe mid-scale baseline habitat conditions using all or selected habitat indicators (A – G) discussed below:

Once a mid-scale habitat map is developed, then a variety of spatial habitat indicators should be considered for describing baseline habitat conditions. Not all of these indicators need to be used – they should be selected based on habitat trends and needs of the assessment area. However, at a minimum, habitat availability and internal patch fragmentation should be measured for all mid-scale assessments. Use of other indicators will depend on the spatial habitat characteristics of the assessment area.

A. Habitat Availability

The total sage-grouse habitat and general composition in the assessment area is an important mid-scale habitat indicator. As the amount of key habitat increases in an assessment area, suitability improves. As the amount of sagebrush shrubland with a native understory increases suitability also improves although this will not always be the case.

B. Habitat Patch Size and Number

While the amount of habitat available to sage-grouse is very important, just as critical to long-term survival is the habitat pattern. Sage-grouse require large, intact and connected expanses of sagebrush shrubland to exist (Connelly et al. 2003a). As sagebrush is fragmented into distinct patches separated by grassland, woodland or other cover type, sage-grouse habitat suitability declines.

C. Habitat Patch Fragmentation

For many areas, one of the most important mid-scale habitat indicators will be the degree of internal habitat patch fragmentation. There are still large key habitat patches but the degree of habitat fragmentation within the patch in the form of roads, powerline corridors, energy sites, livestock watering pipeline systems, OHV trails, mineral sites, canals, landfills, etc. affects patch habitat suitability. The amount and density of these uses can individually affect habitat suitability in different ways but generally, when considered cumulatively, as habitat fragmentation increases for a unit area the habitat suitability decreases.

GIS can be used to calculate roads per unit area or number of communication sites or amount of other land uses per unit patch area. For any given assessment area it will be important to identify fragmentation factors of most concern. To measure cumulative effects an objective inventory of all possible fragmentation factors should be conducted.

D. Habitat Patch Connectivity and Isolation

The number of habitat patches in close proximity and the distance between habitat patches affect movement patterns and dispersal of habitat obligate species. For a highly fragmented landscape in Washington Schroeder and Robb (2003) noted that migrating sage-grouse females were usually located in corridors of sagebrush and avoided crossing agricultural fields on the ground.

E. Habitat Patch Dynamics

Habitat patch dynamics takes into account temporal changes of habitat patches either in a positive or negative direction. For sage-grouse, certain plant communities have the potential to contribute towards positive habitat trends (e.g., native perennial grassland may succeed to shrubland) and others have crossed ecological thresholds (e.g., annual grassland) or been converted to other land uses (e.g., agricultural land) with significant negative influence on habitat trends. The greater the ratio of positive influence cover types to negative influence cover types, the better the potential future for sage-grouse survival.

F. Edge Characteristics: Area/Edge Ratio, Edge Effect, Edge Contrast and Edge Permeability

Shape of the key habitat patch and the vegetation communities surrounding it can have a significant effect on suitability of the patch and future risks. For sage-grouse, suitability declines as the amount of habitat patch edge increases per unit area.

Besides patch shape, suitability is also influenced by the adjacent plant community. A key habitat patch surrounded by annual grassland is less suitable habitat than a similar shaped patch surrounded by native perennial grassland. Landscape ecologists use the terms **edge effect, edge contrast and edge permeability** to describe the effects adjacent plant communities can have on plants and animals. Effects of adjacent plant communities are important for obligate species like sage-grouse that have very specific habitat needs.

G. Habitat Corridors

In some areas sage-grouse will migrate a great distance between seasonal habitats. These movements often include areas outside of a mid-scale planning area. The assessment area of interest may have habitat that is only seasonally used by sage-grouse that may breed or winter some distance away. Connelly et al. (2003a) recommends that seasonal movements should be well understood before landscape assessments are conducted and that "corridors dominated by sagebrush should connect adjacent seasonal ranges."

Historic and current corridors between seasonal ranges should be identified where seasonal movement data exist. The amount of sagebrush cover between seasonal ranges will help define suitability. As corridors are fragmented and there is a loss of sagebrush cover, suitability of these areas will decline.

Fine-scale.—At the allotment/pasture level the goal is to determine structure and composition of a sagebrush community. As condition of each pasture is documented that information should be added as a data field in existing GIS database.

This will allow for easy quantification and inventory of a particular area, ultimately providing an assessment at the mid- and broad-scale. Moreover, this technique provides a comprehensive method for assessing rangeland health, while inventorying wildlife habitats.

At this scale understory conditions and perhaps insect abundance associated with cover and food should be documented. Areas that were identified at larger scales as potentially suitable based on shrub canopy cover and dominant grass understory may only be marginal or even unsuitable at a fine scale due to understory conditions. Fine and site-scale assessments refine larger scale monitoring efforts. This scale of monitoring could be for inventory purposes, habitat rehabilitation efforts, or other range management projects.

Fine-scale assessments can involve qualitative and quantitative data collection depending on management needs. Typically, an area (e.g., pasture or allotment) will have several to many sites identified using a stratified random approach. Qualitative assessments are useful for reconnaissance level reviews and as a means of communication and education. They should not be used as a decision tool unless the outcomes are so obvious to any reasonable person that data collection is not needed. For example, a general description of baseline conditions for crested wheatgrass seeding may not require quantitative data collection since the lack of sagebrush currently makes the site unsuitable as habitat. However, one of the main purposes of baseline descriptions is for predictive modeling of habitat. Quantitative data on shrub, grass and forb cover in a seeding could help predict future habitat suitability for the area.

Not all areas have equal priority for monitoring. Given the limited resources of most agencies, breeding habitats should be given highest priority, followed by winter habitats, and summer habitats. Within breeding habitats, areas with declining sage-grouse populations where the cause of the decline is not obvious (e.g., fire) should be given the highest priority followed by projects intended to improve breeding habitat. The same approach should apply to winter and summer habitats.

An area evaluation should include the following steps:

Step 1. As needed for the project area refine maps that delineate cover types, seasonal habitats, and land uses that may affect habitat use.

The following information should be collated and displayed on maps, as appropriate, for the evaluation area:

1. Shrubland, grassland, woodland, and other pertinent cover types for the area,
2. Seasonal habitats including locations of all known existing and historic leks within 18 km (11 miles) of the area,
3. High human use areas such as residences, recreational sites, or major highways, and
4. Livestock facilities such as watering troughs, fences designated water gaps or trail crossings.

Generally, habitats that are located within 2 km (1 miles) of high human use areas should not be considered as habitat unless local information indicates otherwise.

Step 2. Identify ecological sites within the area and visit ecological reference areas (ERAs).

ERAs should provide information on ecological site potential as it relates to vegetative conditions associated with sage-grouse habitat suitability. At the fine and site scale, site potential is an important factor in an area's ability to provide suitable sage-grouse habitat conditions. Site potential is based on the soil characteristics and precipitation that define certain vegetation communities. For sagebrush communities site potential in terms of shrub, grass and forb composition is mostly determined by precipitation patterns and soil characteristics (Miller and Eddleman 2001).

At this stage a specialist should be consulted to help select the ecological sites within the project area. Directions provided in Pellant et al. (2004) should be used as a reference. When possible, ecological site inventory or soil maps should be obtained. When using soil maps it will be important to remember that most soil units will contain small inclusions of other ecological sites. For sage-grouse these inclusions can provide important habitat.

Step 3. Stratify the cover types in the area by ecological sites, select sampling points within stratified mapping units and develop a data collection method.

A. Qualitative Data Collection

There are some land management situations where qualitative information can be used to determine rangeland conditions using indicators of rangeland health (Pellant et al. 2004). Qualitative assessments should only be used for reconnaissance level reviews. It will be important to document limitations of the data. If data are collected for only one ecological site within a cover type then the data only provide a qualitative description of that ecological site. They cannot be used to broadly characterize the cover type or the project area.

B. Quantitative Data Collection

Sampling sites should be randomly selected for each of mapping units. Random sites located within 2 km (1 mi) of high human use areas or livestock troughs (breeding habitat only) should be not be used. A statistician should help develop appropriate sampling levels. Follow protocols described in Connelly et al. (2003a) for vegetation measurement and data collection.

Staffing constraints and budget limitations, may affect sampling intensity. Thus, in some situations an acceptable approach at describing baseline habitat conditions could include a mixture of qualitative and quantitative data collection. Qualitative descriptions for cover types or ecological sites that are vegetatively simple or not important may suffice. The more important the habitat, the more intensive sampling should be. Professional judgment will be required and rationale for sampling design must be documented.

Step 4. Organize data collection to correspond to season use periods.

Data must be collected at the proper time of year. For example, forbs are nutritionally very important during the breeding season for females and young broods. Breeding habitat data collected in late summer would miss many forbs that are evident during spring and misrepresent habitat conditions.

Breeding Habitat: Data collection must occur in May-June as soon as broods are hatched. Timing within this time frame will vary depending on elevation and climatic conditions. Data collection in low elevation areas should occur in mid-May to early June while higher elevation sites should occur later.

Late Brood-rearing Habitat: Data must be collected July – September. Timing within this 3-month period will depend on elevation and climatic conditions.

Winter Habitat: Data collection can occur at any time since sagebrush distribution, cover and height are the only habitat indicators of concern.

Step 5. Collect field data at sampling locations for the seasonal habitats of interest.

Sample forms that may be useful in collection of field data are presented in Connelly et al. (2003a).

A. Breeding Habitat

There are 9 habitat indicators for which field data are needed. Two protocols are recommended for the canopy cover and height measurements – line transect with Daubenmire frame (LTDF) or point intercept (PI) method method. These methods will produce similar results although there are advantages and disadvantages to both (Elzinga et al. 1998, Connelly et al. 2003a). Both protocols are consistent with guidance developed by an interagency technical team for rangeland vegetation monitoring (U.S. Department of Interior 1995). If the PI method is used at least 300 points should be collected per site to address biases (Connelly et al. 2003a).

1. Leks

There are two "proximity to" indicators that describe lek suitability. Close, protective sagebrush cover and lack of perch sites for avian predator.

B. Late Brood-rearing or Summer Habitat

During summer females and broods move to areas where succulent plants and an abundance of insects are available. They either move to higher elevation sagebrush communities, riparian areas, wet meadows, or in some cases sagebrush communities near agricultural lands. In the latter situation the sagebrush community is providing the protective cover while agricultural field provides succulent forbs. Habitat indicators are slightly different for these three late brood-rearing areas.

C. Winter Habitat

Winter areas must have sagebrush of sufficient height and canopy cover to provide food and cover under most snow conditions. In some areas sage-grouse use low sagebrush communities for food and daytime loafing (e.g., wind swept ridges) while adjacent big sagebrush community provides cover and when weather conditions make the low sage areas unavailable.

Winter habitat measurement can be taken at any time of the year although values will differ depending when measurements were taken. Winter access may limit assessment at that time, so indicators were developed for describing habitat conditions during other seasons (see Bureau of Land Management 2004). Winter measurements should be taken if the project area is accessible.

Step 6. Summarize field data within the cover types.

Once field data have been collected for all sites data should be summarized for each ecological site within the cover types of interest. Standard statistical packages can be used to calculate means and standard deviations for each of the measured habitat indicators.

Step 7. Describe sage-grouse habitat conditions for each habitat type within the area of interest.

Suitability worksheets for breeding, late brood-rearing, and winter were developed from Connelly et al. (2000b). For the purpose of standardizing habitat descriptions, discrete ranges of numeric values or qualitative habitat descriptions were used to describe suitable, marginal and unsuitable habitat. Local adjustments can be made to the suitability criteria provided there are adequate research data to support adjustments.

Place the collected field information in a format for describing baseline habitat suitability for the sites within the area of interest. Two other points concerning the assessment area should also be addressed:

Ecological sites that do not have the potential to ever provide suitable habitat.
Current weather conditions in terms of drought or above normal precipitation that may affect baseline conditions.

The worksheets have places to record ecological site suitability in relation to sage-grouse habitat and weather conditions.

Professional judgment will be needed to interpret data for sage-grouse habitat suitability. As an example, certain abundant, low-statured perennial forbs (e.g., Hood's phlox (*Phlox hoodii*) and grasses (e.g., Sandberg's bluegrass (*Poa secunda*) may skew perennial grass and forb heights and grass canopy cover and wrongly describe site suitability for these indicators. When these species dominate a site they may overwhelm the habitat influence of taller plants that provide protective cover. This can have an effect on the suitability description in two ways. First, they can skew the herbaceous height data such that the herbaceous height indicator for the site is rated as marginal when there is actually enough protective cover in the form of taller perennial plants for the site to be suitable. Second, Sandberg's bluegrass, which is often only 1" tall (excluding the seed stalks), can have canopy cover > 40% and if included in the suitability description may misrepresent grass canopy cover indicator that is intended to help describe protective cover. However, eliminating these species from the analysis will also bias the results—an area may be in relatively poor shape if it is almost entirely dominated by *Poa* but if only measurements for bluebunch wheatgrass and other tall perennials are reported (even though they are relatively rare), the area would be judged to be in good shape from a herbaceous height standpoint. If these conditions are encountered additional samples may be needed to better evaluate overall area quality.

Step 8. Describe baseline sage-grouse habitat conditions for the area for the seasonal use period(s) of interest.

Organize site assessments and then describe baseline habitat conditions for the area. The level of complexity will vary greatly depending on the size of the area and habitat complexity. For small or vegetatively simple areas collating the information will be relatively easy while in other areas it would be advisable to use spreadsheets.

APPENDIX III:Technical Aspects of Trend Analyses

This Appendix was developed to retain the scientific merit of this document while providing the general public with a less technical discussion in the main body of the text. Some of what is found in this appendix is a duplicate of the main document but was retained for continuity and interpretation.

METHODS FOR LEK DATA TREND ANALYSIS

Data

Lek attendance data were obtained from counts of males attending leks during March and April. Historically, the number of times a lek was counted in a year was variable, as of 1996 ODFW field staff attempted to count each trend lek at least 3 times during the breeding season between 0.5 before and 1.5 hours after sunrise. Trend leks are breeding sites that have been counted consistently over a number of years, and generally are a sub-sample of all leks in a region. We provide 3 measures of population trend for sage-grouse in Oregon, changes in males per lek, changes in population rate index (Schroeder et al. 2000), and changes in lek size. The indices chosen and methods for data analyses are similar to those used in the *Conservation Assessment for Greater Sage-Grouse* (Connelly et al. 2004) and have been implemented for continuity and comparison.

Sample size and units

Based on the variance (25.01) of males per lek for the 1980 to 2009 period, a minimum sample size of 10 leks was needed to be counted to make a population estimate within 20% of the mean, and with 80% confidence limits (Zar 1999:106). Thus, Burns and Lakeview districts data sets were truncated to 1981 based on this minimum sample size. Prineville assessment period began in 1980 but in 1984 and 1985 the number of leks monitored fell well below 10 leks, these years were retained for continuity but should be viewed with caution. Vale and Baker began systematic monitoring in 1993 and 1996, respectively, as does the assessment period.

Analyses

We calculated mean and median males per lek for all leks to assess changes in males per lek, rate of population change and lek sizes over time. A lek site is defined as an area with ≥1 male observed displaying. Generally such small sites are associated with a larger lek site in the vicinity (≤ 1 mile) and were categorized as a lek complex. A count of a lek complex generally includes censusing all displaying males in series of leks where no 2 lek sites are >1 mile apart. This rule was adaptive in some cases, based on the field knowledge of District Biologists. Thus all summaries that refer to males per lek, are accounting for lek complexes. Trend data for males per lek are based solely on leks monitored annually and did not include data from helicopter surveys, which likely would have lowered the numbers of males per lek in a given year.

Population rates of change were calculated based on the method described by Schroeder et al. (2000). Briefly, rates of change were estimated by comparing the numbers of birds counted at all leks in consecutive years. Thus, a lek must be counted at least 2 years consecutively to be included in the estimate of population change. Moreover, this alleviates spurious observations or data from single year helicopter surveys from biasing the analyses. The rate of change (r) is formally defined as:

$$r = (n_{t+1} – n_t) / n_t,$$

where n_{t+1} = number of males in year 1, and n_t = number of males in year 0. This provides a proportional change in population size based on leks consistently counted between years. We used *r* to estimate spring populations backward for the duration of the assessment period using 2003 as the baseline. The 2003 population estimate was calculated by:

$$nM + nF = nT,$$

where *nM* = number of males counted / 0.75 (adjustment for unseen males); *nF* (number of females) = *nM* x 1.67 (11 year avg of M:F ratios in the harvest). The adjustments for unseen males and sex ratios for estimating total numbers of birds follows Connelly et al. (2003a). The following example describes how the backward projection of the population size was estimated. The 2003 estimate (*nT*) was divided by 1+ *r* from the 2002-2003 interval, and yielded a population estimate of 2002 birds based on the estimated rate of change, similarly the 2002 estimate was divided by 1 + r from the 2001-2002 interval, etc., Thus, providing an index to past population size based on active leks in 2003.

Lek size was determined by classifying each as): inactive (0 males), small (1-10 males), medium (11-25 males), large (25-50 males), and extra-large (>50 males) and compared the change in the frequency of size classes over time. Because of the annual variability in count data, much of the descriptive statistics were summarized in five year intervals.

TREND ANALYSIS FOR PRODUCTIVITY

METHODS

Reconstructing the locations of brood routes prior to 1993 with respect to BLM districts was difficult, and production was estimated from brood routes only at the state level for the long-term. These data are assessed from 1957 to 2003 to provide a perspective as to the long-term trends in productivity at the gross scale, and from 1980-2003 to be consistent with the assessment of males per lek trend analysis. Wing-data were analyzed statistically only for the 1993-2003 period, per BLM district and at the state level. All trends were analyzed using linear regression.

Wing-data are collected by wildlife management units (MUs) and analyzed by data analysis units (DAUs) which assist in achieving appropriate sample sizes ($n > 99$) for analyses. However, these units do not correspond with BLM district boundaries. Therefore, MUs were pooled to represent each of the BLM districts in this assessment (Table 12). This included using Wagontire and Silvies units twice; combined they represented Prineville, and individually they were included in Lakeview and Burns districts, respectively. Lookout Mountain had too few samples to provide reliable data analyses and separate estimates of productivity for Baker were not provided, Vale estimates were inclusive of Baker.

Table A-2. Regression statistics from trend analyses of sage-grouse chick production in Oregon from 1957-2003.

Data type	Years	r^2	Slope β)	95% CL (β)	P-value
Trend data					
Brood routes	1957-03	0.279	-0.04	–0.05 to –0.02	<0.001
Brood routes	1980-03	0.383	0.05	0.02 to 0.08	<0.001
Wing-data	1993-03	0.416	0.11	0.01 to 0.20	0.032
Route × Wing	1993-03	0.492	0.75	0.29 to 1.20	0.003
Predicting spring lek data					
IM: IF	1993-03	0.693	92.0	42.1 to 141.8	0.003
Wing-data	1993-03	0.543	5.50	1.4 to 9.7	0.020
Brood routes	1993-03	0.064	1.70	–3.6 to 7.0	0.480

APPENDIX IV: SAGE-GROUSE HABITAT MODELING IN OREGON

Several steps were used to define habitat patches in the connectivity model. This appendix discusses the assumptions and limitations of the connectivity model and provides the summary outputs for the model based on each BLM District. It is important to note that data summarized in each table is inclusive of the entire district and is not limited to areas occupied by sage-grouse.

ASSUMPTIONS/LIMITATIONS TO GIS DATA

Classification of viability

Invasive juniper is a difficult landcover to classify with satellite imagery, because low densities or small stature trees are not readily differentiated from sagebrush cover where these to vegetation types co-occur. It is likely that estimates of juniper coverage are conservative because of these difficulties. As with any GIS model ground-truthing is vital to understanding model performance. A sample of 45 points where cover type and suitability was evaluated and 90% of those visually inspected were correctly classified.
The result of combining the two datasets provided a significant amount of detail at the 30-m (0.2 acre) cell size. Such detail was important in developing the baseline information but cumbersome from a land management perspective. Therefore the map was reclassified based on 160 acre units. Briefly, a grid with 160 acre cell size was overlaid on the Oregon map and each 160 acre cell was ranked from 1 to 4 based on the majority of 0.2 acre cell rankings in that area. However, the landcover detail of each 160 acre cell was retained if such information was needed. The final output are maps with 4 colors each representing a viability category, and the base unit for that map is 160 acres.

Ranking of viability

Sagebrush habitats were ranked the highest (1), second was non-sagebrush shrublands and grasslands, all other native vegetation received a rank of 3, and bare rock, alkaline flats, and agriculture were of negligible viability (4). There were four categories of habitat that were adjusted to better reflect conditions on the ground. Pasture/hay land-cover class (includes alfalfa fields and irrigated meadows) was initially ranked as a 4 (negligible viability), because sage-grouse are known to use these habitat types in late summer this viability score was adjusted to reflect this usage. Where sagebrush cover was adjacent to pasture/hay, a 105 m radius from that point into the pasture/hay cover received a viability score of 2. This adjustment reflected the potential use and benefit of this anthropogenic habitat, while recognizing that large areas of pasture/hay are no substitute for native habitat. The potential impact of juniper on sagebrush habitat was characterized by creating a 105 m radius, where juniper was adjacent to sagebrush and reclassifying that 105 m as juniper/sage mix. This buffer distance was based on the estimated average seed dispersal distance of juniper and area of impact on sage-grouse (Commons et al. 1999, Miller et al. 2005). Lastly, the viability of sagebrush habitat was adjusted based on two slope categories 1) slopes >15% and 2) standard deviation of slope. In the case of the former, all sagebrush slopes >15% were ranked as a 2 because the suitability of nesting and brooding diminishes beyond this point (Edelmann et al. 1998). The standard deviation of slope (SD > 6%) quantifies highly rugged topography and steep canyon walls that typically are not used by sage-grouse, these areas were adjusted to negligible viability (rank = 4).

Table A-3. Acres of habitat viability scores for sagebrush habitats by land management entity (percentage) in Oregon 2003.

Status	Habitat viability								
	High	%	Moderate	%	Low	%	Negligible	%	Total
BLM	6,501,663	70.6	5,324,593	38.6	428,373	3.5	1,124,021	14.6	13,378,650
Private	1,940,570	21.1	6,823,480	49.5	3,401,859	27.6	4,723,182	61.2	16,889,091
State	385,583	4.2	221,187	1.6	34,515	0.3	63,325	0.8	704,610
USFS	64,414	0.7	946,390	6.9	7,806,533	63.4	1,270,995	16.5	10,088,332
USFWS	235,320	2.6	121,695	0.9	76,456	0.6	124,421	1.6	557,892
Other	80,416	0.9	348,433	2.5	569,740	4.6	416,568	5.4	1,415,157
Total	9,207,966		13,785,778		12,317,476		7,722,512		43,033,732

Table A-4. Habitat viability amounts (acres) in each BLM District, Oregon 2003.

Habitat viability	BLM District				
	Burns	Lakeview	Prineville	Vale	Total
High	2,438,789	2,473,689	1,003,974	3,291,514	9,207,966
Moderate	1,985,358	1,923,427	4,260,792	5,616,201	13,785,778
Low	650,394	3,535,368	5,599,800	2,531,914	12,317,476
Negligible	695,499	1,204,963	2,182,150	3,639,900	7,722,512
Total	5,770,040	9,137,447	13,046,716	15,079,529	43,033,732

Table A-5. Habitat viability amounts (acres) and percent ownership in Baker Resource Area, Baker County Oregon 2003.

	Habitat viability								
Ownership	High	%	Moderate	%	Low	%	Negligible	%	Total
BLM	55,227	31.2	224,206	28.9	20,587	3.2	57,870	15.4	357,890
Private	119,407	67.5	497,051	64.0	120,456	18.5	214,859	57.1	951,774
State	1,128	0.6	2,619	0.3	4,333	0.7	817	0.2	8,897
USFS	912	0.5	50,572	6.5	504,464	77.6	93,494	24.8	649,442
USFWS	0	--	0	--	0	--	0	--	0
Other	121	0.1	2,152	0.3	116	0.02	9,565	2.5	11,954
Total	176,796		776,600		649,957		376,605		1,979,957

Table A-6. Habitat viability amounts (acres) and percent ownership in the Burns BLM District, Oregon 2003.

	Habitat viability								
Ownership	High	%	Moderate	%	Low	%	Negligible	%	Total
BLM	1,789,081	73.4	1,231,773	62.0	60,038	9.2	262,160	37.7	3,343,052
Private	533,200	21.9	561,988	28.3	91,939	14.1	293,749	42.2	1,480,876
State	72,000	3.0	60,546	3.0	1,311	0.2	3,191	0.5	137,048
USFS	8,820	0.4	72,828	3.7	463,219	71.2	33,117	4.8	577,984
USFWS	15,928	0.7	49,737	2.5	31,257	4.8	90,331	13.0	187,253
Other	19,760	0.8	8,486	0.4	2,630	0.4	12,951	1.9	43,827
Total	2,438,789		1,985,358		650,394		695,499		5,770,040

Table A-7. Habitat viability amounts (acres) and percent ownership in the Lakeview BLM District, Oregon 2003.

	Habitat viability								
Ownership	High	%	Moderate	%	Low	%	Negligible	%	Total
BLM	1,917,524	77.5	1,057,779	55.0	128,959	3.6	323,086	26.8	3,427,348
Private	262,188	10.6	555,701	28.9	1,227,342	34.7	616,621	51.2	2,661,852
State	62,297	2.5	50,873	2.6	17,818	0.5	29,173	2.4	160,161
USFS	11,979	0.5	200,476	10.4	1,952,517	55.2	44,125	3.7	2,209,097
USFWS	219,348	8.9	44,328	2.3	30,555	0.9	19,566	1.6	313,797
Other	353	0.0	14,270	0.7	178,177	5.0	172,392	14.3	365,192
Total	2,473,689		1,923,427		3,535,368		1,204,963		9,137,447

Table A-8. Habitat viability amounts (acres) and percent ownership in the Prineville BLM District, Oregon 2003.

	Habitat viability								
Ownership	High	%	Moderate	%	Low	%	Negligible	%	Total
BLM	407,181	40.6	839,547	19.7	196,726	3.5	153,778	7.0	1,597,232
Private	481,107	47.9	2,859,732	67.1	1,296,191	23.1	1,573,944	72.1	6,210,974
State	31,268	3.1	22,001	0.5	9,017	0.2	5,305	0.2	67,591
USFS	40,548	4.0	320,409	7.5	3,714,690	66.3	317,490	14.5	4,393,137
USFWS	44	0.0	25,545	0.6	14,644	0.3	9,241	0.4	49,474
Other	43,826	4.4	193,558	4.5	368,532	6.6	122,392	5.6	728,308
Total	1,003,974		4,260,792		5,599,800		2,182,150		13,046,716

Table A-9. Habitat viability amounts (acres) and percent ownership in the Vale BLM District, Oregon 2003.

	Habitat viability								
Ownership	High	%	Moderate	%	Low	%	Negligible	%	Total
BLM	2,387,877	72.5	2,195,494	39.1	42,650	1.7	384,997	10.6	5,011,018
Private	664,075	20.2	2,846,059	50.7	786,387	31.1	2,238,868	61.5	6,535,389
State	220,018	6.7	87,767	1.6	6,369	0.3	25,656	0.7	339,810
USFS	3,067	0.1	352,677	6.3	1,676,107	66.2	876,263	24.1	2,908,114
USFWS	0	-	2,085	0.0	0	-	5,283	0.1	7,368
Other	16,477	0.5	132,119	2.4	20,401	0.8	108,833	3.0	277,830
Total	3,291,514		5,616,201		2,531,914		3,639,900		15,079,529

APPENDIX V: SAGE-GROUSE MANAGEMENT AREAS IN OREGON

Risk and project matrix for greater sage-grouse populations in Baker County, Oregon, 2006.

Population	Status	Risks/Issues/Opportunities	Projects
Virtue	Stable-	1) Human interaction 2) Brush encroachment on leks 3) Improve understory condition 4) Increase proportion of sagebrush (White Swan fire)	1) Improve coordination on OHV use, mitigation, education, seasonal closure, remove signage 2) Brush control at lek sites 3) Evaluate grazing management 4) seedings and reclamation work evaluated at White Swan
County Line	Stable	Improve understory condition (Bowman Flat)	BLM evaluate and implement changes in grazing as needed Beaver Creek Riparian (Dixie)
Unity—Denny Flat	Risk	1) Human interaction 2) Fringe habitat 3) Juniper encroachment	OHV mitigation and education Evaluate ponderosa and juniper removal
Durkee	Stable	Improve data collection Juniper encroachment	Identify movement and genetic linkages Increase spring lek survey effort Identify areas needing juniper removal
Keating	Decline & Unk	Improve understory condition Wind energy development (potential) Improve data collection	Evaluate and change range management as needed Mitigate habitat loss if development is realized Increase spring lek survey effort
Powder River	Stable	Improve data collection Population appears stable few leks counted	Additional helicopter surveys to identify distribution More leks should be counted in this region
Peavine, Maiden Gulch Ebell Sutton Crk.	Unk	Potential habitats—currently unoccupied	Additional helicopter surveys to identify distribution Ground surveys and habitat evaluation maybe needed
"In General"	----	Identify method for quantifying benefits from indirect actions (e.g., CREP)	

Risk and project matrix for greater sage-grouse populations in Burns BLM District Boundary, Oregon, 2006.

Population	Status	Risks/Issues/Opportunities	Projects
Silvies-Wagontire-N Juniper	Stable-decline	1) Human interaction 2) Juniper encroachment 3) Improve understory condition 4) N. fringe of range—fragmentation 5) Fuel breaks at low elevation	1) Improve coordination on OHV use, mitigation, education, seasonal closure? remove signage (Glass Butte area) 2) Evaluate grazing management 3) Seedings and reclamation work 4) Brush beat along existing roads
Steens	Stable	1) Juniper encroachment 2) restoration of sagebrush post fire 3) Improve understanding of birds S. Steens	1) Five Creeks & other juniper removal projects 2) Evaluate sagebrush re-establishment 3) Work to collect more data from S. Steens
Foster Flat	Stable-decline	1) Human interaction 2) Fuel breaks at low elevations	1) Evaluate need to limit/control viewing location of Foster Flat leks for public use 2) Brush beat along existing roads
Pueblos	Stable-increas	1) Restoration of sagebrush post fire 2) Wind energy development (potential)	Identify movement and genetic linkages Increase spring lek survey effort Identify areas needing juniper removal
Drewsey	Decline & Unk	1) N. fringe of range 2) Conifer encroachment 3) Wind energy development (potential Stk Water) 4) Improve data collection	1)Evaluate ponderosa and juniper removal 2) Mitigate habitat loss if development is realized 3) Additional helicopter surveys to identify distribution
Trout Creek Mtn	Stable-increase	1)Improve data collection Population appears stable few leks counted	1) Additional helicopter surveys to identify distribution 2) More leks should be counted in this region
North Whitehorse	Stable & Unk	1)Improve data collection Population appears stable few leks counted	1) Additional helicopter surveys to identify distribution 2) More leks should be counted in this region

Opportunity and project matrix for greater sage-grouse populations in Lakeview BLM District Boundary, Oregon, 2006.

Population	Status	Risks/Issues/Opportunities	Projects
Hart Mtn Beatys	Stable	1) Juniper encroachment 2) Wildfire 3) West Nile Virus 4) Invasive weeds 5) Improve understory condition 6) Energy development	1) Prioritize areas for treatment 2) Roadside brush beating—fuel breaks, fire fighting strategy 3) Continue to monitor presence/absence of disease 4) Identify private lands & other opportunities to treat or ready as experimental areas for developing treatments of invasives (e.g., cheatgrass on NE Beatys Butte) 5) Evaluate impacts of various treatments on vegetation and invasives 6) Mitigate—determine avoidance—monitor impacts
Warner – Drake Flat	Stable	1) Juniper encroachment 2) Wildfire 3) Invasive weeds 4) Wet meadow enhancement 5) Energy development	1) Use as leverage for mitigating direct losses to wind energy Weeds Mediterranean Sage –present at Sage Hen Hill 2) Site stabilizing techniques used 3) Treat where possible 4) Complement O'Keeffe project of juniper thinning/removal onto BLM (Deep Crk. Project may include some of this need to check) 5) Mitigate (see 1), determine avoidance, monitor impacts
North Wagontire (Ft Rock)	Risk	1) Juniper encroachment 2) Wildfire 3) Understory condition 4) Shrub cover	1) Prioritize areas for treatment—use as leverage 1b) Prescribed fire possible tool 2) Roadside brush beating—fuel breaks, fire fighting strategy 3a) 2 BLM demonstration projects Jaynes Well & Benj. Lake (chaining) 3b) Joint fire proj. compare cut vs. burn and control 3c & 4) Brush treatments to enhance forb & grasses and mixed age stand of brush
South Wagontire (Silver Lake)	Stable—small numbers	1) Wildfires of 1983 and type conversion greatest limiting factors 2) Understory condition in remaining sagebrush This unit maybe lower priority given the constraints on habitat	1) Native vegetation interseeding into crested wheat (e.g., Coyote Hills) 2) Shrub cover enhancement and invigorating forb & grass component Research needed on restoration techniques

Opportunity and project matrix for greater sage-grouse populations in Prineville BLM District Boundary, Oregon, 2006.

Population	Status	Risks/Issues/Opportunities	Projects
Brothers	Declining	1) Understory condition 2) Shrub cover 3) Wildfire 4) ORV use—legal and illegal 5) Human interaction	1 & 2) Cooperative livestock management plan including private, federal and state lands 3) Fuels treatments 4) Increase access management 5) Outreach and education to various user groups
GI Ranch	Stable and declining (at lower elevation)	1) juniper encroachment 2) loss of sagebrush at lower elevation	TO BE DETERMINED
Crooked River	Declining-unknown Low density	1) Population status unknown 2) Edge of range—fringe habitat	1) Conduct additional surveys to determine population status 2) Take measures to secure or enhance remaining habitat 3) develop working relationship with landowners in the region
S. Fork John Day	Unknown	1) Population status unknown 2) Small remnant habitat	1) Conduct additional surveys to determine population status 2) Take measures to secure or enhance remaining habitat

Risk and project matrix for greater sage-grouse populations in Vale Implementation Team Area, Oregon, 2006.

Population	Pop Status	Habitat Status	Risks/Issues/Opportunities	Projects
Louse Canyon Rattlesnake	Stable-increase	Functioning	1) Human interaction (ORV use) 2) Weeds (medusa head rye), roads 3) Grazing mgt. to maintain understory 4) Proximity to "Birds of Prey" refuge in ID 5) Wildfire 6) WNV	1) Mitigation, education, seasonal closure, BLM is addressing 2) Aerial application-direct attack-catalog outbreaks w/ GIS-integrate McDermitt country with JVWMA 3) Evaluate grazing mgt-monitoring in place Louse 4) Non-lethal control of avian predator eliminate perches 5) Develop attack plans and create fuel breaks 6) Monitoring disease and parasites (ODFW)
Trout Creek	Stable-increase	Functioning [Rangelands <5000 ft functioning at-risk]	1) Weeds and fire 2) ORV 3) Recreational mining 4) riparian & grazing management understory condition	1) Range rehabilitation (ongoing), Interseeding crested wheat seedings with natives/forbs 2) ?? 3) ?? 4) prescribed fires (higher elevations)
Barren-Saddle	Low density	Functioning at-risk	1) Wild horse issue? 2) Possible winter range 3) Tamarisk in playas	1) Evaluate AMLs and potential habitat impacts 2) radiocollar grouse determine seasonal movements 3) Eradicate tamarisk in affected playas & drainages
Solider & Cow Creek	Stable-decrease	Functioning-at-risk	1) Wildfire 2) juniper encroachment 3) Re-treatment of seedings 4) Invasive weeds	1) Green stripping-fuel breaks 2) BLM proj. underway (B. Luchin) 3) Seek creative treatments for enhancing "old" seedings 4) Ongoing on private—BLM needs to address
Jackie's Butte	Long-term decline Short-term stability	Not-functioning	1) Loss of water source 2) Vegetation structure (lack of shrub cover) 3) Weeds & structural functioning plant (forb & grass cover lacking) groups--wildfire 4) Wild horses?	1) Mitigate as best possible if lost 2) Range rehab—sagebrush colonies in Rome seedings (attempted) 3) Fire break, fuel break along Westside of butte protect the remaining "good habitat" 4) Ongoing on private—BLM needs to address

Bully Creek-N. Fork Malheur	Stable to increase & decrease	Functioning -functioning at-risk	1) Wildfire 2) juniper encroachment	1) Seeding enhancement 2) Juniper removal (need to identify prospective projects-landowners)
Dry Creek Mainstem Malheur	Unknown-decrease	Functioning - at-risk	1) Weeds and fire	1) Crowley Rd. corridor fire 2) rehab to stabilize 3) summer water? 4) GMA process evaluating springs/riparian 5) salt cedar/tamarisk eradication
S. Fork Malheur-Stockades	Low density	Functioning - at-risk	??	??
Succor Creek-Owyhee	Decreasing	Not-functioning	1) Fire 2) invasisves—structurally not grouse habitat	1) Maybe opportunities for rehab 2) GMA evaluation scheduled 2007
Sandhills-Willow	Increase-stable	Functioning	1) Weeds and fire 2) Mining	1) Private land opportunities 2) DSL management

APPENDIX VI: Socio-Economic Profile and Analysis
Of Seven Oregon Counties Included in the Greater Sage-Grouse Conservation Strategy for Oregon

Provided by Association of Oregon Counties

February 23, 2011

The proposed Greater Sage-Grouse conservation strategy is focused on those eight counties that are within the current range of the greater sage-grouse in Oregon:

- Baker
- Crook
- Deschutes
- Harney
- Klamath
- Lake
- Malheur
- Union

This socio-economic analysis was prepared to provide decision makers with the socio-economic context for the eight counties included in the proposed management guidelines contained within the July 6, 2010 Strategy as presented to the Oregon Fish and Wildlife Commission. It should be noted that Klamath County is considered within the "unoccupied range" since no known breeding populations have been documented since the mid 1990's.

Socio-Economic Profile of Counties

The eight affected counties are located in the Southeastern and Central region of Oregon. In general, the region is characterized by a low population density and relative isolation from large economic markets. Residents of the area often must travel far distances to access services, retail and wholesale markets, and healthcare facilities. The majority of lands in the counties are federally and state owned with Deschutes, Harney, Lake and Malheur having over 75 percent of their lands in state/federal ownership. Union County had the lowest percentage (48.1%), but it still amounts to nearly half of land ownership in the Union County by federal and state governments.

A significant portion of the population earns their livelihood from the region's natural resources and amenities. As a result, most of the counties' employment have heavier concentrations in farm and government sectors compared to the state's average overall distribution of employment by industry (Oregon Employment Department). The region includes a mix of families who have resided in the area for generations such as ranchers, farmers, and millworkers as well as newcomers with a desire for rural living and an attraction to the region's stunning beauty and recreational opportunities (Davis, Moseley, and Nielsen-Pincus, 2010).

The region is sparsely populated and has higher unemployment rates and a greater proportion of persons living below the poverty level than the statewide average (Table 1). Population densities range from a low of less than one person per square mile in Harney and Malheur counties to a high of 38.2 in Deschutes County. September 2010 seasonally adjusted unemployment rates registered a low of 10.6% in Union County to a high of 19.0% in Crook County compared to the statewide rate of 10.6%. These unemployment rates mask significant underemployment with many workers employed in part-time, seasonal or transitional employment.

The poverty rate ranged from a high of 21.3% in Malheur County to 10.4% in Deschutes County. Similarly, U.S. Census 2008 median household income for six of the eight counties was significantly below the statewide median of $50,165 with Lake at $36,215; Malheur ($36,403); Baker ($37,282); Harney ($39,507); Klamath ($41,093); Crook ($44,069); and Union ($41,896)

The counties' economies have struggled with high unemployment rates, a greater than the statewide average of persons living below the poverty level, and large distances to many markets. As a result of shifts in public land management since the 1990's, the region's natural resource dependent industries have suffered especially the wood products industry, forestry, logging, and contracting businesses (Davis, 2010). Burns, for example, lost all its major industries when sawmills and recreation vehicle plants shut down over the past decade. Ranchers and farmers have experienced major swings in beef and agricultural commodities due to the impact of national and international market gyrations, resulting in significant swings in the fortunes of the region's inhabitants.

In contrast with the other counties affected by the strategy, Crook and Deschutes counties experienced a boom starting with extremely rapid population and real estate growth from the 1990's through 2007, followed by a bust with the collapse of the housing market during the 2008-2009 Great Recession. From 2000 to 2008, Deschutes County witnessed a nearly 40 percent population growth resulting in a much more dense population than the other counties. Both Deschutes and Crook Counties saw their unemployment rates triple from a low of around 5 percent in 2007 to 15.5 percent and 19.0 percent, respectively, as of September 2010. Since June 2009, Deschutes County lost approximately three percent of its employment or 1,880 jobs. The largest percentage losses in the private sector were in mining, logging, and construction (-6.4%). (Oregon Employment Department and U.S. Census)

Economic Activities within the Region of the Sage-grouse Strategy

1. Ranching

Cattle is ranked as the top agricultural commodity gross farm sales for the state amounting to $709.1 million or about 17% of total 2010 Oregon gross farm sales. For the eight counties within the plan, cattle sales amounted to $391.8 million. Malheur ($119.3 million) and Klamath counties ($109.3 million) accounted for 58% of the sales among the eight counties. (Oregon State Extension Service, 2010) Depending upon the extent of measures that will be taken to conserve sage-grouse habitat, ranching activities may be affected by changes to livestock grazing under the Strategy. The implementation of the Strategy, however, would likely not have the same regulatory impacts to grazing management in Oregon as a listing under the federal Endangered Species Act. Further economic analysis will need to be done to understand how grazing may be affected should the recommendations be adopted.

The Strategy calls for:

> *Where livestock grazing management results in a level of forage use (use levels) that is consistent with Resource Management Plans, Allotment Management Plans, Terms and Conditions of Grazing Permits or Leases, other allotment specific direction and regulations, no changes to use or management are required if habitat quality meets Rangeland Health Standards and Guidelines. Where livestock grazing management results in a forage use level detrimental to habitat quality, changes in grazing management that will maintain or rehabilitate habitat quality should be made as soon as possible. Adjustments to grazing management should be conducted in accordance with responsible land management agency regulation.*

Sage-grouse habitat needs for breeding, nesting, and brooding coincide with periods when cattle are grazing on public lands. According to Greer (1995), the reliance of southeastern Oregon ranchers on public lands can appear insignificant when calculated on an acreage or AUM basis, but when calculated on a seasonal dependency basis, federal grazing is very important.

Torell et al (2002) examined the impacts of reductions in federal grazing allotments assuming a listing of the sage-grouse on the federal Endangered Species list. They estimated the value of BLM spring forage for livestock production and the economic consequences of eliminating spring grazing and reducing grazing capacity on BLM lands to improve and maintain habitat for sage-grouse. Their analysis of Lake County ranchers revealed that the economic impact of sequentially reducing the availability of BLM AUM's ranged from about $10/BLM AUM removed for 50% and 75% BLM allotment reductions to $11.77/AUM with total elimination of BLM grazing. Annual net cash income was reduced to $21,808 per year or a 56% drop with a 100% BLM reduction. The average number of livestock reduced was about 33 percent. Under their model, Lake County ranchers suffered higher average economic losses from removing AUM's than from Jordan Valley, Idaho and Northeastern Nevada. The differences were due to ranchers' ability to substitute alternative forages as federal AUMs are eliminated. Substituting forages minimizes economic losses relative to the option of feeding hay and reducing cow herd size. Torrell et al. (2002) noted that many ranchers need supplemental off ranch income with part-time ranchers relying on ranch income for about 20% of annual disposable income to full-time ranchers depending on the ranch for about 80% of disposable income. For those ranchers with limited off-ranch wealth and income, reducing public land grazing capacity by even marginal amounts was found to greatly impact the ability of ranchers to meet financial obligations and repay debt.

2. Hunting and Wildlife Viewing

The proposed strategy calls for evaluating and adjusting harvest permits and allows for hunting within the recommendations of the Strategy. Regarding wildlife viewing, the strategy guidelines provide for protections from direct harassment and minimizing disturbance.

According to a study by Dean Runyan and Associates, prepared for the Oregon Department of Fish and Wildlife and Travel Oregon, travel generated and local recreation expenditures was estimated at $972.9 million for the entire state for fishing, hunting, and wildlife viewing for 2008. For the eight counties in the strategy, total estimated expenditures in these categories ranged from $9.2 million in Malheur County to $78.5 million in Deschutes County (Table 1).
Travel generated and local recreation spending is a significant boost for these counties, but it is unknown how much of these amounts are directly and indirectly attributed to sage-grouse hunting and wildlife viewing.

3. Renewable Energy

The proposed strategy calls for constructing wind turbines 5 km (greater than/equal to three miles) from occupied leks. The plan notes that "currently, there is a lack of specific information about the effects of renewable energy development on sage-grouse ecology" (p. 104 of Sage-Grouse Strategy).

Wind energy turbines have become an increasingly common site in Eastern Oregon, tapping into the significant wind resources in the region. Most of the existing wind turbines are located along the Columbia River particularly in Sherman, Morrow, Gilliam, and Umatilla counties. There is increasing interest in wind turbine siting elsewhere in Eastern Oregon as the quality of wind is excellent and in some places even better than the Columbia River area. Not every area of the state, however, is good for placement of each type of renewable energy development, whether it be from biomass, wave, solar, geothermal or wind because placement is dependent on the quality of the resource available.

The state of Oregon adopted legislation through the passage of SB 838 in 2007 (ORS Chapter 301) that sets forth comprehensive renewable energy policies to "accelerate the transition to a more reliable and more affordable energy system." The statute also declared that "by 2025 at least 8% of Oregon's retail electric load comes from small-scale renewable energy projects with a generating capacity of 20 megawatts or less." Overall, the state aims to have 25 % of its overall electrical generation derived from renewable sources by the year 2025.

Siting of wind turbines has had a major impact on the economies of Columbia River Eastern Oregon counties. Northwest Economic Associates (2003) studied the economic development impacts of wind power in three case studies, including Umatilla County and found that:

1. The projects contributed to significant increases in employment, personal income, tax income and landowner net revenues.

2. Tax effects, particularly property taxes were important.

3. Non-market benefits may be important: wind power is a non-polluting, low impact, and non-extractive form of energy that provides large positive benefits to local economies but has a relatively light impact on communities and their infrastructure (schools, roads, and social services).

4. Wind energy development does not involve the "boom and bust" economic and social conditions associated with other energy development.

5. The authors noted possible negative impacts of wind energy development, such as bird kills, damages to roads and impact on land values.

M. Pedden (2006) confirmed these conclusions regarding rural communities with a review of a broad cross-section of data available from existing studies. Wind installations have a large direct impact on the economies of rural communities, especially those with few supporting industries. For example, Pedden noted that the installation of wind farms create another industry in the community that becomes a large percentage of the local tax base and contributes to local businesses.

Ouderkirk and Pedden (2004) studied the economic impacts of the 24 megawatt Klondike Wind Farm Project in Sherman County. They concluded that the benefits of the Project were widespread in Sherman County and the surrounding region. Employment from development, construction, and operations stimulated regional businesses and boosted personal income in the county. Sherman County realized substantial tax revenues, while individual farmers received additional income from royalty payments while still carrying on their farming operations.

Since many farmers and ranchers must supplement their income with outside sources of revenue, wind turbines can provide the additional revenue to improve the viability of their operations. According to the American Wind Energy Association (AWEA), wind farms can revitalize the economy of rural communities, providing steady income through lease or royalty payments to farmers and other landowners. Although leasing arrangements vary widely, a reasonable estimate for income to a landowner from a single utility-scale turbine is about $3,000 per year. For a 250-acre farm, with income from wind at about $55 an acre, the annual income from a wind lease could be $14,000, with no more than 2-3 acres removed from production. Such a sum can significantly increase the net income from farming. Farmers can grow crops or raise cattle next to the towers. Wind farms may extend over a large geographical area, but their actual "footprint" covers only a very small portion of the land, making wind an ideal way for farmers and ranchers to earn additional income. Other renewable energy facility construction such as solar and geothermal projects may be affected by the recommendations depending upon the proposed location of those facilities and proximity to sage-grouse habitat and leks. These facilities could also affect counties' economies through construction, maintenance, and generation of electricity.

Table 1
Socio-Economic Profile
Oregon Counties Affected by Sage-Grouse Strategy

Demographics	**Baker**	**Crook**	**Deschutes**	**Harney**	**Klamath**	**Lake**	**Malheur**	**Union**	**Oregon**
Population, 2009 Estimate	16,082	22,566	158,629	6,756	66,247	7,089	30,745	25,038	3,825,657
Population, percent change, April 1, 2000 to July 1, 2009	-3.9%	17.6%	37.5%	-11.2%	3.9%	-4.5%	-2.8%	2.1%	11.8%
High school graduates, percent of persons age 25+, 2000	80.3%	80.5%	88.4%	81.2%	81.5%	79.6%	71.0%	85.6%	85.1%
Bachelor's degree of higher, pct of persons age 25+, 2000	16.4%	12.6%	25.0%	11.9%	15.9%	15.5%	11.1%	21.8%	25.1%
Homeownership rate, 2000	70.1%	74.3%	72.3%	72.7%	68.8%	68.9%	63.8%	66.5%	64.3%
Median value of owner-occupied housing units, 2000	$84,700	$100,000	$148,800	$73,300	$91,100	$65,700	$86,900	$93,600	$152,100
Median household income, 2008	$37,282	$44,069	$51,897	$39,507	$41,093	$36,215	$36,403	$41,896	$50,165
Persons below poverty level, percent, 2008	16.9%	12.6%	10.4%	15.9%	17.0%	17.9%	21.3%	15.0%	13.5%
Personal Income ($ millions, 2008)	$443.9	$619.6	$5,635.3	$186.4	$1,938.9	$217.2	$713.8	$772.6	$137,569.0
Employment, September 2010									
Civilian Labor Force	7,700	9,354	79,873	3,640	30,684	4,006	13,750	12,602	1,979,670
Employed	7,027	7,909	69,414	3,185	27,127	3,589	12,500	11,497	1,783,367
Unemployed	673	1,445	10,459	455	3,557	417	1,250	1,105	196,303
Seasonally Adjusted Unemployment Rate, percent	11.1	19.0	15.5	15.8	14.0	14.0	12.1	10.6	10.6
Business									
Private nonfarm establishments, 2008	556	530	6,474	201	1,728	209	738	802	113,389
Private nonfarm employment, 2008	4,227	5,051	60,995	1,518	19,705	1,322	8,620	7,611	1,482,968
Geography									
Land area, 2000 (square miles)	3,068.12	2,979.38	3,018.15	10,134.33	5,944.19	8,135.75	9,887.09		95,996.79
State/Federal ownership, percent	52.3	51.2	78.9	77.6	55.8	78.0	75.6		56.4
Persons per square mile, 2000	5.5	6.4	38.2	0.8	10.7	0.9	3.2		35.6
Travel Generated and Local Recreation Expenditures ($ Millions, 2008)									
Fishing	$6.3	$4.0	$25.7	$3.1	$5.3	$2.9	$5.1	$2.4	$341.5
Hunting	$5.0	$3.3	$8.5	$4.8	$4.2	$2.8	$2.6	$6.0	$136.1
Wildlife Viewing	$8.6	$7.0	$44.3	$8.0	$14.9	$4.9	$1.5	$4.5	$495.3
Total	$19.9	$14.3	$78.5	$15.9	$24.4	$10.6	$9.2	$12.9	$972.9

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