U.S. FISH AND WILDLIFE SERVICE
DRAFT SPECIES REPORT
OF GREATER SAGE-GROUSE

SCIENTIFIC NAME: *Centrocercus urophasianus*

COMMON NAME: Greater sage-grouse

EXECUTIVE SUMMARY

[PLACEHOLDER]

INTRODUCTION

The intent of this Species Report is to facilitate the U.S. Fish and Wildlife Service (Service) in the evaluation of a candidate species, the greater sage-grouse, for listing under the Endangered Species Act (Act). The greater sage-grouse (range-wide) was first recognized as a candidate species under the Act following the publication of our 12-month finding on March 23, 2010 (75 FR 13910).

From 1999 to 2005, we received eight petitions to list the greater sage-grouse throughout its range or within specific Distinct Population Segments (DPSs) (Table I-1). Among those, two were petitions to list the Bi-State DPS of the greater sage-grouse (2002 and 2005). The Bi-State DPS has been addressed in a separate species report and status review and was determined to be not warranted for listing on April 23, 2015 (80 FR 22828); therefore, the Bi-State population will not be addressed in this species report. Our responses to the other six petitions and the outcomes of ensuing lawsuits and court settlements are detailed in our March 23, 2010, warranted but precluded finding for the greater sage-grouse (75 FR 13910), and are summarized in Table I-1.

Table I-1. Summary of petitions and responses for greater sage-grouse, including the eastern and western sub-species, and Columbia Basin. Two petitions for the Bi-State DPS are not included here. The regulatory history for the Bi-State DPS can be found at (79 FR 45420 and 80 FR 22828).

Petitioner	Date	Request of Petition	Petition Finding	Status Review Finding	Legal Challenges	Outcome
Craig Dremann	Jul. 2, 2002	List range-wide	These 3 petitions combined in one substantial finding; Apr. 21, 2004	Not Warranted; Jan. 12, 2005	Western Watersheds Project challenged in 2006; claim was arbitrary and politically influenced	Finding remanded in 2007; Warranted finding published March 23, 2010
(Institute for Wildlife Protection	Mar. 24, 2003	List range-wide				
American Lands Alliance [lead] + 20 other organizations)	Dec. 29, 2003	List range-wide				

Petitioner	Date	Request of Petition	Petition Finding	Status Review Finding	Legal Challenges	Outcome
Institute for Wildlife Protection	Jan. 24, 2002	List the western subspecies	Non-substantial; Feb. 7, 2003	N/A	Institute for Wildlife Protection challenged; 2006 court ruling that USFWS failed to provide adequate definition for sub-species	Positive 90-day finding April 29, 2008; Part of March 23, 2010 finding, but determined it was not a valid sub-species
Institute for Wildlife Protection	Jul. 3, 2002	List the eastern subspecies	Non-substantial; Jan. 7, 2004	N/A	Institute for Wildlife Protection challenged	Judge ruled in favor of USFWS on Sept. 28, 2004 and dismissed plaintiff case
NW Ecosystem Alliance and Biodiversity Legal Foundation	May 28, 1999	List the Columbian Basin as a DPS	Substantial; Aug. 24, 2000	Warranted but precluded; May 7, 2001	N/A	Committed to resolve the DPS status in the range-wide status review

On May 10, 2011, we filed a multiyear work plan as part of a proposed settlement agreement with Wild Earth Guardians and other plaintiffs in a consolidated case in the U.S. District Court for the District of Columbia to resolve the status of species on our candidate list. On September 9, 2011, the Court accepted our agreement with the plaintiffs in Endangered Species Act Section 4 Deadline Litig., Misc. Action No. 10–377 (EGS), MDL Docket No. 2165 (D. DC) (known as the "MDL case") on a schedule to publish proposed rules or not-warranted findings for the 251 species designated as candidates as of 2010 no later than September 30, 2016. The work plan included a deadline to submit a proposed rule or not-warranted finding to the Federal Register for greater sage-grouse, including any DPSs[1], by the end of FY 2015.

[1] The Bi-State DPS was due a year earlier per the MDL settlement (see 80 FR 222828).

CHAPTER 1: GREATER SAGE-GROUSE SPECIES DESCRIPTION

The greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse) is the largest North American grouse species. Adult male sage-grouse range in length from 66 to 76 centimeters (cm) (26 to 30 inches (in)) and weigh between 2 and 3 kilograms (kg) (4.4 and 6.6 pounds (lb)). Adult females are smaller, ranging in length from 48 to 58 cm (19 to 23 in) and weigh between 1 and 2 kg (2.2 and 4.4 lb). Males and females have dark grayish brown body plumage with many small gray and white spots, fleshy yellow combs over the eyes, long pointed tails, fully feathered legs and feet, and dark green toes. Males also have blackish chin and throat feathers, conspicuous phylloplumes (specialized erectile feathers) at the back of the head and neck, and white feathers forming a ruff around the neck and upper belly. During breeding displays, males exhibit olive green apteria (fleshy bare patches of skin) on their breasts (Schroeder *et al.* 1999, p. 2).

Taxonomy

Greater sage-grouse are birds in the Phasianidae family, which is a diverse taxonomic group consisting of over 50 genera commonly known as grouse, turkeys, pheasants, partridges, francolins, and Old World quail. Greater sage-grouse are one of two species in the genus *Centrocercus*; the other being the Gunnison sage-grouse (*C. minimus*) (AOU 2000, pp. 849–850). The Gunnison and greater sage-grouse were once considered a single species but in 2000 Gunnison sage-grouse was identified as a distinct species based on morphological (Hupp and Braun 1991, pp. 257–259; Young *et al*. 2000, pp. 447–448), genetic (Kahn *et al*. 1999, pp. 820–821; Oyler-McCance *et al*. 1999, pp.1460–1462), and behavioral (Barber 1991, pp. 6–9; Young 1994; Young *et al*. 2000, pp. 449–451) differences and geographical isolation (AOU 2000, pp. 849–850; Young *et al*. 2000, pp. 447–451).

Habitat

Sage-grouse depend on a variety of shrub-steppe habitats throughout their life cycle and is a sagebrush (*Artemisia* spp.) obligate (Patterson 1952, p. 48). Variable by elevation, location, and ecological site characteristics across the range, sage-grouse use a variety of sagebrush species including, but not limited to: *A. tridentata wyomingensis* (Wyoming big sagebrush), *A. t. vaseyana* (mountain big sagebrush), *A. t. tridentata* (basin big sagebrush), *A. nova* (black sagebrush), *A. frigida* (fringed sagebrush), *A. cana* (silver sagebrush), and *A. arbuscula* (little sagebrush) (Patterson 1952, p. 48; Braun *et al.* 1976, p. 168; Schroeder *et al.* 1999, pp. 4–5; Connelly *et al.* 2000a, pp. 970–972; Connelly *et al.* 2004, pp. 3-4; Connelly *et al.* 2004, p. 4-1; Miller *et al.* 2011, p. 145). Thus, sage-grouse distribution is strongly correlated with the distribution of sagebrush vegetation (Schroeder *et al.* 2004, p. 364).

Sagebrush Ecosystem

Sagebrush is the most widespread vegetation in the intermountain lowlands in the western U.S. (West and Young 2000, p. 259) and is considered one of the most imperiled ecosystems in North America (Knick *et al.* 2003, p. 612; Miller *et al.* 2011, p. 452, and references therein). Scientists recognize 13 species and 12 subspecies of sagebrush (Shultz 2009, p. 1), each with unique habitat requirements and responses to perturbations (West and Young 2000, p. 259). Sagebrush species and subspecies occurrence is dictated by local soil type, soil moisture, and climatic conditions (West 1983, p. 333; West and Young 2000, p. 260; Miller *et al.* 2011, pp. 151–154). The degree of dominance by sagebrush varies with local site conditions and disturbance history. Plant associations, typically defined by native perennial grasses, further define distinctive sagebrush communities (Miller and Eddleman 2000, pp. 10–14; Connelly *et al.* 2004, p. 5-3), and are influenced by topography, elevation, precipitation, and soil type. These ecological site conditions influence the resistance and resiliency of sagebrush and their associated understories to natural and human-caused changes (Chambers *et al.* 2014, entire).

Sagebrush occurs in two natural vegetation types that are delineated by temperature and patterns of precipitation (Miller *et al.* 2011, pp. 147–148). Sagebrush-steppe ranges across the northern portion of sage-grouse range, from British Columbia and the Columbia Basin, through the northern Great Basin, Snake River Plain, and Montana, and into the Wyoming Basin and northern Colorado. Sagebrush is a co-dominant plant, along with perennial bunchgrasses in sagebrush-steppe range. Great Basin sagebrush occurs south of sagebrush-steppe, and extends from the Colorado Plateau westward into Nevada, Utah, and California (Miller *et al.* 2011, pp. 147–148). Sagebrush is usually the dominant plant layer accompanied by sparse understories. Other sagebrush types within sage-grouse range include mixed-desert shrubland in the Bighorn Basin of Wyoming, and grasslands in eastern Montana and Wyoming that also support silver sagebrush and *A. filifolia* (sand sagebrush) (Miller *et al.* 2011 p. 148).

Sagebrush is typically divided into two groups, big sagebrush and low or dwarf sagebrush, based on their affinities for different soil types (West and Young 2000, p. 259). Big sagebrush species and subspecies, such as Wyoming big sagebrush, are limited to coarse-textured and/or well-drained sediments, whereas low (or dwarf) forms of sagebrush, such as black sagebrush, typically occur where erosion has exposed clay or calcified soil horizons (West 1983, p. 334; West and Young 2000, p. 261). None of the sagebrush taxa tolerate soils with high salinity (West 1983, p. 333; West and Young 2000, p. 257).

All species of sagebrush produce large ephemeral leaves in the spring, which persist until reduced soil moisture occurs in the summer. Most species also produce smaller, over-wintering leaves in the late spring that last through summer and winter. Sagebrush have fibrous tap root systems, which allow the plants to draw surface soil moisture, and also to access water deep within the soil profile when surface water is limited (West and Young 2000, p. 259). Most sagebrush flower in the fall. However, during years of drought, or other moisture stress, flowering may not occur (West and Young 2000, p. 260). Although seed viability and germination are high, seed dispersal is limited (West and Young 2000, p. 260). Additionally, sagebrush seeds typically do not remain viable for more than one growing season and evidence suggests seed banks are transient (i.e., seeds persist in the soil less than one year); however, seeds have higher odds of persisting in the seed bank if they are buried (Wijayratne and Pyke 2012, p. 438).

Sagebrush is long-lived, with plants of some species surviving up to 150 years (West 1983, p. 340). Sagebrush has resistance to environmental extremes, with the exception of fire and occasionally defoliating insects (e.g., the webworm (*Aroga* spp.); West 1983, p. 341). Most species of sagebrush are killed by fire (Miller and Eddleman 2000, p. 17; West 1983, p. 341; West and Young 2000, p. 259). Depending on the species of sagebrush and other site-specific characteristics, fire return intervals of 10 to over 300 years have been reported (McArthur 1994, p. 347; Peters and Bunting 1994, p. 33; Miller and Rose 1999, p. 556; Kilpatrick 2000, p. 1; Frost 1998 cited in Connelly *et al.* 2004, p. 7-4; Zouhar *et al.* 2008, p. 154; Baker 2011, pp. 190–197; Bukowski and Baker 2013, entire). In general, mean fire return intervals in low-lying, xeric, big sagebrush communities range from 100 to 350 years, and return intervals decrease to 50 to over 200 years in more mesic areas, mountain sagebrush communities at higher elevations, during wetter climatic periods, and in locations associated with grasslands (Baker 2006, p. 181; Mensing *et al.* 2006, p. 75; Baker 2011, pp. 194–195; Miller *et al.* 2011, p. 166; Bukowski and Baker 2013, entire). Natural sagebrush re-colonization in burned areas depends on the presence of adjacent live plants for a seed source or on the seed bank, if present (Miller and Eddleman 2000, p. 17).

Productivity of plants associated with the sagebrush understory varies widely and is influenced by moisture availability, soil characteristics, climate, and topographic position (Miller *et al.* 2011, pp. 151–154). Forb abundance can be highly variable from year to year and is largely affected by the amount and timing of precipitation.

Few areas with sagebrush have been undisturbed or unaltered since EuroAmerican settlement in the late 1800s (Knick *et al.* 2003, p. 612 and references therein). Due to the disruption of primary patterns, processes and components of sagebrush ecosystems since EuroAmerican settlement (Knick *et al.* 2003, p. 612; Miller *et al.* 2011, p. 147), the large range of abiotic variation, the minimal short-lived seed banks, and the long generation time of sagebrush, restoration of disturbed areas is very difficult, particularly at the scales required by sage-grouse to meet all their seasonal habitat requirements. Not all areas previously dominated by sagebrush can be restored because ~~alteration of vegetation, nutrient cycles, topsoil, and biological soil crusts have~~alterations of vegetation, nutrient cycles, topsoil, and biological soil crusts have exceeded recovery thresholds (Knick *et al.* 2003, p. 620). Additionally, processes to restore sagebrush ecology are relatively unknown (Knick *et al.* 2003, p. 620). Active restoration activities are often limited by financial and logistic resources (Knick *et al.* 2003, p.620; Miller *et al.* 2011, p. 147; Pyke 2011, p. 544) and may require decades or centuries (Knick *et al.* 2003, p.620 and references therein). Meaningful restoration for sage-grouse requires landscape, watershed, or eco-regional scale context rather than individual, unconnected efforts (Knick *et al.* 2003, p. 623 and references therein; Wisdom *et al.* 2011, p. 469). Landscape restoration efforts require partnerships across multiple ownerships and jurisdictions in order to restore and maintain a connective network of intact vegetation (Knick *et al.* 2003, p. 623; Pyke 2011, p. 548; see ***Land Ownership and Management*** section). Except for areas where active restoration is attempted following disturbance (e.g., mining, wildfire), management efforts in sagebrush ecosystems are usually focused on maintenance (Miller *et al.* 2011, p. 183; Wisdom *et al.*2011, pp. 470, 472).

Although sage-grouse require large, interconnected expanses of sagebrush with healthy, native understories (Patterson 1952; Connelly *et al.* 2004, pp. 4–15; Knick *et al.* 2003, p. 623; Connelly *et al.* 2011b, p. 80; Pyke 2011, p. 540; Wisdom *et al.* 2011, p. 461), there is little information available regarding minimum sagebrush patch sizes required to support populations of sage-grouse. This is due in part to the migratory nature of some, but not all, sage-grouse populations, the lack of juxtaposition of seasonal habitats, and differences in local, regional and range-wide ecological conditions which influences the distribution of sagebrush and associated understories. Occupancy of a home range is also based on multiple variables, including local vegetation and landscape characteristics (Knick *et al.* 2003, p. 621). Home range calculations are extremely variable (4 to 615 km^2 range [1.5 to 237.5 $miles^2$ (mi)]; Connelly *et al.* 2011a, p. 60 and references therein). Migratory populations of sage-grouse may use very large areas, exceeding 2,700 km^2 (1,042 mi^2, 667,185 acres; Leonard *et al.* 2000, p. 269, Davis 2014, p. 713). Large seasonal and annual movements emphasize the landscape nature of the sage-grouse (Knick *et al.* 2003, p. 624; Connelly *et al.* 2011a, p. 60).

Seasonal Habitat Selection and Life History Characteristics

Sage-grouse are dependent on large areas of contiguous sagebrush to meet all seasonal habitat requirements (Patterson 1952, p. 48; Connelly *et al.* 2004, p. 4-1; Connelly *et al.* 2011, pp. 82–83; Wisdom *et al.* 2011, p. 465). Loss of any of these seasonal habitats could impact the ability of sage-grouse to persist in an area (Connelly *et al.* 2011, pp. 67). Sage-grouse exhibit strong site fidelity (loyalty to a particular area, even when the area is no longer of value) to seasonal habitats, which includes breeding, nesting, brood-rearing, and wintering areas (Connelly *et al.* 2004, p. 3-1; Connelly *et al.* 2011, p. 60 and references therein).

During the breeding season, male sage-grouse gather together to perform courtship displays on areas called leks. Areas are often characterized by having bare soil, shortgrass-steppe, windswept ridges, exposed knolls, or other relatively open sites typically serve as leks (Patterson 1952, p. 83; Connelly *et al.* 2004, p. 3-7 and references therein). Leks are often surrounded by denser shrub-steppe cover, which is used for escape, thermal, and feeding cover. Leks can be formed opportunistically at any appropriate site within or adjacent to nesting habitat (Connelly *et al.* 2000a, p. 970), and therefore lek habitat availability is not considered to be a limiting factor for sage-grouse (Schroeder 1999, p. 4). Numerous researchers have observed that a relatively small number of dominant males account for the majority of copulations on each lek (Schroeder *et al.* 1999, p. 8). However, recent genetic analyses found that on average 45.9 percent (range 14.3 to 54.5 percent) of genetically identified males in a population fathered offspring in a given year (Bush *et al.* 2013, p. 33). This suggests that males and females likely engage in off-lek copulations. Males do not participate in incubation of eggs or rearing chicks.

The distances females travel to nest locations from leks varies across the range, ranging from 0.14 km (0.087 mi) up to more than 20 km (12.5 mi) to their nest site after mating (Connelly *et al.* 2000a, p. 970; Connelly *et al.* 2011, p. 62 and references therein). Nest sites are selected independent of lek locations, but that the reverse is not true (Bradbury *et al.* 1989, p. 22; Wakkinen *et al.* 1992, p. 382). Distance between the lek and nest site location is influenced by the juxtaposition of habitats, disturbance, and extent of habitat fragmentation (Lyon and Anderson 2003, pp. 489–490; Connelly *et al.* 2004, p. 3-10; Schroeder and Robb 2003, pp. 293–297). Females in highly fragmented habitats of Washington moved almost twice as far to nest (Schroeder *et al.* 1999. pp. 11–12) as females in relatively intact habitats of southeastern Idaho (Wakkinen *et al.* 1992, p. 382; Fischer 1997, p. 85). Similarly, females from undisturbed leks in southwestern Wyoming moved an average of 2.1 km (1.3 mi) to nests while females from disturbed leks moved 4.1 km (2.5 mi) (Lyon and Anderson 2003, p. 489).

~~The distances between a nest site and the lek on which breeding occurred is also variable (Connelly *et al.* 2004, p. 4-5). Average distance between a female's nest and the lek on which the female was first observed ranged from 3.4 km (2.1 mi) to 7.8 km (4.8 mi) in five studies examining 301 nest locations (Schroeder *et al.* 1999, p. 12). Other studies have reported the average lek-to-nest distance was larger for the lek of capture compared with the distance to the nearest lek (Petersen 1980, p. 24; Wakkinen *et al.* 1992a, p. 382; Fischer 1993, p. 1039; Schroeder *et al.* 1999, p. 12; Herman-Brunson 2007, p. 24). In northeastern California (Davis *et al.* 2014, pp. 716–717) the average distance between a female's nest and the nearest lek was 4.67 km (2.9 mi) and ranged from 0.14km (0.087 mi) to 14.10 km (8.76 mi). These results are consistent with other studies conducted in peripheral populations (Schroeder *et al.* 1999, pp. 11–12; Aldridge and Brigham 2001, p. 541; Moynahan *et al.* 2007, p. 1777; Herman-Brunson *et al.* 2009, p. 400; Wiechman 2013, pp. 129–130). Nest sites are selected independent of lek locations, but that the reverse is not true (Bradbury *et al.* 1989, p. 22; Wakkinen *et al.* 1992, p. 382).~~

Productive nesting areas are typically characterized by sagebrush with an understory of native grasses and forbs, with horizontal and vertical structural diversity that provides an insect prey base, herbaceous forage for pre-laying and nesting females (Barnett and Crawford 1994, p. 116), and cover for the female while she is incubating (Gregg 1991, p. 19; Schroeder *et al.* 1999, p. 4; Connelly *et al.* 2000a, p. 971; Connelly *et al.* 2004, pp. 4-17, 18). Sage-grouse may also use other shrub or bunchgrass species for nest sites (Klebenow 1969, p. 649; Connelly *et al.* 2000a, p. 970; Connelly *et al.* 2004, p. 4-4; Davis *et al.* 2014, p. 5). Shrub canopy and grass cover provide concealment for sage-grouse nests and young (Gregg *et al.* 1994, p. 164; DeLong *et al.*1995, p. 90; Connelly *et al.* 2004, p. 4-4), and forb availability and abundance are critical for reproductive success (Barnett and Crawford 1994, p.116; Gregg *et al.* 2008, p. 539).

Sage-grouse clutch size ranges from 6 to 9 eggs with an average of 7 eggs (Connelly *et al.* 2011a, p. 62). The likelihood of a female nesting in a given year averages 82 percent in the eastern portion of the range and 78 percent in the western portion of the range (Connelly *et al.* 2011a, p. 63). Adult females have higher nest initiation rates than yearling females (Connelly *et al.* 2011a, p. 58). Nest success (one or more eggs hatching from a nest) varies widely (15 to 86 percent of initiated nests [Schroeder *et al.* 1999, p. 11]; 12 to 71 percent of initiated nests [Connelly *et al.* 2011a, p. 58]). Overall, the average nest success for sage-grouse in non-altered habitats is 51 percent and for sage-grouse in altered habitats is 37 percent (Connelly *et al.* 2011a, p. 58). Re-nesting only occurs if the original nest is lost (Schroeder *et al.* 1999, p. 11). Sage-grouse re-nesting rates average 28.9 percent with a range from 5 to 41 percent (Connelly *et al.* 2004, p. 3-11). Other game bird species have much higher re-nesting rates, often exceeding 75 percent. The impact of re-nesting on annual productivity for most sage-grouse populations is unclear and thought to be limited (Crawford *et al.* 2004, p. 4).

Little information is available on the level of productivity (number of chicks per female that survive to fall) that is necessary to maintain a stable population (Connelly *et al.* 2000b, p. 970). Approximately 2.25 chicks per female may be necessary to maintain stable to increasing populations (Connelly *et al.* 2000b, p. 970, and references therein). Long-term productivity estimates of 1.40 to 2.96 chicks per female across the species range have been reported (Connelly and Braun 1997, p. 20). A recent study assessing the population structure of sage-grouse based on the collection and analysis of over 67,000 wings from hunter harvested birds in Colorado and Oregon during 1973 to 1998 and 1993 to 2013 found the average number of juveniles in the harvest per female in the harvest varied from 1.2 to 2.4 (Braun *et al.* 2015, p. 10). Despite average clutch sizes of 7 eggs (Connelly *et al.* 2011a, p.62), due to low chick survival and limited re-nesting, there is little evidence that populations of sage-grouse produce large annual surpluses (Connelly *et al.* 2011a, p. 67).

Females rear their broods in the vicinity of the nest site for the first 2 to 3 weeks following hatching (0.2 to 5 km [0.1 to 3.1 miles]), based on studies in Wyoming (Connelly *et al.* 2004, p. 4-8). Forbs and insects are essential nutritional components for chicks (Klebenow and Gray 1968, p. 81; Johnson and Boyce 1991, p. 90; Connelly *et al.* 2004, p. 4-9). Therefore, early brood-rearing habitat must provide adequate cover adjacent to areas rich in forbs and insects to assure chick survival during this period (Connelly *et al.* 2004, p. 4-9).

All sage-grouse gradually move from sagebrush uplands to more mesic areas during the late brood-rearing period (12 weeks post-hatch; Peterson 1970, p. 149) in response to summer desiccation of herbaceous vegetation (Connelly *et al.* 2000a, p. 971). Summer use areas can include sagebrush habitats as well as riparian areas, wet meadows, and alfalfa fields (Schroeder *et al.* 1999, p. 4). These areas provide an abundance of forbs and insects for both females and chicks (Schroeder *et al.* 1999, p. 4; Connelly *et al.* 2000a, p. 971). Sage-grouse will use free water although they do not require it since they obtain their water needs from the food they eat (Schroeder et al. 1999, p. 6). However, natural water bodies and reservoirs can provide mesic areas for succulent forb and insect production, thereby attracting sage-grouse females with broods (Connelly *et al.* 2004, p. 4-12). Broodless females and males will also use more mesic areas in close proximity to sagebrush cover during the late summer, often arriving before females with broods (Connelly *et al.* 2004, p. 4-10).

Sage-grouse are considered to be sagebrush obligate, which becomes most obvious during the winter when birds depend almost exclusively on sagebrush for both food and cover (Schroeder 1999, p. 5; Thacker *et al.* 2012, p. 588). Winter areas used by sage-grouse are characterized by large expanses of big sagebrush and tall shrubs, predominantly located on relatively gentle south or west-facing slopes that provide more favorable thermal conditions and above snow forage (Beck 1977, p. 22; Hupp and Braun 1987, p. 826; Doherty *et al.* 2008, p. 192; Hagen *et al.* 2011, p. 536; Dzialak *et al.* 2013, p. 16). During the winter, sage-grouse avoid bare ground, conifer and riparian areas, and anthropogenic features (e.g., roads, energy development) (Beck 1977, p. 21; Doherty *et al.* 2008, p. 192; Carpenter *et al.* 2010, p. 1811; Dzialak *et al.* 2012, p. 12; Dzialak *et al.* 2013, p. 16; Smith *et al.* 2014, p. 15; Holloran *et al.* 2015, p. 9999).

The timing of movement to winter ranges varies considerably, but peaks around mid-October through late November (Schroeder *et al.* 1999, p. 10). Movement has been described as slow and meandering, with birds typically traveling less than 1 km (0.6 mi) per day (Connelly *et al.* 1988, p. 119). The distance sage-grouse travel (walking and flying) to reach wintering areas is highly variable both within and among populations (Fedy *et al.* 2012, p. 1067). Distances recorded across the range vary from 0.33 km (0.2 mi) to 120 km (74.6 mi) (Connelly *et al.* 1988, p. 119; Fedy *et al.* 2012, p. 1067, Tack *et al.* 2012, p. 65). A population in Canada travels annually to a winter range in Montana, a distance of more than 120 km (74.6 mi) one way and the longest documented annual migration for sage-grouse (Tack *et al.* 2012, p. 65). The high degree of variability both within and among populations makes generalizations on winter habitat locations in relation to other seasonal habitats difficult (Fedy *et al.* 2012, p. 1067).

Sage-grouse exhibit fidelity to winter sites (Berry and Eng 1985, p. 239). The degree of fidelity, however, may be somewhat more relaxed than for other seasonal habitats, as birds have displayed some ability to shift winter habitat use in response to severe conditions by moving to areas where sagebrush remains above the snow (Beck 1977, p. 24; Smith 2010, p. 8).

Sage-grouse are well adapted to the incredibly harsh conditions typical of a winter on the sagebrush-steppe, which is characterized by periods of sub-zero temperatures, extreme winds, limited shelter, and snow. For example, sage-grouse have feathered legs and feet with small narrow scales adept for walking and burrowing in the snow for shelter and to forage (Patterson 1952, p. 6). All sage-grouse switch from diets containing varying amounts of sagebrush, forbs, and insects during breeding season to a diet that consists almost entirely of sagebrush during winter (Schroeder *et al.* 1999, p. 5).

During the average winter sage-grouse typically experience low overwinter mortality (2 percent, Connelly *et al.* 2000b, p. 229; 0 to 15 percent, Wik 2002, p. 40; 2 to 3 percent Sika 2006, p. 90; 4 percent, Bruce *et al.* 2011, p. 421). In fact, sage-grouse not only survive the winter, but may actually gain weight over the winter months (Beck and Braun 1978, p. 243). During notably severe winters, however, significant population-level mortality has been documented (58 percent, Moynahan *et al.* 2006, p. 1536; 54 percent, Anthony and Willis 2008, p. 544).

The distribution and abundance of suitable winter habitats is limited. Across the range of sage-grouse winter habitat comprised from 6.8 to 18 percent of the total landscape used by different populations (Beck 1977, p. 20; Dzialak *et al.* 2013, p. 10; Smith *et al.* 2014, p. 12). In south central Montana, the numbers of males counted on leks declined by 73 percent following a 30 percent loss of winter habitat to cropland conversion (Swenson *et al.* 1987, p. 128). This decline occurred despite the fact that 84 percent of the total area remained unplowed sagebrush-steppe (Swenson *et al.* 1987, p. 128). This information highlights the importance of winter habitats to sage-grouse persistence. The loss of these essential winter habitats can have impacts disproportionate to their makeup on the landscape (Swenson *et al.* 1987, p. 128). Winter habitat can be even more limited during severe winters when heavy snow fall and increasing snow depths further decrease or even eliminates access to sagebrush. During harsh winters, birds become even more concentrated in the few remaining areas of exposed sagebrush that are critical for shelter and foraging (Beck 1977, p. 24; Hupp and Braun 1987, p. 828). Thus, areas critical to survival during winters with heavy snowfall, may not be the same areas the birds regularly occupy during an average winter (Caudill *et al.* 2013, p. 256).

Seasonal Movements and Dispersal

The distances sage-grouse move between seasonal habitats are highly variable across the occupied range (Dalke *et al.* 1960, p. X; Connelly *et al.* 1988, p. X). Seasonal habitats may be distinct necessitating movement between areas, or integrated (e.g., sage-grouse may use the same area for breeding and brood-rearing, or winter and breeding, or all three seasonal habitats; Connelly *et al.* 2000b, p 968). Therefore sage-grouse may migrate between two or three distinct seasonal ranges, or not migrate at all. Non-migratory sage-grouse have seasonal movements of <10 km (6.2 mi) while birds in migratory populations may travel well over 100 km (62 mi; Patterson 1952, p. 189; Hulet 1986, p. 169, Hagen 1999, p. X). Movement patterns may be (1) non-migratory—sage-grouse make one-way movements less than 10 km (6.2 mi) between or among seasonal ranges, (2) one-stage migration—grouse move greater than or equal to10 km (6.2 mi) between two distinct seasonal ranges, or (3) two-stage migration—grouse move greater than or equal to 10 km (6.2 mi) among three distinct seasonal ranges (Connelly *et al.* 2000, p. 968). Migration between seasonal ranges is usually in response to seasonal habitat distribution (Schroeder *et al.* 1999, p. 3; Connelly *et al.* 2004, p. 3-5). Migration distances for female sage-grouse generally are less than for males (Connelly *et al.* 2004, p. 3-4), but in one study in Colorado, females travelled further than males (Braun and Beck 1976, p. X).

Almost no information is available regarding the distribution and characteristics of migration corridors for sage-grouse (Connelly *et al.* 2004, p. 4-19). Sage-grouse dispersal (permanent moves to other areas) is poorly understood (Connelly *et al.* 2004, p. 3-5) and appears to be sporadic (Dunn and Braun 1986, p. 89). Despite the documentation of extensive seasonal movements in this species (Fedy *et al.* 2012, p. 1066; Tack *et al.* 2012, p. 65; Davis *et al.* 2014, pp. 5–7), the dispersal abilities of sage-grouse are assumed to be low (e.g., median natal dispersal distance = 8.8 km (5.5 mi) for females versus 7.4 km (4.6 mi) for males [Dunn and Braun 1985, p. 622] and 3.8 km (2.4 mi) and 2.7 km (1.7 mi), for males and females, respectively [Thompson 2012, p. 193]). Small scale differences in habitat are not likely to influence sage-grouse dispersal at landscape scales (Row *et al.* 2015, p. 10). Rather, the arrangement of habitat quality was more influential on sage-grouse dispersal (Row *et al.* 2015, p. 11) than the presence of unsuitable habitats.

Previous investigations describing space use by sage-grouse have been constrained by highly variable seasonal movement patterns within and among populations, limited sample size, variation in the duration of the study, and variation in methods of home range estimation (e.g., Hagen 1999, p. 267; Leonard *et al.* 2000, p. X; Hausleitner 2003, p. X; Fedy *et al.* 2012, p. X). Moreover, the extensive movements between seasonal ranges and highly clustered distributions of sage-grouse (Hagen *et al.* 2001, p. X) have made estimating home range size and comparisons between studies difficult.

Population Connectivity and Landscape Genetics

Population connectivity can be an important factor influencing a species' viability. Species that have multiple interconnected populations are more likely to persist because connectivity among populations ensures a pathway for recolonization following local extirpations (Gilpin and Hanski 1991, p. X). Population connectivity can be estimated by evaluating habitat models in the context of species movement ecology or can be measured through the evaluation of gene flow from genetic data.

Habitat-based measures show that maintaining population connectivity is essential for sage-grouse persistence. Average movement between population centers (leks) of sage-grouse range-wide was 16.6 km (10.3 mi) (Knick and Hanser 2011, entire). Leks within approximately 18 km (11.2 mi) of each other had common features when compared to leks further than this distance (Figure I-1; Knick and Hanser 2011, p. 393; Row *et al.* 2015, p. 7). Connectivity between sage-grouse populations declined from 1965 to 2007 due to the loss of leks that historically provided connectivity and lower numbers of birds left to disperse (Knick and Hanser 2011, p. 395). As connectivity declined, leks with low connectivity were lost first (Knick and Hanser 2011, p. 395), with small decreases in lek connectivity resulting in large increases in probability of lek abandonment (Knick and Hanser, 2011, p. 403). This suggests that as connectivity between leks at the edge of the range is lost, the probability these leks will persist is likely to decline (Knick and Hanser 2011, p. 396). An updated connectivity model is currently being reviewed, but is not yet available for inclusion in this report.

Sagebrush distribution is the most important factor in maintaining sage-grouse population connectivity (Knick and Hanser 2011, p. 404). Habitat loss resulting from fragmentation and conversion decreases the connectivity between seasonal habitats potentially resulting in the loss of the population (Doherty *et al.* 2008, p. 194). Loss of connectivity can increase population isolation (Knick and Hanser 2011, p. 402 and references therein) and, therefore, the probability of loss of genetic diversity and extirpation from stochastic events. Environmental factors such as habitat fragmentation, habitat loss, and altered habitat disturbance regimes (e.g., fire frequency), rather than stochastic events, were identified as the likely primary influences on sage-grouse population trend (Knick and Hanser 2011, p. 403).

Formatted: Normal

~~Landscape genetic studies show a pattern of localized gene flow – birds moving among neighboring populations but not moving across the entire species' range (isolation by distance) (Oyler-McCance *et al.* 2005, entire; Oyler-McCance and Quinn 2011, p. 91).~~ Highly resistant landscapes (e.g., large areas of unsuitable habitat such as mountain ranges) can impede genetic information flow in sage-grouse (Row *et al.* 2015, p. 11). In Wyoming, the distribution of unsuitable habitat was more influential than the quality of usable habitat for dispersing sage-grouse (Row *et al.* 2015, p. 11).

~~Sage-grouse mitochondrial DNA (mtDNA) and microsatellite DNA has been analyzed (Oyler-McCance *et al.* 2005, p. 1294).~~ Mitochondrial DNA (mtDNA) is maternally inherited without recombination, making it a more conserved marker that is useful for identifying species, subspecies, and conservation units (Wan *et al.* 2004, p. X). Microsatellites, short tandem repeats in nuclear DNA, are subjected to recombination and evolve orders of magnitude faster than mtDNA. Thus, microsatellites provide a powerful tool for analyzing recent gene flow (Wan *et al.* 2004, p. X).

Formatted: Highlight

Sage-grouse ~~mitochondrial DNA~~ (mtDNA) and microsatellite DNA has been analyzed (Oyler-McCance *et al.* 2005, p. 1294). ~~Landscape genetic studies show a pattern of localized gene flow – birds moving among neighboring populations but not moving across the entire species' range~~

(isolation by distance) (Oyler-McCance *et al.* 2005, entire; Oyler-McCance and Quinn 2011, p. 91).

Sage-grouse populations were grouped into genetic clusters based on microsatellites using a model-based clustering analysis without regard to geographic location (Figure 1-1) (Oyler-McCance *et al.* 2005, p. 1301–1304). Populations were structured geographically with a positive correlation between genetic distance and geographical distance (Figure 1I-1) (Oyler-McCance *et al.* 2005, p. 1301–1304).. Gene flow is limited to the movement of individuals between neighboring populations and it is unlikely that individuals move across large portions of the range (isolation by distance; Oyler-McCance *et al.* 2005, p. X). entire; Oyler-McCance and Quinn 2011, p. 91). Patterns of mtDNA across the species' range indicated that, consistent with the nuclear DNA, there is a gradual shift across the range in the percentage of individuals in each clade (Figure 1I-1;) (Oyler-McCance *et al.* 2005, p. X). The genetic data (both microsatellite markers and mtDNA) provide strong support for separating out the Bi-State population as an independent conservation unit (Oyler-McCance *et al.* 2005, p. X), as detailed in our 2013 proposal to list it as a DPS (78 FR 64358).

Most of the reported genetic clusters were large and consisted of many populations, but smaller, more fragmented areas on the periphery of the range in Colorado, Utah, Lyon-Mono in Nevada and California (Bi-State), and Washington, made up their own clusters, suggesting lower amounts of gene flow in these areas (Pritchard and Donnelly 2000, p. X; The genetic data (both microsatellite markers and mtDNA) provide strong support for separating tout the Bi-State population as an independent conservation unit (Oyler-McCance et al. 2005, p. X), as detailed in our 2013 proposal to list it as a DPS [(78 FR 64358]).). The least genetically diverse grouping of sage-grouse occurs in the Columbia Basin, likely as a result of habitat loss, isolation, and subsequent population decline (Oyler-McCance and Quinn 2011, p. 92).

Formatted: Indent: First line: 0"

Formatted: Highlight

Formatted: Highlight

Comment [DMD1]: And also see new publication Oyler-McCance et al. 2015

Formatted: Font: Not Bold, Not Italic

Formatted: Font: Not Bold, Not Italic

Comment [DMD2]: And also see new publication Oyler-McCance et al. 2015

Formatted: Font: Not Bold, Not Italic, Highlight

Formatted: Font: Not Bold, Not Italic

Formatted: Font: Not Bold, Not Italic

Formatted: Font: Not Bold, Not Italic

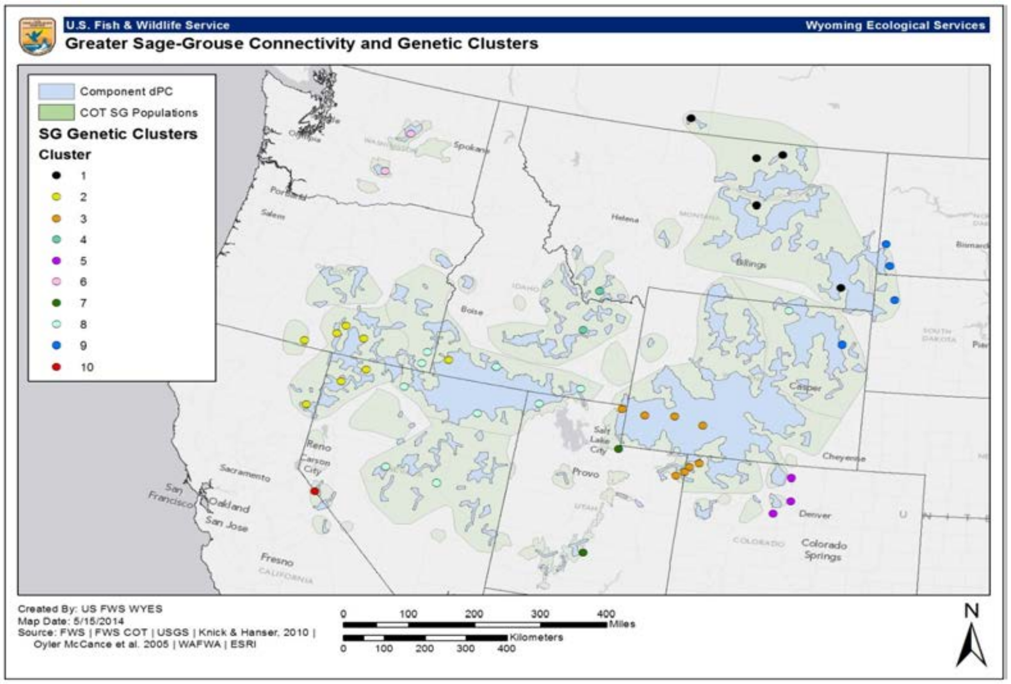


Figure ~~1~~I-1. Overlay of nuclear genetic cluster information (Oyler-McCance *et al.* 2005) with habitat connectivity analyses (Knick and Hanser 2011).

Analyses of mitochondrial information from southwestern Montana and northwestern Wyoming has subsequently identified Jackson Hole and Gros Ventre areas in Wyoming as isolated with reduced levels of diversity when compared to surrounding areas (Schulwitz *et al.* 2014. p. 566). Landscape features, such as mountains, may be important factors leading to genetic differentiation (Schulwitz *et al.* 2014, p. 568; Row *et al.* 2015, p. 12). However, habitat loss from anthropogenic activities could not be ruled out as a contributing factor to genetic isolation in Jackson Hole (Schulwitz *et al.* 2014. p. 566). It is possible that other areas of isolation are present, but the scale of genetic analyses currently available are too coarse to detect these differences. The distribution of breeding and winter seasonal habitats in Wyoming was the best predictor of gene flow (Row *et al.* 2015, p. 11). An analysis of genetic connectivity currently being conducted by the U.S. Geological Service (USGS) may provide this information; however, the results will not be available until after September, 2015.

CHAPTER 2: HISTORICAL AND CURRENT RANGE AND DISTRIBUTION

Sage-grouse distribution is associated with sagebrush (Schroeder *et al.* 2004; p. 364), although sagebrush is more widely distributed. Sagebrush does not always provide suitable sage-grouse habitat due to fragmentation and degradation (Schroeder *et al.* 2004, pp. 369, 372). There are challenges in mapping altered and depleted understories, particularly in semi-arid regions, so maps depicting only sagebrush as a dominant cover type are deceptive in their reflection of sage-grouse habitat quality and use by sage-grouse (Knick *et al.* 2003, p. 616).

Prior to European settlement of western North America in the 19th century, sage-grouse occurred in 13 States and three Canadian provinces—Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Colorado, Utah, South Dakota, North Dakota, Nebraska, Arizona, British Columbia, Alberta, and Saskatchewan (Schroeder *et al.* 1999, p. 2; Young *et al.* 2000, p. 445; Schroeder *et al.* 2004, p. 369) (Figure 2-1). Sagebrush habitats that potentially supported sage-grouse occurred over approximately 1,200,483 km^2 (463,509 mi^2) before 1800 (Schroeder *et al.* 2004, p. 366). Currently, sage-grouse occur in 11 States (Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Colorado, Utah, South Dakota, and North Dakota), and two Canadian provinces (Alberta and Saskatchewan), occupying approximately 56 percent of their historical range (Schroeder *et al.* 2004, p. 369) (Figure 2-1). Approximately 2 percent of the total range of sage-grouse occurs in Canada, with the remainder in the U.S. (Knick 2011, p. 24).

Sage-grouse have been extirpated from Nebraska, British Columbia, and possibly Arizona (Schroeder *et al.* 1999, p. 2; Young *et al.* 2000 p. 445; Schroeder *et al.* 2004, p. 369). Current distribution of the sage-grouse is estimated at 703,453 km^2 (271,604 mi^2; USFWS, unpublished data). Changes from the estimated historical distribution are the result of sagebrush alteration and degradation (Schroeder *et al.* 2004, p. 363; Knick and Connelly 2011, p. 6).

Comment [LW 3]: Former citation:

668,412 km^2 (258,075 mi^2; Connelly *et al.* 2004, p. 6-9; Schroeder *et al.* 2004, p. 369)

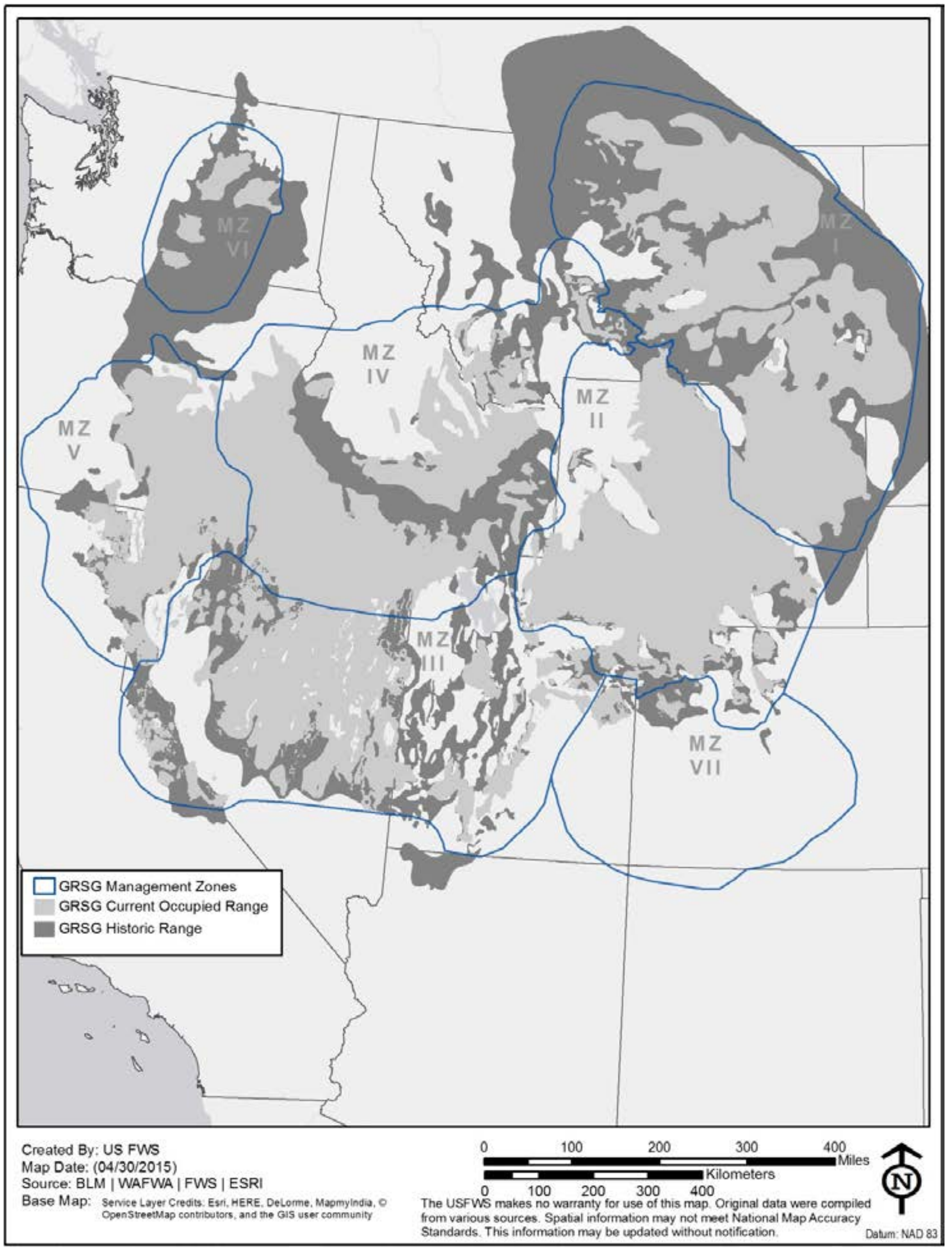


Figure 2-1. Historical and current range of the greater sage-grouse (derived from Schroeder *et al.* 2004 and updated by the Service) and the WAFWA Sage-Grouse Management Zones (Stiver et al. 2006, p. 1-6).

Fundamental characteristics of sagebrush landscapes have changed since Euro-American settlement (Knick and Connelly 2011, p. 7). The quantity of area dominated by sagebrush land cover has been reduced by conversion to cropland and other less abundant land uses. The composition of sagebrush communities has changed. In the Great Basin, this change has facilitated shifts in fire regimes that are significantly different from historic patterns. In low elevation sagebrush systems, fire is more frequent (in part due to the presence of *Bromus tectorum* (cheatgrass; West and Young 2000, p. 262) than in higher elevations, where a reduction of fire has facilitated the expansion of *Juniperus* spp. (junipers) and *Pinus* spp. (pinyon) woodlands (Miller and Rose 1999, p. 556). Habitat suitability is also affected by the presence of anthropogenic structures (e.g., communication towers and power lines; Connelly *et al.* 2000, p. 974; Beck *et al.* 2006, p. 1070). Lastly, the configuration of sagebrush mosaics across the species' range has changed (Knick and Connelly 2011, p. 7). Increased edges are prevalent due to the high level of infrastructure network, which can change predator movement (Tewksbury *et al.* 2002, p. 7), isolate populations (Saunders *et al.*1991, Trombulak and Frissell 2000, as cited by Knick and Connelly 2011, p. X), and facilitate the spread of invasive plants (Gelbard and Belnap 2003, p. 424). Very little of the extant sagebrush is undisturbed, with up to 50 to 60 percent having altered understories or having been lost to direct conversion (Knick *et al.* 2003, p. 612). Sage-grouse are disproportionately distributed across their range as a result of variation in habitat quality and abundance (Figure 2-2).

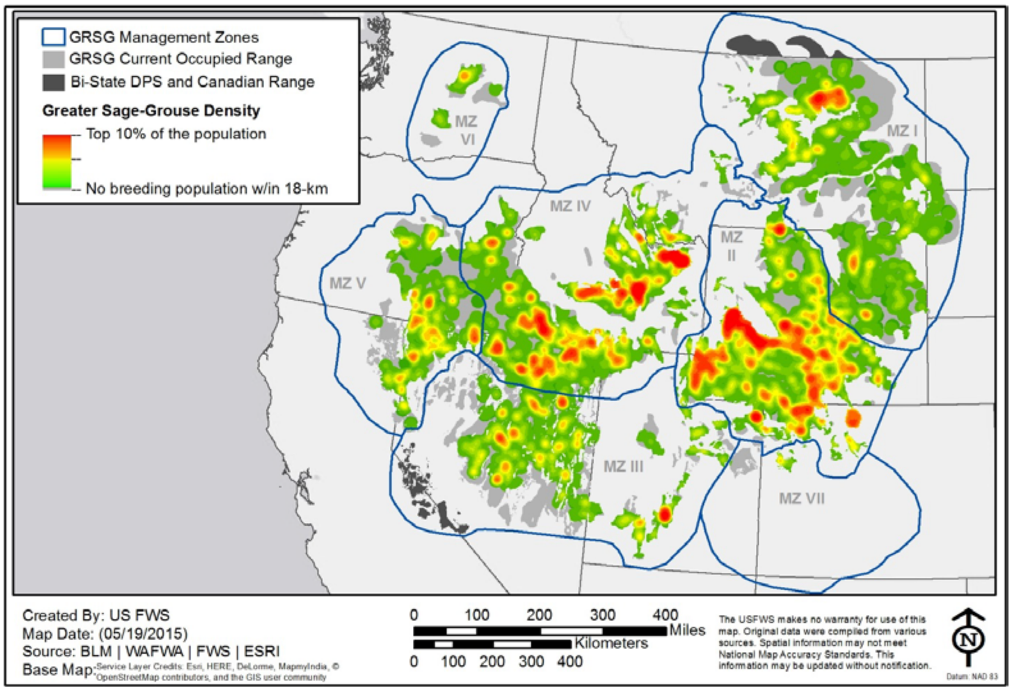


Figure 2-2. Greater sage-grouse population densities rangewide.

Management Zones

The Western Association of Fish and Wildlife Agencies (WAFWA) Conservation Strategy for Greater Sage-grouse (Stiver *et al.* 2006, p. 1-6) delineated seven sage-grouse Management Zones (MZ; Figure 2-1) to guide conservation and management. The boundaries of these MZs were delineated based on their ecological and biological attributes (floristic provinces) rather than on arbitrary political boundaries (Stiver *et al.* 2006, p. 1-6); therefore, vegetation is similar within each MZ and sage-grouse, and their habitats within these areas, are likely to respond similarly to environmental factors and management actions. The WAFWA Conservation Strategy includes the Gunnison sage-grouse, and the boundary for MZ VII includes its range (Stiver *et al.* 2006, pp. 1-1, 1-8), which does not overlap with the range of the greater sage-grouse. Management zones are depicted in Figure 2-1 and more detailed descriptions of them, along with their associated threats, can be found in Appendix A.

Management Zones have been grouped to delineate similarities among, and differences between, the Great Basin and Rocky Mountain regions. In general, the Great Basin portion of the range, which encompasses MZ III, IV, V and VI, is lower in elevation and experiences less precipitation. The Rocky Mountain portion of the range, which encompasses MZs I, II and VII, generally is higher in elevation and has greater precipitation. The differences in regional characteristics are not exclusive – as reflected by shared sagebrush species (but not similar abundance) across the two regions. However, due to the variance in the ecological conditions, the regions have differential susceptibility to threats facing the species. For example, the wildfire/invasive annual grass cycle (see ***Fire*** chapter, ***Invasive Plants*** chapter, and ***Threats Interaction*** section) is more prevalent in the Great Basin region (MZs III-V) due to lower elevations and drier conditions which facilitate spread of invasive plants. Sage-grouse are not equitably distributed across the MZs (Figure 2-3).

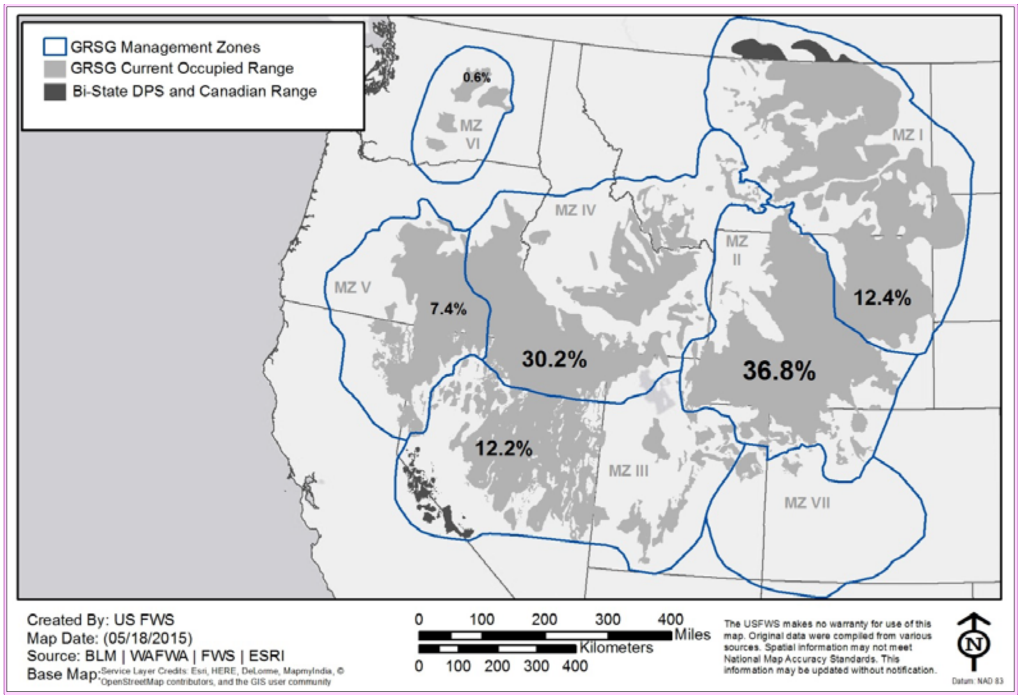


Figure 2-3. Percent of rangewide greater sage-grouse population by Management Zone.

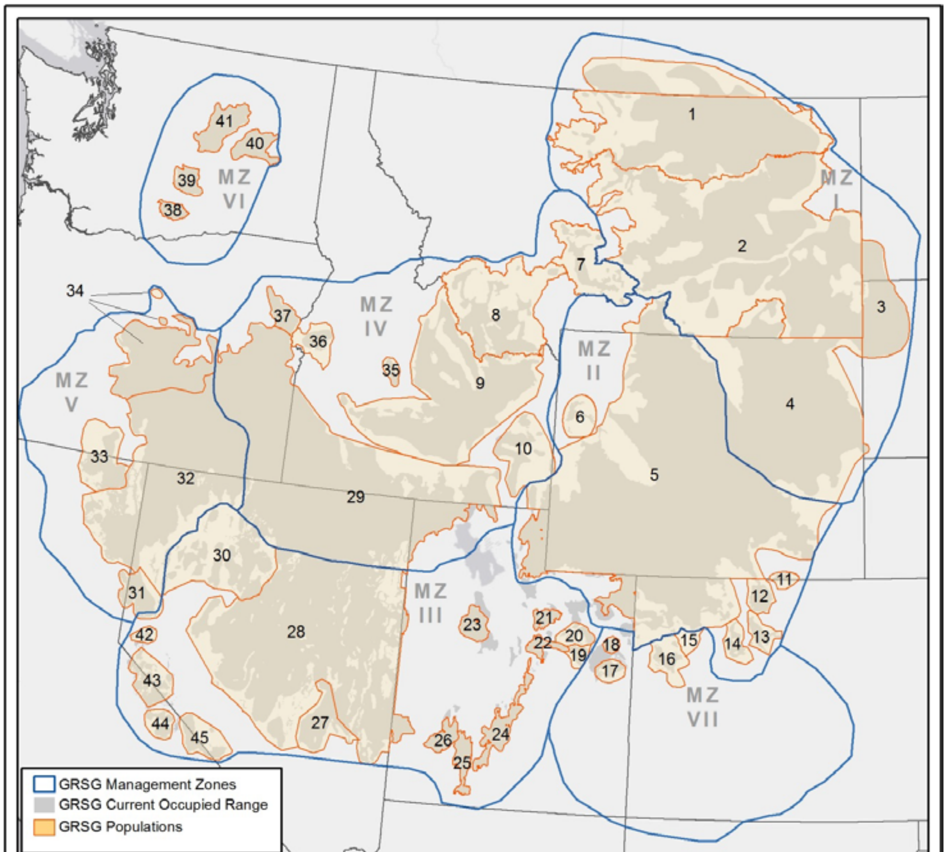
Comment [LW 4]: Need to add "0.3%" to MZ 7

For the purposes of our status review, we use MZs to organize our analysis. Management Zones were used because: (1) they reflect regional differences in the species status; (2) they are generally accepted by WAFWA and the sage-grouse conservation community; (3) population trend data have been summarized according to these units; and (4) our distribution and population index models were calibrated, and performed well, at the scale of MZs.

Comment [LW 5]: The term we're using is "population index" when referring to the models. (will double check with KD)

Populations

Sage-grouse have been delineated into 45 populations (Figure 2-4), defined by geographic or physical barriers to movement (Connelly *et al.* 2004, p. X). Populations at the edge of the current range increasingly are isolated from the larger interior areas (Schroeder *et al.* 1999, p. X, Schroeder *et al.* 2004, p. 370).



Population Name	Population ID No.	Population Name	Population ID No.	Population Name	Population ID No.	Population Name	Population ID No.
Northern Montana	1	Middle Park	13	Panguitch	25	Baker	37
Yellowstone Watershed	2	Eagle - South Routt	14	Bald Hills	26	Yakama Indian Nation	38
Dakotas	3	Meeker - White River	15	Quinn Canyon Range	27	Yakima Training Center	39
Powder River Basin	4	Parachute - Piceance - Roan	16	Southern Great Basin[b]	28	Crab Creek	40
Wyoming Basin[a]	5	East Tavaputs Plateau	17	Northern Great Basin[c]	29	Moses Coulee	41
Jackson Hole	6	South White River	18	Northwest Interior	30	Pine Nut (Bi-State DPS)[d]	42
Belt Mountains	7	West Tavaputs	19	Warm Springs Valley	31	North Mono Lake (Bi-State DPS)[d]	43
Southwest Montana	8	Anthro Mountain	20	Western Great Basin	32	South Mono Lake (Bi-State DPS)[d]	44
Snake, Salmon, and Beaverhead	9	Strawberry	21	Klamath	33	White Mountains (Bi-State DPS)[d]	45
East Central	10	Carbon	22	Central	34		
Laramie	11	Sheeprock Mountains	23	Sawtooth	35		
North Park	12	Parker Mountain & Emery	24	Weiser	36		
[a] Includes: Rich-Summit-Morgan (UT), Uintah (UT), Northwest Colorado				[c] Inculdes: Box Elder (UT)			
[b] Includes: Ibapah (UT), Hamlin Valley (UT)				[d] Excluded from this analysis			

Figure 2-4. Greater sage-grouse population boundaries (updated by the Service in coordination with the Bureau of Land Management and WAFWA).

Priority Areas for Conservation

In December 2011, the Service was tasked with the development of rangewide conservation objectives for the sage-grouse. The Service created a Conservation Objectives Team (COT), consisting of state and Service representatives, to develop a report that defined the degree to which threats need to be reduced or ameliorated to the point where sage-grouse are no longer in danger of extinction or likely to become in danger of extinction in the foreseeable future. The resulting peer-reviewed COT Report (USFWS 2013, entire) delineates objectives for the conservation and survival of sage-grouse. One key component of the report is the identification of Priority Areas for Conservation (PACs). Priority Areas for Conservation are key habitats that are essential for sage-grouse conservation and were identified by the team based on existing state sage-grouse conservation plans or other sage-grouse conservation efforts (e.g., the current Bureau of Land Management [BLM] planning effort for sage-grouse). The key components of conservation biology - redundancy, resilience and representation (Naeem 1998, p. X; Redford *et al.* 2011, p. X) were captured in these PAC delineations (USFWS 2013, pp. 13–14). Long-term conservation of the PACs is a key measure for ensuring the long-term persistence of the species, particularly within each state boundary. The COT report also encouraged conserving habitats outside of PACs, but acknowledged that many of these areas may no longer be capable of providing habitats that will continue to support sage-grouse within the foreseeable future due to existing habitat loss and fragmentation and valid existing rights.

Since completion of the 2013 COT report, Montana has identified a new PAC, and Nevada has completed new habitat modeling exercise (Coates 2014, entire) which modifies the original PACs in that state with better data (Figure 2-5). However, the state has not officially adopted these new designations so the Service has identified them as Important Priority Areas (IPA). Areas of occupied habitat in Utah, that are not PACs, have also been identified as IPAs by the Service (Figure 2-5). Priority Areas for Conservation and IPAs are key components in land management planning and they will be discussed further in the ***Regulatory Mechanisms*** section.

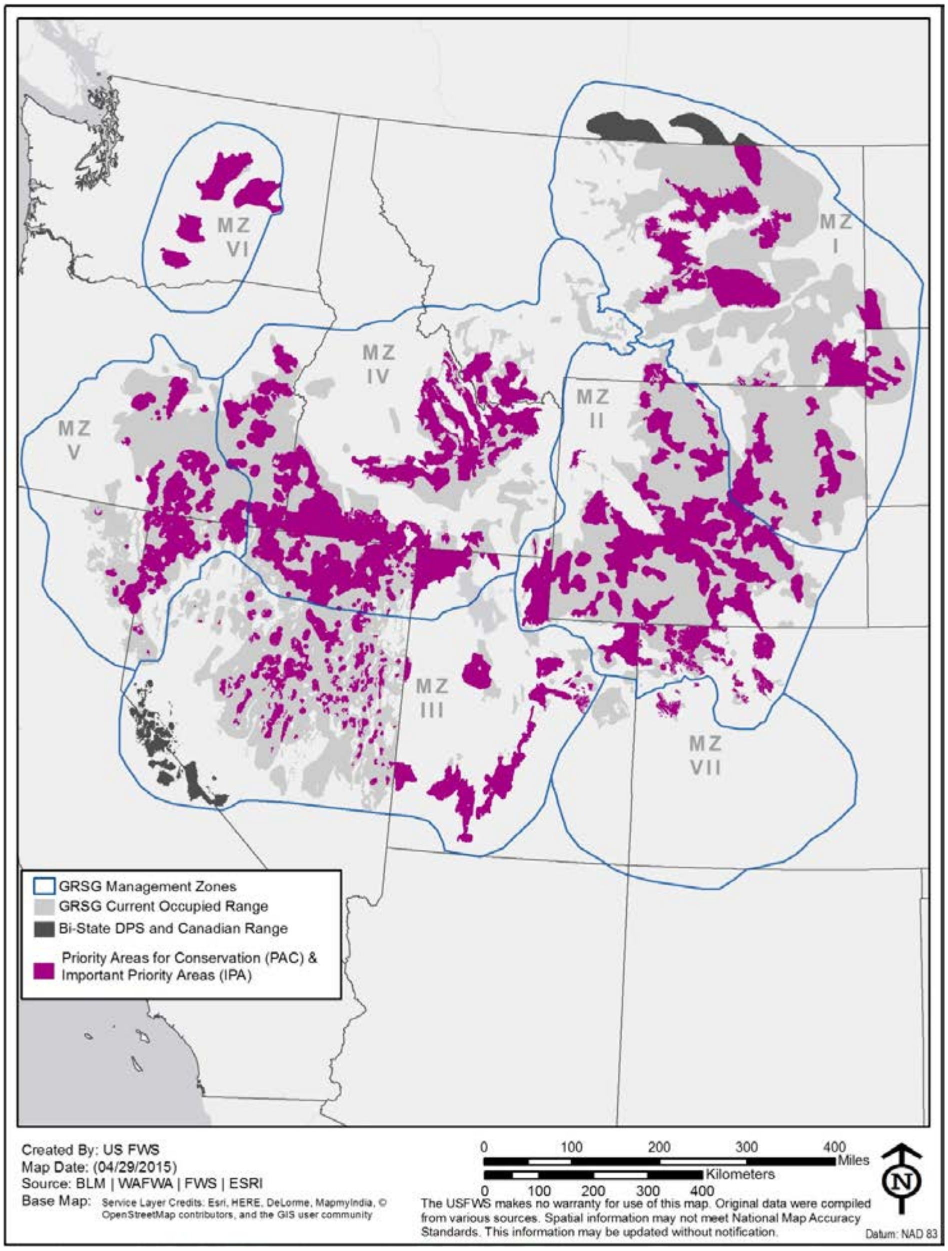


Figure 2-5 – Greater sage-grouse Priority Areas for Conservation (PACs), modified to incorporate Important Priority Areas (IPAs).

CHAPTER 3: POPULATION ESTIMATES AND TRENDS

Sage-grouse population numbers are most commonly tracked by counting sage-grouse (primarily males) on leks. Estimating population size from lek data is difficult due to the large range of the species, incomplete sampling (often related to remote location and accessibility to some occupied leks), and the potential of under counting females due to their cryptic coloration, behavior, or potential misidentification as a subadult male (Garton *et al.* 2011, pp. 295–296). Problems exist with inconsistent sampling protocols for lek surveys (e.g., number of times a lek is counted, number of leks surveyed in a year, observer bias, observer experience, time of day surveyed) (Walsh *et al.* 2006, pp. 61–64; Stiver *et al.* 2006, p. 3-1; Garton *et al.* 2011, p. X; Blomberg *et al.* 2013, p. 1584). The relationship of lek survey data to actual population size (e.g., ratio of males to females, percent unseen birds) is usually unknown (WAFWA 2008, p. 3). Due to the issues with lek counts, the validity of using them to assess population change is problematic (Beck and Braun 1980, p. X; Walsh *et al.* 2004, entire). The use of harvest data is the only other consistent source of information for estimating population numbers; however, harvest data is also of limited value, because: 1) not all areas are open to hunting (see ***Recreational Hunting*** chapter), 2) hunters may not provide specific harvest collection locations, 3) not all harvest is reported, and 4) birds may be migratory and therefore harvested in a different area than where they are counted on leks.

Despite these difficulties, the annual counting of males on leks remains the primary approach to monitor long-term trends of populations (WAFWA 2008, p. 3) because of their breeding behavior of concentrating and displaying at open and sparsely vegetated lek sites (Garton *et al.* 2011, p. 296). When counts are done according to a standardized protocol, these counts can be a useful index of long-term population trends (Connelly *et al.* 2004, p. 6-6; Johnson 2008, p. X; Johnson and Rowland 2007, p. X; Williams *et al.* 2004, p. X; WAFWA 2008, p. 3, Blomberg *et al.* 2013, p. 1590).

Sage-grouse populations are cyclic (Rich 1985, p. 5–8, Fedy and Doherty 2011, p. 919), further increasing the difficulty in assessing population numbers and determining population stability. The length of the cycle appears to vary across the range, but most populations have an 8 to 10 year population cycle. Drivers of the cycle are unknown (Fedy and Doherty 2011, p. 921), although may be associated with the amount and timing of precipitation (Rich 1985, p. 14). Further research is needed to assess if synchrony in sage-grouse cycles within or across populations are related to weather conditions. Sage-grouse males in one study area in Nevada did not attend the lek every year, a practice called "reproductive skipping" (Blomberg *et al.* 2013, p. 1589). The influence of reproductive skipping on population cycling is unknown.

Several populations demonstrated a 1- to 2-year delay in population response to habitat conditions (Garton *et al.* 2011, p. 370). This result is consistent with field observations in Montana and Wyoming (Holloran 2005, p. 55; Walker *et al.* 2007a, p. 2652) where sage-grouse continued to be observed for 3 to 4 years after disturbance resulted in unsuitable habitat conditions. The delayed response is likely the result of the high site fidelity demonstrated by sage-grouse. Therefore the influence of habitat loss and fragmentation may not be reflected in population estimates until several years after the impact has occurred.

Historic Population Trends

Estimates of sage-grouse abundance were mostly anecdotal prior to the implementation of systematic surveys in the 1950s (Braun 1998, p. 139). Early reports suggested the birds were abundant throughout their range. However, concerns about extinction were raised in early literature due to market hunting and habitat alteration (e.g., Hornaday 1916, pp. 181–185). Periods of historical decline in sage-grouse abundance occurred from the late 1800s to the early-1900s (Hornaday 1916, pp. 179–221; Crawford 1982, pp. 3–6; Drut 1994, pp. 2–5; WDFW 1995; Braun 1998, p. 140; Schroeder *et al.* 1999, p. 1). Other noticeable declines in sage-grouse populations occurred in the 1920s and 1930s, and then again in the 1960s and 1970s (Connelly and Braun 1997, pp. 3–4; Braun 1998, p. 141). Declines in the 1920s and 1930s were attributed to hunting, and declines in the 1960s and 1970s were primarily as a result of loss of habitat quality and quantity (Connelly and Braun 1997, p. 2). State wildlife agencies were sufficiently concerned with the decline in the 1920s and 1930s that many closed their hunting seasons and others significantly reduced bag limits and season lengths as a precautionary measure (Patterson 1952, pp. 30–33; Autenrieth 1981, p. 10). Following a review of published literature and anecdotal reports, Connelly *et al.* (2004, ES-1-3) concluded that the abundance of sage-grouse has declined from pre-settlement (defined as 1800) numbers. Most of the historical population changes were the result of local extirpations, which has been inferred from a 44 percent reduction in sage-grouse distribution described by Schroeder *et al.* 2004 (cited in Connelly *et al.* 2004, p. 6-9).

Using lek counts as an index for abundance, Connelly *et al.* (2004, p. 6-28) reported rangewide declines from 1965 through 2003. Declines averaged 2 percent per year from 1965 to 2003. The decline was more dramatic from 1965 through 1985, with an average annual change of 3.5 percent. The rate of decline rangewide slowed to 0.37 percent annually during 1986 to 2003, and some populations increased (Connelly *et al.* 2004, p. 6-71). Based on these analyses, Connelly *et al.* 2004 (p. 6-71) estimated that sage-grouse population numbers in the late 1960s and early 1970s were likely two to three times greater than current numbers (Connelly *et al.* 2004, p. 6-71). Using a statistical population reconstruction approach, Garton *et al.* (2011, p. 67) also demonstrated a pattern of significantly higher numbers of sage-grouse in the late 1960s and early 1970s (Garton *et al.* 2011, p. 307, 319, 328, 343, 353, 359), which is consistent with several independent sources of data (see Garton *et al.* 2011, pp. 369–370).

Comment [DP6]: We should cite the original sources

Recent Population Trends

The minimum rangewide population in the spring of 1998 was estimated at approximately 157,000 sage-grouse, based on the number of males counted on leks (Braun 1998, p. 141). The same year, State wildlife agencies within the range of the species estimated the population was at least 515,000 based on lek counts and harvest data (Warren 2008, pers. comm.). In 2000, the rangewide abundance of sage-grouse was estimated from 100,000 to 500,000 individuals (based on harvest data from Idaho, Montana, Oregon, and Wyoming, with the assumption that 10 percent of the population is typically harvested; 65 FR 51578). In 2003, based on increased lek survey efforts, the rangewide population numbers were estimated to be much greater than the 157,000 estimated in 1998 (Braun 1998, p. 141), but a rangewide population size was not estimated (Connelly *et al.* 2004, p. 13-5).

Comment [DMD7]: Do we need to update this?

Comment [DP8]: this was the only citation for those numbers.

In 2008, new population trend analyses incorporated an additional four years of data using lek counts (data through 2007; WAFWA 2008, p. X), but different statistical techniques than the 2004 analysis (Connelly *et al.* 2004, p. X). A long-term population decline was detected during 1965 to 2007 (3.1 percent; WAFWA 2008, p. 12) that attributed the decline to the reduction in number of active leks (WAFWA 2008, p. 51). The rate of decline lessened during 1985 to 2007 (average annual change of -1.4 percent annually) (Connelly *et al.* 2004, p. X; WAFWA 2008, p. 58).

Although the MZs were not formally adopted by WAFWA until 2006, the population trend analyses conducted in 2004 (Connelly *et al.* 2004, p. X) included trend analyses based on the same floristic provinces used to define the MZs. While the average annual rate of change was not presented, the results suggested long-term declines in sage-grouse for MZs I, II, III, IV and VI. Population trends in MZs V and VII were increasing, but the trends were not statistically significant (Stiver *et al.* 2006, p. 1-7). The 2008 population trend analyses reported that MZs I through VI had negative population trends from 1965 to 2007 (WAFWA 2008, entire). A new population trend analysis incorporating lek data through 2014 is currently being prepared by WAFWA, but is not yet available for our consideration.

The results of a 2011 population re-construction and projection model (Garton *et al.* 2011, entire) were similar to the results of the 2008 trend analysis (WAFWA 2008, entire) and 2004 estimate (Connelly *et al.* 2004, p. X), despite using different statistical techniques. The percent change in number of males per lek and the percent change in active leks reflected population declines, and possibly habitat loss in all MZs (Garton *et al.* 2011, p. X). A rangewide minimum of 88,816 males counted on leks in 2007 was estimated in this analysis (Garton *et al.* 2011, p. X). A revised estimate incorporating an additional 6 years of lek data suggests the rangewide minimum number of males counted on leks declined to 44,297 males in 2013 (Garton, unpublished data 2015). However, unlike 2007, the 2013 estimate does not include data from the Colorado Plateau and is likely an underestimate. Updated trend analyses by Garton and others incorporating lek data collected through 2013 is currently undergoing peer review and its availability for consideration by September 2015 is unknown.

Comment [AB9]: WAFWA 2008?

Population trend data since 2010 is variable by state. In general, the previously declining population numbers reported in our 2010 status review have continued with the exception of Colorado, Oregon, Utah, and Wyoming (Table 3-1). Increasing trends are attributed to improving weather conditions (i.e., cessation of drought conditions, lack of severe winter weather and of unusually wet and cold spring storms) resulting in increased population recruitment through improved productivity (chicks per female), and the expected increases in population cycles (i.e., moving out of the low trough). Reasons for continuing population declines are attributed to drought, recent wildfires which removed large acreages of habitat, and previous West Nile virus (WNv) outbreaks. No reason for continued declines in Lassen, California has been provided, but it is likely that population was severely impacted by the large 2012 Rush fire which burned 1,280 km^2 (315,557 acres; 490 mi^2), primarily in sage-grouse habitat. Population numbers remain low in Alberta and the Province is implementing translocations and captive breeding programs in an attempt to maintain their birds. No updated information was received from Saskatchewan.

[PLACEHOLDER FOR POPULATION TREND INFORMATION]
[PLACEHOLDER FOR POPULATION TREND FIGURES]
[PLACEHOLDER FOR POPULATION TREND TABLES]

Comment [DP10]: We need a trend analysis line, but not sure Garton 2015 should be singled out. So this is a placeholder to put in a trend graphic - just not sure which one at this point.

Table 3-1. [**PLACEHOLDER – NEED WAFWA TREND ANALYSIS**] Summary of population trends by State and Province since 2010. This information was taken directly from the data call information received by each State[a].

State/Province	Trend Since 2010	Comments
Alberta	Not reported	Only 4-5 active leks remain; 14 males counted on 4 leks in 2013
California	Declining	Leks in Alturas BLM field office are no longer active. Leks in Lassen area declining.
Colorado	Increasing since 2013	Only 4 of 6 populations increased. Remaining 2 populations remained relatively constant at low numbers and are affected by habitat fragmentation.
Idaho	Stable	Trend from 1996 – 2014 stable; hypothesized that population numbers have not recovered from drought and West Nile virus outbreak in X
Montana	Declining	Declining trend through 2012; no updated information provided
Nevada	Declining	Numbers are down marginally, likely due to poor weather conditions (drought)
North Dakota	Declining	No population recovery from West Nile virus outbreak in 2007. Declines continuing at a constant rate
Oregon	Increasing	Numbers have increased from 2013 to 2014; population was declining prior to 2013 as a result of habitat loss from wildfires and drought.
Saskatchewan	No data provided	
South Dakota	Declining	Numbers have steadily declined since 2007 due to West Nile virus outbreaks
Utah	Increasing	Numbers have been increasing since 2011, but overall there has been a long-term gradual decline since 1968
Washington	Declining	Numbers have declined by 50% from 1970 - 2013
Wyoming	Increasing	Lek numbers declined through 2013, then increased in 2014.

[a] Given the diversity of data presentation by responding state and Provincial agencies quantitative comparisons were not possible. All information, except California, taken from data submission for 2015 status review. California lek data provided by CDFG (pers. comm.).

Population forecast models suggested that at least 13 percent of the 23 populations, but none of the MZs analyzed, may decline below effective population sizes of 50 within the next 30 years (Garton *et al.* 2011 (p. 374); note: not all populations were included in the analyses due to insufficient data for some populations). Seventy-five percent of the populations and 29 percent of the MZs are likely to decline below effective population sizes of 500 within 100 years (Garton *et al.* 2011, p. 374). However, these results do not consider conservation efforts or regulatory mechanisms that may ameliorate threats to the species. New population forecasts using the same methodology are currently undergoing peer review and it is unknown whether or not those projections will be peer reviewed and published by September 2015.

Population Summary

Information reviewed in 2010 suggested a long-term population decline of sage-grouse. New information collected in the interim suggests populations in some areas are increasing, as anticipated with the alleviation of drought conditions and the expected upswing in the population cycle. However, this is not consistent across the species' range. Previous trend analyses demonstrated long-term population declines in the past 43 years, with that decline lessening in the past 22 years. Many of these declines are the result of loss of leks (WAFWA 2008, p. 51), indicating either a direct loss of habitat or habitat function (Connelly and Braun 1997, p. 2). Short-term increases in trends, while encouraging, may not indicate that populations are recovering but may instead be a function of fewer leks and not increasing numbers (WAFWA 2008, p. 51). Population stability may also be compromised if cycles in sage-grouse populations (Schroeder *et al.* 1999, p. 15; Connelly *et al.* 2004, p. 6-71) are lost, minimizing the opportunities for population recovery if habitat were available (Garton 2009, pers. comm.). We are anticipating the receipt of up to three additional population trend analyses that will help inform this section of the species report. However, those analyses are not currently available.

Comment [DMD11]: Update?

Breeding Habitat Distribution and Population Index Models

The Service developed two models for use in the Statue Review: 1) Occupied Breeding Habitat Distribution Model, and 2) Population Index Model, to evaluate risk to sage-grouse populations and conservation actions designed to ameliorate those risks. These models were built at the Management Zones scale because wide variation exists in occupied habitats across the range, and risks to sage-grouse vary across Management Zones. We chose these metrics, because not all areas within the current occupied range (Schroeder *et al.* 2004) are sage-grouse habitat and within occupied habitats, some areas contain a disproportionate number of birds (Connelly *et al.* 2004, Doherty *et al.* 2010). The population index ~~relative abundance~~ metric allows for a better spatial understanding of how risks align sage-grouse and with population centers of sage-grouse. For example, strong documented negative effects (e.g. oil & gas, fire, cropland conversion in MZ I), ~~do~~ may not necessarily translate to large scale population impacts across vast areas such as the entire sage-grouse range. We would expect high levels of future impacts to occur if current sage-grouse population centers overlap areas with high probabilities of loss to stressors in the future. Conversely, we would expect future impacts to be low, if current sage-grouse population centers do not overlap areas with high probabilities of future losses.

Comment [LW 12]: We'll get these figures at a later date.

Formatted: Indent: First line: 0"

We used lek data assembled by WAFWA to develop both our breeding habitat distribution model and our ~~relative abundance~~population index models. The input lek data we used to build our models and detailed model outputs were reviewed by biologist from each state, including statistical tables of model fit and how predictions aligned with landscapes local biologist work in. We also presented summaries to state wildlife agency directors. Our models, built with collaboration from WAFWA, are used as metrics for subsequent risk analyses and general GIS queries.

We developed a probabilistic model of occupied breeding habitat by statistically linking habitat characteristics within 4-miles of an occupied lek using a non-linear machine learning technique called random forest (Citation). Model predictions produce a value of 0 to 1 for each 120-m^2 grid cell within each sage-grouse management zone. Habitat characteristics were quantified in GIS from various sources, but generally represent standard abiotic and biotic variables used in species habitat modeling (see ~~appendix~~ ***Appendix TBD*** for list of variables used in modeling). Statistical model fit was high (Mean = 82.0%, Range = 75.4% – 88.0%) as were cross-validations (Mean = 80.9%, Range = 75.1% – 85.8%). All active leks within the range were located on probabilities > 0.65, thus we used this threshold to define our occupied breeding habitat (Figure 3-1). Our model represents breeding habitat and may or may not include other seasonal habitats known to be important to sage-grouse such as wintering and late summer habitats. Our model represents the first seamless predictions of sage-grouse breeding habitat across the entire range.

Formatted: Font: Not Italic

Formatted: Font: Bold

Formatted: Font: Not Italic

Formatted: Font: Not Italic

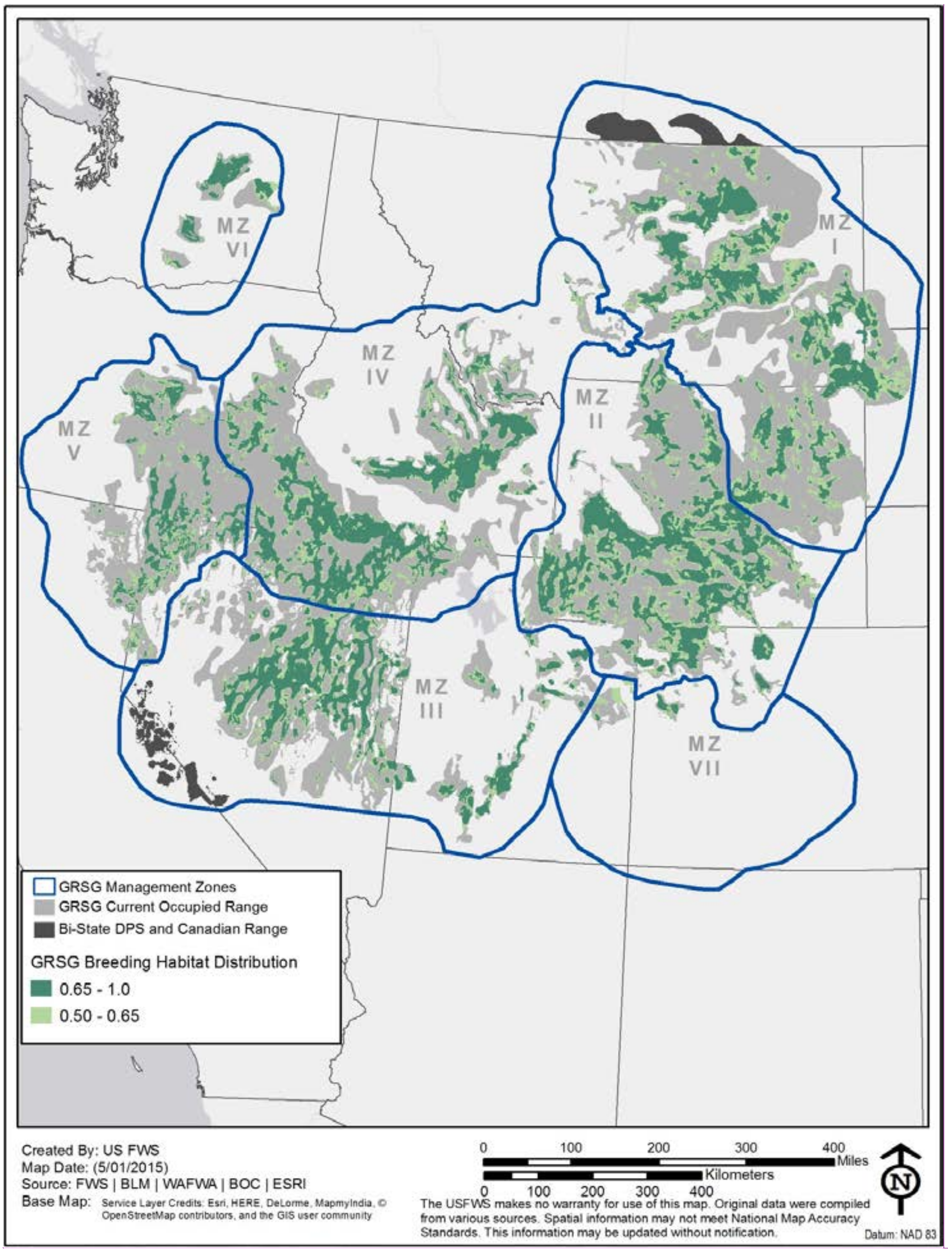


Figure 3-1. Modeled distribution of greater sage-grouse breeding habitat.

Comment [LW 13]: We can decide between this **full page** and half page (not shown) map.

I have MZ-scale maps that can be inserted into Appendix 1..2 -OR- As their own appendix (which would precede 1.2).

We also developed a model to quantify the relative density of breeding birds across a management zone because past work across the range has shown sage-grouse populations to be highly clumped (Connelly *et al.* 2004, Figure X, p.X,; Doherty *et al.* 2010 Figure X, p.X; Coates *et al.* 2013, p.X). We originally planned on using Random Forest regression (mean counts of birds during 2010-2014) to model abundances of sage-grouse, because recent work showed large proportions of the yearly abundance of waterfowl predicted across a landscape of similar size using this technique (Doherty et al. 2015). However, these models explained low amounts of variation in the counts of sage-grouse across the sagebrush ecosystem in pilot areas (~11%). We therefore adapted and used different methodologies following logic similar models developed by the USGS for Nevada (Coates *et al.* 2014, p.X). We modified Coates *et al.* (2015) to better represent grouse population numbers because their original technique was developed to highlight management priority areas (see ***Appendix X*** for additional details). The result of our models are grids that represents an index to the relative amount of breeding birds for each 120-m^2 within management zone (Figure 3-2). This index allows us to understand if conservation actions or threats to a species are occurring in areas which could impact large proportions of the sage-grouse populations or are occurring in areas where overall acreage impacts may be high, but sage-grouse population exposure is low.

Comment [LW 14]: Bi-State

Comment [LW 15]: OFR

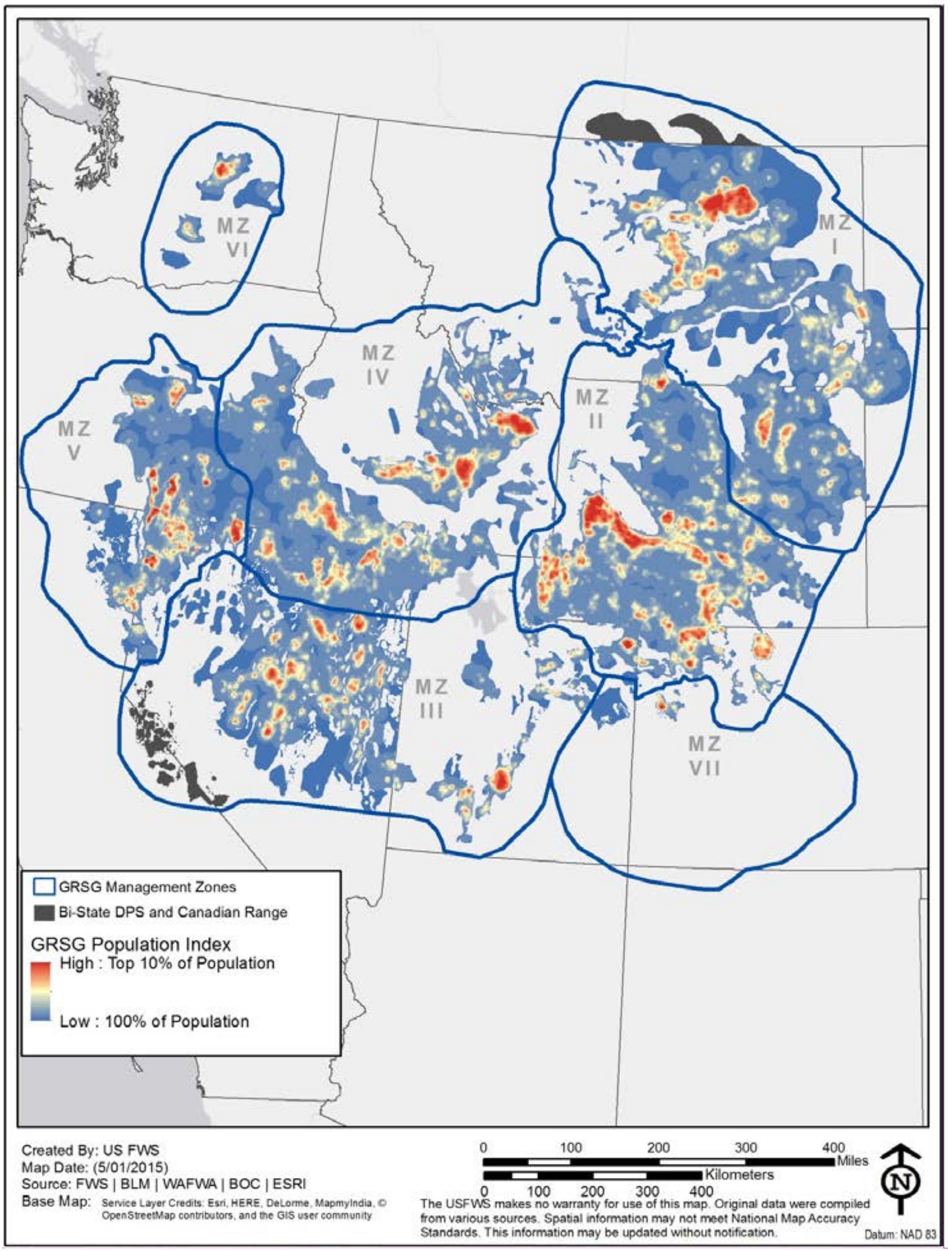


Figure 3-2. Modeled population index of greater sage-grouse, by Management Zone.

Comment [LW 16]: We can decide between this **full page** and half page (not shown) map.

I have MZ-scale maps that can be inserted into Appendix 1..2 -OR- As their own appendix (which would precede 1.2).

CHAPTER 4: LAND OWNERSHIP AND MANAGEMENT

Federal Lands

Federal lands encompass the majority of the sage-grouse range (53 percent; Figure 4-1; Table 4-1; Appendix B) and modeled breeding habitat distribution (61 percent) (Table 4-2). They are also areas of relatively high sage-grouse population index (Table 4-3); and, thus appropriate management of these lands is crucial for sage-grouse conservation.

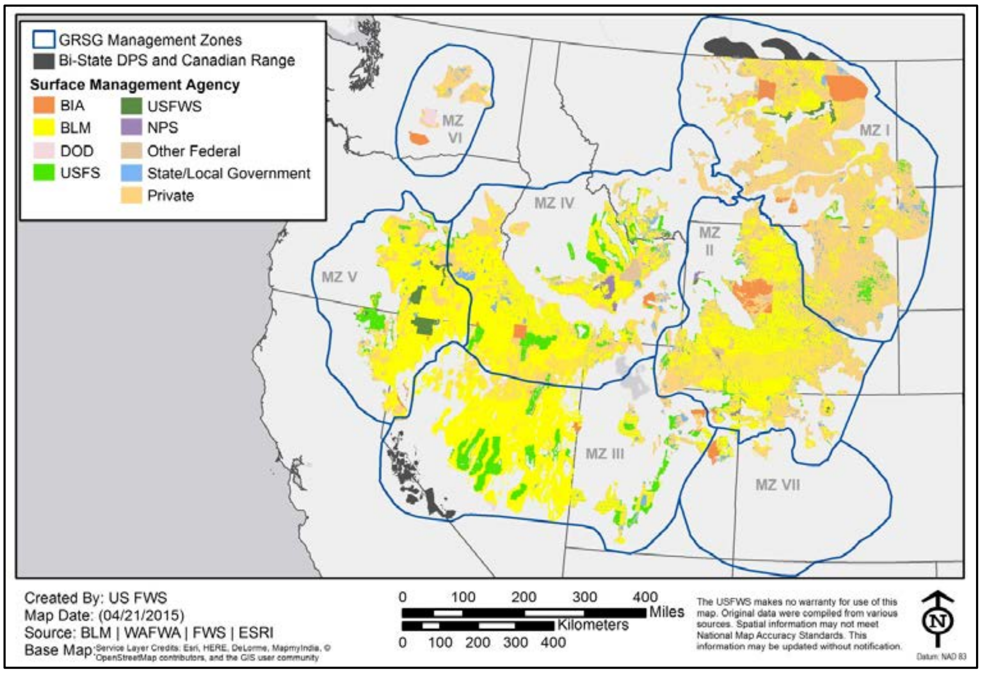


Figure 4-1. Land ownership within the range of the greater sage-grouse.

Primary Federal land managers within the sage-grouse range include BLM and the U.S. Forest Service (USFS), which collectively manage 51 percent of the sage-grouse range and 58 percent of the modeled breeding distribution. Secondary Federal owners (those with less ownership) include the National Park Service (NPS), Department of Defense (DoD), Service, and Department of Energy (DOE), which combined manage only 2 percent of the sage-grouse range (Table 4-1) and 3 percent of the modeled breeding distribution (Table 4-2). Despite these small rangewide percentages, some of these other Federal agencies own areas that are important to sage-grouse persistence at the local or MZ scales.

Table 4-1. Percent of the occupied range within MZ, by surface managing agency.

	Sage-grouse MZ	BLM	USFS	Other Federal	Tribal	State	Private[a]
I	**Great Plains**[b]	16	2	1	5	8	69
II	**Wyoming Basin**	49	2	2	3	6	38
III	**Southern Great Basin**[c]	69	14	1	1	2	13
IV	**Snake River Plain**	52	8	3	1	5	30
V	**Northern Great Basin**	62	7	6	1	2	23
VI	**Columbia Basin**	5	0	13	11	7	63
VII	**Colorado Plateau**	39	0	0	25	11	25
	TOTALS	**45**	**6**	**2**	**3**	**5**	**39**

[a] Includes those lands labeled as "undetermined."
[b] Does not include lands in Canada.
[c] Does not include lands in the Bi-State DPS.

Table 4-2. Percent of modeled breeding habitat distribution within MZ, by surface management agency.

	Sage-grouse MZ	BLM	USFS	Other Federal	Tribal	State	Private[a]
I	**Great Plains**[b]	27	1	1	1	7	63
II	**Wyoming Basin**	58	<1	1	1	6	34
III	**Southern Great Basin**[c]	71	12	<1	2	3	11
IV	**Snake River Plain**	62	3	5	2	5	23
V	**Northern Great Basin**	77	<1	10	<1	1	12
VI	**Columbia Basin**	4	0	17	3	9	66
VII	**Colorado Plateau**	18	0	0	12	2	68
	TOTALS	**55**	**3**	**3**	**1**	**5**	**33**

[a] Includes those lands labeled as "undetermined."
[b] Does not include lands in Canada.
[c] Does not include lands in the Bi-State DPS.

Table 4-3. Percent of the population index within MZ, by surface managing agency. [Note: Population index percentages were not totaled because there index values were specific to each MZ].

	Sage-grouse MZ	BLM	USFS	Other Federal	Tribal	State	Private[a]
I	**Great Plains**[b]	34	1	1	<1	7	57
II	**Wyoming Basin**	58	<1	1	1	7	33
III	**Southern Great Basin**[c]	68	13	0	1	7	11
IV	**Snake River Plain**	62	4	5	<1	6	22
V	**Northern Great Basin**	70	<1	15	<1	1	13
VI	**Columbia Basin**	3	0	17	0	11	69
VII	**Colorado Plateau**	21	0	0	0	2	77

[a] Includes those lands labeled as "undetermined."
[b] Does not include lands in Canada.
[c] Does not include lands in the Bi-State DPS.

BLM

The BLM is the primary land owner and land management agency within the range of sage-grouse for all MZs except the Great Plains and Columbia Basin MZs, where the amount of BLM-administered land is relatively small (16 percent and 5 percent, respectively) and private ownership predominates (69 percent and 63 percent, respectively). In MZ VII, although more acres within the sage-grouse range are in BLM ownership than are in private ownership, 39 and 25 percent respectively (Table 4-1), 77 percent of the population index occurs on private lands (Table 4-3).

The Federal Land Policy and Management Act of 1976 (FLPMA) (43 U.S.C. 1701 *et seq.*) is the primary Federal law governing most land uses on BLM-administered lands. This law requires the development and implementation of Resource Management Plans (RMPs) which direct management at a local level. Resource Management Plans are the basis for all actions and authorizations involving BLM-administered lands and resources. They authorize and establish allowable resource uses, resource condition goals and objectives to be attained, program constraints, general management practices needed to attain the goals and objectives, general implementation sequences, intervals and standards for monitoring and evaluating RMPs to determine effectiveness, and the need for amendment or revision (43 CFR 1601.0-5(k)). The RMPs also provide a framework and programmatic direction for implementation plans, which are site-specific plans written to regulate decisions made in a RMP. Examples include allotment management plans (AMPs) that address livestock grazing, oil and gas field development, travel management, and wildlife habitat management. If an RMP contains specific direction regarding sage-grouse habitat, conservation, or management, it represents a regulatory mechanism that has the potential to ensure that the species and its habitats are protected during permitting and other decision-making on BLM-administered lands.

In our 2010 finding we stated, "Of the existing 92 RMPs that include sage-grouse habitat, 82 contain specific measures or direction pertinent to management of sage-grouse or their habitats (BLM 2008g, p. 1). However, the nature of these measures and direction vary widely, with some measures directed at a particular land use category (e.g., grazing management), and others relevant to specific habitat use categories (e.g., breeding habitat) (BLM 2008h)."

Since 2010, there has been a concerted effort to amend or revise BLM RMPs and USFS Land and Resource Management Plans (LRMPs) (see *Forest Service* section below), collectively called Land Use Plans (LUPs) to include specific and coordinated direction to conserve sage-grouse and their habitats across their range on BLM ownership. The BLM and the USFS are in the process of revising or amending 96 LUPs within 15 planning areas[2] (Figure 4-2, Appendix C) to incorporate sage-grouse conservation measures. Specifics on the regulatory and non-regulatory provisions of these plans are provided in each threat chapter, and in the ***Regulatory Mechanisms*** and ***Non-regulatory Conservation Efforts*** sections.

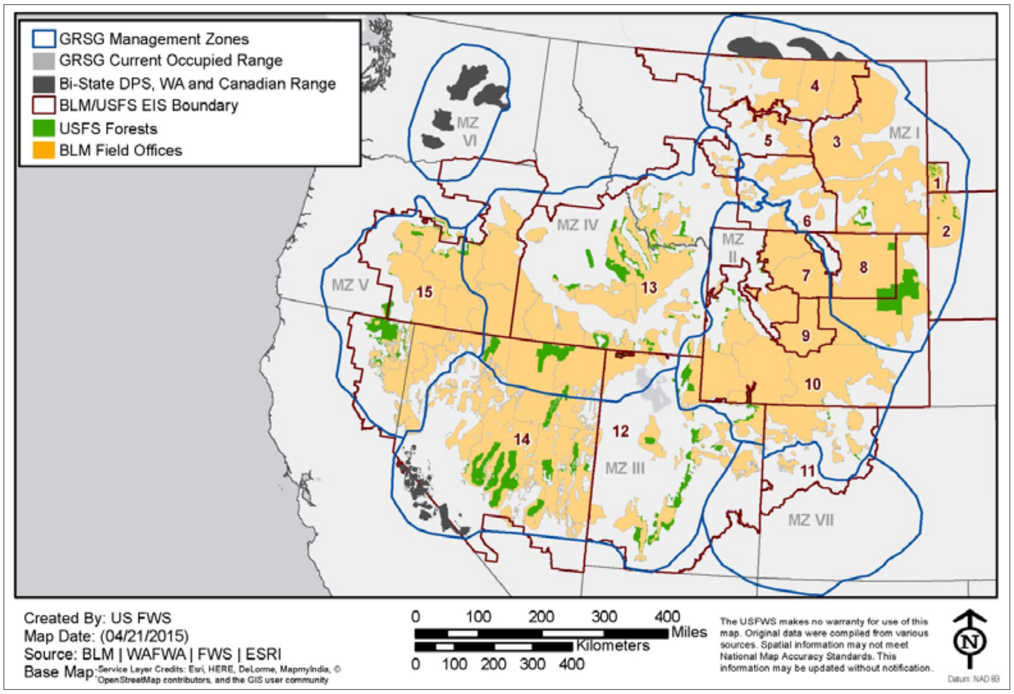


Figure 4-2. BLM and USFS RMP and LRMP planning areas. Portions of the greater sage-grouse range in Washington and the Bi-State DPS are undergoing separate planning processes.

[2] In addition to these 96 plans, two additional plans are slated for revision in the near future and are expected to incorporate sage-grouse conservation measures: the BLM plan for Eastern Washington and the National Forest plan for the Dakota Grasslands.

Management direction in the Environmental Impact Statements (EISs) for amending and revising LUPs is organized by Priority and General Habitat Management Areas (previously called preliminary priority habitat (PPH) and preliminary general habitat (PGH) in some of the draft EISs). Priority Habitat Management Areas (PHMAs) contain a large majority of known leks across the range, cover 88 percent of the PACs/IPAs (not including MZ VI, which has little Federal land) and the BLM and USFS determined, in cooperation with partners, that PHMAs have the highest conservation value for maintaining viable sage-grouse populations (Figure 4-3). Therefore, PHMAs have more stringent protections than General Habitat Management Areas (GHMAs) in the LUPs (see ***Impacts Analysis*** and ***Regulatory Mechanisms*** sections).

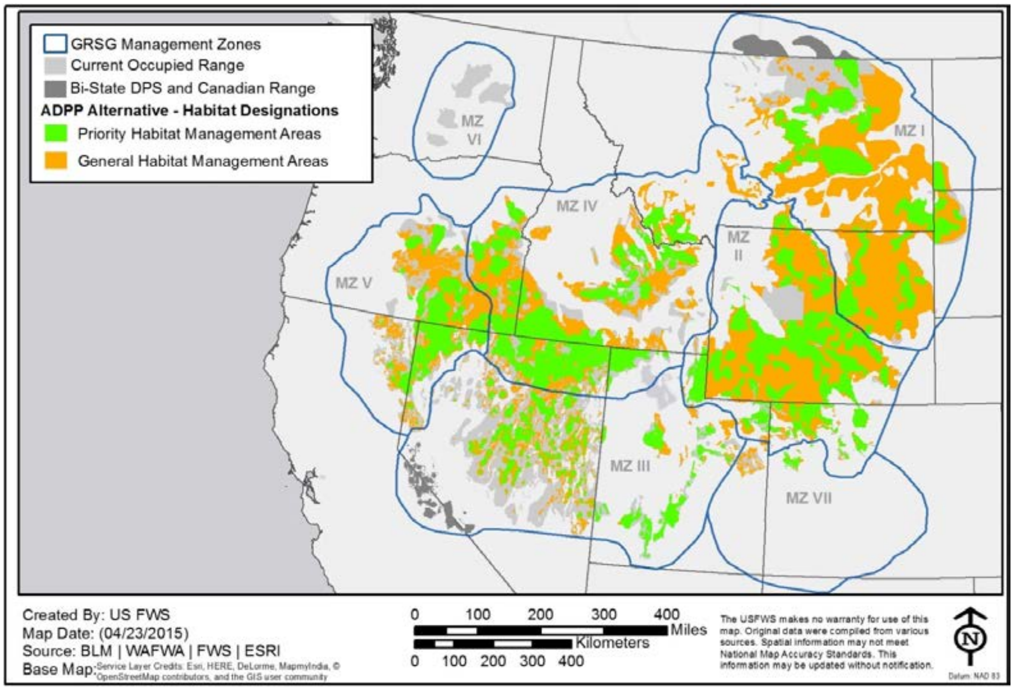


Figure 4-3. Priority and General Habitat Management Areas in BLMs RMPs and USFSs LRMPs. (Note: habitat management areas are shown covering more than just BLM and USFS land due to management of subsurface rights that may exist in other surface ownerships).

U.S. Forest Service

Forest Service lands make up 6 percent of the range of the sage-grouse but only 3 percent of the breeding distribution (Tables 4-1 and 4-2). Management Zones with significant amounts of USFS ownership include the Southern Great Basin (14 percent of the range, 12 percent of the breeding distribution, and 13 percent of the population index in MZ III) and the Snake River Plain (8 percent of the range, 3 percent of the breeding distribution, and 4 percent of the population index in MZ IV) (Table 4-1).

Management of activities on National Forest System lands is guided principally by the National Forest Management Act (NFMA) (16 U.S.C. 1600-1614, August 17, 1974, as amended 1976, 1978, 1980, 1981, 1983, 1985, 1988, and 1990) and the Multiple-Use Sustained-Yield Act of 1960 (16 U.S.C. 528-531) (MUSYA). The NFMA specifies that the USFS must have a LRMP (16 U.S.C. 1600) to guide and set standards for all natural resource management activities on each National Forest or National Grassland. Under the MUSYA, the USFS manages its lands to sustain the multiple uses of its renewable resources in perpetuity while maintaining the long-term health and productivity of the land.

In our 2010 warranted but precluding finding we stated, "all of the LRMPs that currently guide the management of sage-grouse habitats on USFS lands were developed using the 1982 implementing regulations for land and resource management planning (1982 Rule, 36 CFR 219)." Under these implementing regulations, all national forest plans were directed to: "…provide for multiple use and sustained yield of goods and services from the National Forest System in a way that maximizes long term net public benefits in an environmentally sound manner." Since that time, the USFS has undertaken an effort to update or amend all of its LRMPs within the range of the sage-grouse (see ***Impacts Analysis*** and ***Regulatory Mechanisms*** sections).

U.S. Fish and Wildlife Service

A total of 11 National Wildlife Refuges (NWRs) are currently known to be occupied by sage-grouse. The Service directly manages only 1 percent of sagebrush habitats as part of the National Wildlife Refuge System (Knick 2011, p. 26); however, in MZ V, the Sheldon-Hart National Wildlife Refuge Complex comprises 9 percent of the modeled sage-grouse distribution and approximately 15 percent of the population index within the MZ, and supports more than 100 leks.

Refuges are administered under the National Wildlife Refuge Administration Act (NWRAA) of 1966 (16 U.S.C. §668dd–668ee) and the National Wildlife Refuge System Improvement Act (Public Law 105-57), which amended the NWRAA. The Refuge Improvement Act consolidated existing refuge law and articulated a system-wide mission statement uniquely focused on putting wildlife first: "To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations." The Refuge Improvement Act specifically calls for managing the Refuge System to conserve biological diversity by applying the latest scientific information and methods to refuge management and its evaluation and by expanding the refuge system through planned land acquisition. The Refuge Improvement Act also requires each refuge to develop a 15-year Comprehensive Conservation Plan (CCP) to guide management.

Department of Defense

Eight DoD facilities have confirmed sage-grouse presence (see ***Military Activity*** chapter), but collectively these installations encompass less than 1 percent of the currently estimated sage-grouse range (Knick 2011, p. 26).

Department of Energy

There are only two DOE facilities within the range of sage-grouse: the Central Nevada Test Site Base Camp (MZ III) and the Idaho National Energy Laboratory (MZ IV). The Nevada Test Site Base Camp is small (1,053 ha; 2,603 ac) and overlays less than 405 ha (1,000 ac) of modeled breeding distribution, whereas the INEL covers over 202,343 ha (0.5 million ac) with 1.5 percent of the modeled breeding distribution in MZ IV.

National Park Service

There are 11 National Park System units that intersect with the range of sage-grouse, but only six that overlap with the modeled breeding distribution of sage-grouse. National Park Service lands are managed pursuant to the National Park Service Organic Act of 1916 (39 Stat. 535; 16 U.S.C. 1, 2, 3 and 4) and the authorizing legislation that created each park. The fundamental purpose of the National Park System, established by the Organic Act and reaffirmed by the General Authorities Act of 1970 (16 U.S.C. 1a-1), as amended, is to conserve park resources and values.

Of the six units that contain modeled breeding distribution of sage-grouse, only two park units contained a substantial amount of modeled habitat – Grand Teton National Park (approximately 16,187 ha; 40,000 ac), and Craters of the Moon National Monument and Preserve (greater than 80,937 ha; 200,000 ac) of modeled breeding habitat; part of which is managed by BLM). Grand Teton National Park only comprised 0.3 percent of modeled distribution of sage-grouse in MZ II, while Craters of the Moon National Monument and Preserve comprised 2 percent of the modeled distribution of sage-grouse in MZ IV.

Wilderness and Protected Areas

Federal lands managed by various agencies can be protected by special designations including wilderness, wilderness study areas, and national monuments. These areas can provide substantial protection from anthropogenic threats. Wilderness and protected areas make up less than 1 percent of the occupied range of sage-grouse (Knick 2011, p. 28); however, our analysis showed that these areas make up over 6 percent of the modeled breeding distribution of sage-grouse rangewide, and over 9 percent of the population index. Management Zone V contained the highest percentage of wilderness and protected areas of any MZ (32 percent of the modeled breeding distribution and 36 percent of the population index) (Figure 4-4; Table 4-4).

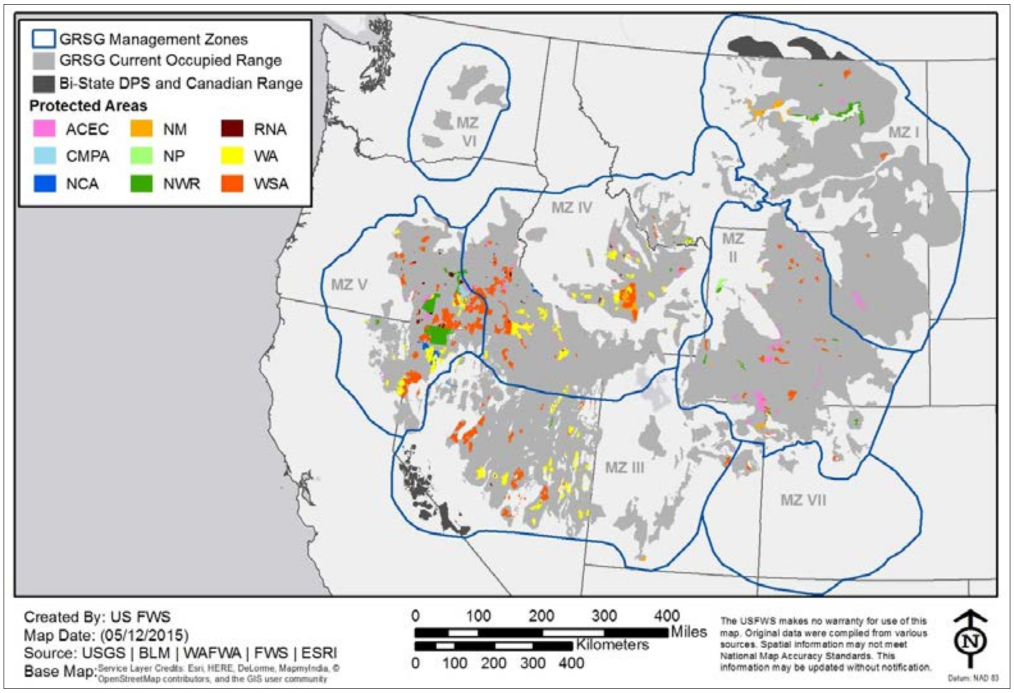


Figure 4-4. Wilderness and protected areas within the range of the greater sage-grouse.

Table 4-4. Percent of the population index within wilderness and protected areas, by MZ.[a]

Sage-grouse MZ		Percent Population Index
I	**Great Plains**[b]	2.7
II	**Wyoming Basin**	2.6
III	**Southern Great Basin**[c]	3.1
IV	**Snake River Plain**	10.0
V	**Northern Great Basin**	36.1
VI	**Columbia Basin**	<1
VII	**Colorado Plateau**	1.9
Rangewide Total		9.2

[a] Wilderness and protected areas designations included: Wilderness Area, Wilderness Study Area, National Wildlife Refuge, National Monument, Research Natural Area, National Conservation Area, Cooperative Management and Protected Area, and Area of Critical Environmental Concern.
[b] Does not include lands in Canada.
[c] Does not include lands in the Bi-State DPS.

Tribal Lands

There are 26 reservations that intersect with the range of sage-grouse, but most are less than1 percent of the area of the MZ. Reservations with 1 percent or more of the land within a MZ are: Fort Belknap Indian Reservation (1 percent of MZ 1), Fort Peck Indian Reservation (3 percent of MZ 1), Wind River Indian Reservation (3 percent of MZ II), Yakima Indian Reservation (12 percent of MZ VI), and the Uintah and Ouray Indian Reservation (less than 1 percent of MZ II, less than 1 percent of MZ III, and 25 percent of MZ VII). When evaluated by the modeled breeding distribution, three reservations made up 1 percent or more of their MZs: Uintah and Ouray Indian Reservation (1 percent in MZ III, and 12 percent in MZ VII), Duck Valley Indian Reservation (2 percent of MZ IV), and the Yakima Indian Reservation (3 percent of MZ VI).

Tribal lands were retained by tribes or were set aside for tribal use pursuant to treaties, statutes, judicial decisions, executive orders or agreements. These lands are managed by tribes in accordance with tribal goals and objectives, within the framework of applicable laws. Each tribal government operates according to its own constitutional rules and can promulgate their own laws and regulations that apply on tribal lands under their jurisdiction (Robertson and Viersen 2001, entire).

State Lands

State lands cover approximately 5 percent of the current sage-grouse range (Table 4-1). Management Zones with the greatest percent of the population index on state land are the Columbia Basin (11 percent), Great Plains (7 percent), Wyoming Basin (7 percent), and Southern Great Basin (7 percent) (Table 4-3).

Private Lands

Private lands make up approximately 39 percent of all lands within the current range of sage-grouse. Management Zones with the highest proportion of private lands within the sage-grouse range include: MZ I (69 percent), MZ VI, (63 percent), and MZ VII (25 percent) (Table 4-1). Private lands also cover most of the modeled breeding distribution of sage-grouse in these MZs; 63 percent, 66 percent, and 68 percent, respectively (Table 4-2).

Settlers in the arid west overwhelmingly selected land that held temporary or persistent wet habitats (SGI 2014, p. 3). Privately owned lands are characterized by deeper soils and greater ability to store water in each MZ when compared with public lands (Knick 2011, p. 24). While wet sage-grouse habitats in Oregon, California, and western Nevada made up only 1 to 2 percent of the land area, 81 percent of that area was in private ownership (SGI 2014, p. 3). Furthermore, in many areas, private lands provide key sage-grouse habitat components that are not available on adjacent public lands (SGI 2014, pp. 3–4). Thus, although private land is not the predominant ownership category in four of the seven MZs, these areas can be crucial for sage-grouse persistence because sage-grouse require these areas to complete their life-cycle (see ***Seasonal Habitat Selection and Life History Characteristics*** section).

In addition to settlers claiming private lands, checkerboard patterns of private and Federal land along a large swath of southern Wyoming, northern Utah, and Nevada (Figures 4-1, B-2, B-4) are the result of the Pacific Railway Act of 1862 (U.S. Statutes at Large, 12, 489 ff.) which facilitated building a railroad and telegraph line connecting the Pacific Coast to Missouri (Knick 2011, pp. 15–21). The Act granted the Union Pacific Railroad and the Central Pacific Railroad 25.9 km^2 (10 mi^2) of land, to be distributed in alternate sections on each side of the track, for every 1.6 km (1 mi) of completed track. An amendment to the Act in 1864 (U.S. Statutes at Large, 13, 356 ff.) increased the land area given to railroad companies to 51.8 km^2 (20 mi^2) for each 1.6 km (1 mi) of track completed. Railroads have successfully swapped lands to consolidate holdings in some states, but large areas of checkerboard pattern ownership are still prevalent, and those lands retained by the railroads are generally managed to maximize profit (Loomis 2001, p. 30), rather than for conservation.

The management of private lands is specific to each State. Wyoming is the only State that has specific and binding regulatory mechanisms on private lands, formalized in an executive order, for the expressed purposes of conserving sage-grouse (see ***Regulatory Mechanisms*** section). Planning efforts that address private land management in sage-grouse habitats for other States are ongoing (see ***Regulatory Mechanisms*** section).

There are several non-regulatory programs that substantially contribute to sage-grouse conservation on private lands. Most notable among these are the Sage-grouse Initiative (SGI), the USDA Farm Service Agency Conservation Reserve Program (CRP), and Candidate Conservation Agreements with Assurances (CCAAs). See the ***Non-regulatory Conservation Efforts*** section for details regarding these programs.