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

SCIENTIFIC NAME: *Centrocercus urophasianus*

COMMON NAME: Greater sage-grouse

ANIMAL GROUP AND FAMILY: Birds, Phasianidae (pheasants, grouse, turkeys, and partridges)

INTRODUCTORY AND BACKGROUND SECTIONS

Executive SummaryEXECUTIVE SUMMARY

[-PLACEHOLDER]

INTRODUCTION

The intent of this Species Status Assessment is to facilitate the U.S. Fish and Wildlife Service (Service) in the evaluation of a candidate species, the Greater Sage-Grouse (Sage-grouse), for listing under the Endangered Species Act (Act). The greater sage-grouse (rangewide) 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,

Regulatory history

wWe have received 86 petitions to list the Greater sage-grouse throughout its range or within specific Distinct Population Segments (DPSs) ((Table 1-1X) throughout all or parts of its range. Among those, 2 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 status review. Our responses to the other 6 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 1-1All of these petitions were addressed in our 2010 warranted but precluded determination. At that time the eastern and western sub-species designations were resolved with the recognition that the previous delineations were not supported by the currently best available science (75 FR 13192-13193). The remaining range-wide petitions, as well as the petition for the Columbia Basin are being addressed in our current efforts. We also received 2 petitions to list the Bi-State DPS of the greater sage-grouse (2002 and 2005). As the Bi-State DPS has been addressed in a separate species report and status review, it will not be discussed further here. On April 23, 2015, a not warranted determination for the Bi-State DPS was published in the Federal Register. A complete summary of the regulatory history of the Bi-State DPS can be found at (FR citation for Bi-state finding).

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Table 1-1.: 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 (cite Bi-state FR notice of April 2379 FR 45420 and 80 FR 22828).

Petitioner	**Date**	**Request of Petition**	**Petition Finding**	**Status Review Finding**	**Legal Challenges**	**Outcome**
Craig Dremann	July 2, 2002	List range-wide	These 3 petitions combined in one substantial finding; April 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	March 24, 2003	List range-wide				
American Lands Alliance (lead) + 20 other organizations	December 29, 2003	List range-wide				
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 FWS 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	July 3, 2002	List the eastern subspecies	Non-substantial, Jan. 7, 2004	N/A	Institute for Wildlife Protection challenged	Judge ruled in favor of FWS on Sept. 28, 2004 and dismissed plaintiff case
NW Ecosystem Alliance and	May 28, 1999	List the Columbian Basin as a	Substantial, August 24, 2000	Warranted but precluded,	N/A	Committed to resolve the DPS

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Biodiversity Legal Foundation		DPS		May 7, 2001		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 others 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 a not-warranted finding to the Federal Register for sage-grouse, including any Distinct Population Segments (DPSs)[1], by the end of FY 2015. ~~This plan addressed the Bi-State DPS separately, and it is not included in this species report.~~

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

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Regulatory history

We have received 6 petitions to list the Greater sage-grouse (Table X) throughout all or parts of its range. All of these petitions were addressed in our 2010 warranted but precluded determination. At that time the eastern and western sub-species designations were resolved with the recognition that the previous delineations were not supported by the currently best available science (75 FR 13192-13193). The remaining range-wide petitions, as well as the petition for the Columbia Basin are being addressed in our current efforts. We also received 2 petitions to list the Bi-State DPS of the greater sage-grouse (2002 and 2005). As the Bi-State DPS has been addressed in a separate species report and status review, it will not be discussed further here. On April 23, 2015, a not warranted determination for the Bi-State DPS was published in the Federal Register. A complete summary of the regulatory history of the Bi-State DPS can be found at (FR citation for Bi-state finding).

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Institute for Wildlife	July 3, 2002	List the eastern subspecies	Non-substantial,	N/A	Institute for Wildlife	Judge ruled in favor of

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~~Protection~~			~~Jan. 7, 2004~~		~~Protection challenged~~	~~FWS 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, August 24, 2000~~	~~Warranted but precluded, May 7, 2001~~	~~N/A~~	~~Committed to resolve the DPS status in the range-wide status review~~

BIOLOGICAL INFORMATION

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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 and 7 pounds (lb)). Adult females are smaller, ranging in length from 48 to 58 cm (19 to 23 in) and weighing between 1 and 2 kg (2 and 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,

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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~~was~~ once considered ~~part of~~ a single ~~sage-grouse~~ species~~in the western United State~~ 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, p. 449–451) differences and geographical isolation (AOU 2000, pp. 849-850; Young *et al*.2000, pp. 447–451) ~~(AOU 2000, pp. 849–850)~~.

In 1957, the American Ornithologists' Union (AOU) (AOU 1957, p. 139) recognized two subspecies of the sage-grouse, the eastern (*Centrocercus urophasianus urophasianus*) and western (*C. u. phaios*), based on information from Aldrich (1946, p. 129). The original designation of the western subspecies was based on differences in coloration (reduced white markings and darker feathering on western birds) among 11 specimens collected from 8 locations in Washington, Oregon, and California. The AOU has not published a revised edition of their Check-list of North American Birds at the subspecies level, so the eastern and western sage-grouse subspecies are still recognized by this organization (Banks 2000).

Since 1957, the validity of the subspecies of sage-grouse have been questioned by taxonomic authorities (Johnsgard 1983, p. 109, 2002, p. 108; Drut 1994, p. 2; Schroeder *et al.* 1999, p. 3; Banks 2000, 2002; International Union for Conservation of Nature (IUCN) 2000, p. 62; Benedict *et al.* 2003, p. 301) as described in the Taxonomy section of the 2010 12-month finding (75 FR 13912–13913). In that finding, we thoroughly analyzed the available information and determined that the best scientific and commercial information did not support the taxonomic validity of the purported eastern or western subspecies (75 FR 13915). We are not aware of any new information since that time that would suggest we revisit this finding. Therefore, our status assessment is based on an analysis of the entire range of greater sage-grouse (sans the Bi-State DPS which has already been assessed.~~.~~

~~**In 1957, prior to the Gunnison sage-grouse being described as a distinct species, the American Ornithologists' Union (AOU) recognized two subspecies of sage-grouse, the eastern sage-grouse (Centrocercus urophasianus urophasianus) and the western sage-grouse (C. u. phaios) (AOU 1957, p. 139). This subspecies classification was based solely on differences in coloration (specifically, reduced white markings and darker feathering on western birds) among 11 museum specimens collected from 8 locations in Washington, Oregon and California (Aldrich 1946, p. 129).**~~

~~**The 1957 AOU subspecies classification has not been revisited by AOU since 1957 and that taxonomic classification has been determined to be invalid by more recent information, including information on morphology, behavior, geography, and molecular genetics (Johnsgard 1983, p. 109; 2002, p. 108; Drut 1994, p. 2; Schroeder et al. 1999, p. 3; Banks 2000, 2002; Benedict et al. 2003, p. 301; (75 FR 13910, pp. 13912–13915). Thus, our analysis of the status of the greater sage-grouse (below) does not address considerations at the scale of subspecies. See the Taxonomy section of the FWS 2010 12-month finding (75 FR 13910; March 23, 2010, p. 13912) for additional details.**~~

~~Genetics – PLACEHOLDER (Craig/Jesse – roll into small pops~~??)

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An analysis of genetic variation of sage-grouse (Oyler-McCance et al. 2005, entire; Oyler-McCance and Quinn 2011) found a gradual shift across the range in the composition of mitochondrial and nuclear genetic information. This pattern suggests localized gene flow – birds moving among neighboring populations but not moving across the entire species' range (isolation by distance). The results of a genetic clustering analysis conducted by Pritchard and Donnelly (2000) corroborated the findings by Oyler-McCance and Quinn (2011) showing that all unique genetic clusters of sage-grouse were composed of populations geographically adjacent to one another. 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). The least genetically diverse grouping of sage-grouse occur in the Columbia Basin, likely as a result of habitat loss and subsequent population decline (Oyler-McCance and Quinn 2011, p. 92).

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). The analyses suggested the differences were due to isolation of birds vs. the presence of unique alleles. Landscape features, such as mountains, may be important factors leading to genetic differentiation (Schulwitz et al. 2014, p. 568) as suggested in this paper, and supported by the analyses conducted of the Bi-State DPS (Oyler-McCance and Quinn 2011, p. 91). However the authors could not rule out habitat loss from anthropogenic activities as a contributing factor to genetic isolation. 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. An analysis of genetic connectivity currently being conducted by USGS may provide this information, but those results won't be available until after Sept. 2015.

Connectivity

In an analysis of connectivity (movement between populations) Knick and Hanser (2011, entire) found that the average movement between population centers (leks) of sage-grouse range-wide was 16.6 km (10.3 mi). Leks within 18 km (11.2 mi) of each other had common features when compared to leks further than this distance (Knick and Hanser 2011, p. 393). While this linear measure of connectivity may not accurately capture genetic information flow (Knick and Hanser 2011, p. ?) the authors used 18 km (11.2 mi) to model movement between populations. Due to the loss of leks and declining populations connectivity between sage-grouse populations declined from 1965 to 2007 (Knick and Hanser 2011, p. 395). Historic leks with low connectivity also were lost (Knick and Hanser 2011, p. ?), suggesting that current isolation of leks by distance (including habitat fragmentation) will likely result in their future loss (Knick and Hanser 2011, p.?). Small decreases in lek connectivity resulted in large increases in probability of lek abandonment (Knick and Hanser, 2011, p.?). Therefore, maintaining population connectivity is essential for sage-grouse persistence.

Sagebrush distribution was the most important factor in maintaining population connectivity (Knick and Hanser 2011, p. 404). This result is consistent with research from both Aldridge et al. (2008, p. 988) and Wisdom et al. (2011, p. ?), which independently identified the proximity of sagebrush patches and area in sagebrush cover as the best predictors for sage-grouse presence. Habitat loss resulting from fragmentation and

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Formatted: Font: (Default) Times New Roman, Bold 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. , and references therein) and, therefore, the probability of loss of genetic diversity and extirpation from stochastic events. Environmental factors such as habitat fragmentation, loss and altered habitat disturbance regimes (e.g. fire frequency), rather than stochastic events were identified as the likely primary influences on population trend, with extirpation likely more probable than colonization for many sage-grouse components due to their low abundance and isolation (Knick and Hanser 2011, p. ?). New analyses of connectivity using genetic data are currently being conducted. Unfortunately this information will not be available before September 30, 2015.

Greater sage-grouse habitat The sagebrush ecosystemHabitat

-Greater 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 (fig. 1) across the range, sage-grouse use a variety of sagebrush species including but not limited to: *Artemisia tridentata wyomingensis* (Wyoming big sagebrush) (*Artemisia tridentata wyomingensis* (), mountain big sagebrush (*A. t. vaseyana* (mountain big sagebrush), basin big sagebrush *A. t. tridentatea* (basin big sagebrush)), black sagebrush *A. nova* (black sagebrush), fringed sagebrush *A. frigida* (fringed sagebrush), silver sagebrush (*A. cana* (silver sagebrush), and little sagebrush *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, p. 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 habitats vegetation (Schroeder- et al. 2004, p. 364). 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).

Sagebrush Ecosystem

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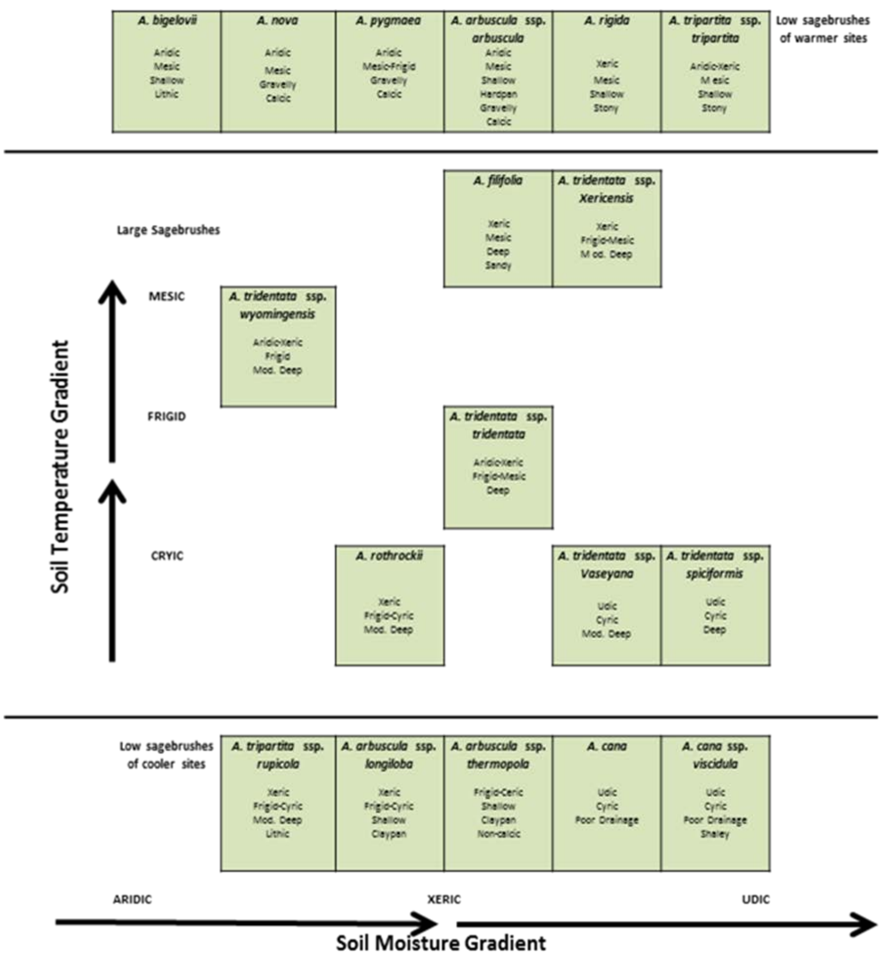

~~Figure . Ordination of major sagebrush taxa in the Intermountain Region against gradients of soil temperature and moisture (From Miller *et al*. 2011)~~

~~Sage-grouse are dependent on large areas of contiguous sagebrush (Patterson 1952, p. 48; Connelly *et al*. 2004, p. 4-1; Connelly *et al*. 2011, pp. 82–83; Wisdom *et al*. 2011, p. 465), and large-scale characteristics within surrounding landscapes influence sage-grouse habitat selection (Knick and Hanser 2011, pp. 396–405).~~ Sagebrush is the most widespread vegetation in the intermountain lowlands in the western United States (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 in an area is dictated by local soil type, soil moisture, and climatic conditions (West 1983, p.

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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 greater sage-grouse range include mixed-desert shrubland in the Bighorn Basin of Wyoming, and grasslands in eastern Montana and Wyoming that also support *A. cana* and *A. filifolia* (sand sagebrush) (Miller *et al*. 2011 p. 148).

Sagebrush is also 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 sage, typically occur where erosion has exposed clay or calcified soil horizons (West 1983, p. 334; West and Young 2000, p. 261). ~~Reflecting these soil differences, big sagebrush will die if surfaces are saturated long enough to create anaerobic conditions for 2 to 3 days (West and Young 2000, p. 259). Some low sagebrush are more tolerant of occasionally saturated soils, and many low sagebrush sites are partially flooded during spring snowmelt.~~ 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). ~~(citation?).~~ 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). ~~(West and Young 2000, p. 260).~~

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Comment [DP8]: Unless we find that saturated soils are a significant problem in sagebrush persistence I suggest deleting.

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Comment [LW 9]: Highlighting these could devalue the numerous other dozen(s) type of sagebrush and hybrids used by grouse.

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Comment [DMD10]: Wijayratne, U. P., and D. A. Pyke. 2012. Burial increases seed longevity of two *Artemisia tridentata* (Asteraceae) subspecies. American Journal of Botany 99:438-447.

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Sagebrush is long-lived, with plants of some species surviving up to 150 years (West 1983, p. 340). Sagebrush exhibit allelopathic effects, producing chemicals that reduce seed germination, seedling growth and root respiration of competing plant species and inhibit the activity of soil microbes and nitrogen fixation. 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 from 10 to well 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, 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 over 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).

Plants associated with the sagebrush understory, and their productivity also vary widely and are 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.

Very little sagebrush within its extant range is undisturbed or unaltered from its condition prior to 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 cryptobiotic 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 and lack of political motivation (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 discussion of landownershipLand Ownership and Management section, below). 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).

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Comment [DMD11]: Also see Pyke 2011, p. 544 who found that rehabilitation and restoration efforts are also hindered by cost and the ability to procure the equipment and seed needed for projects.

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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, associated with both local vegetation characteristics and landscape characteristics (Knick *et al*. 2003, p. 621). Where home ranges have been reported (Connelly *et al*. 2011a, p. 60 and references therein) they are extremely variable (4 to 615 km2 range [1.5 to 237.5 mi2]). Migratory populations of sage-grouse may use areas exceeding 2700 km^2 (667,185 acres, 1,042 mi^2; Leonard et al. 2000). However, diurnal space use and seasonal movement patterns observed by Davis et al. (2014) exceeded estimates of individual home range size reported in previous investigations, reporting a cumulative annual range of 3072 km^2 (1186 mi^2). ~~Occupancy of a home range is also based on multiple variables, associated with both local vegetation characteristics and landscape characteristics (Knick- *et al*. 2003, p. 621).~~ ~~Pyke (2011, p. 540) estimated that a minimum of 4,000 ha (9,884 acres) was necessary for population sustainability.~~ ~~However, he did not indicate whether this value was for migratory or non-migratory populations, nor if this included juxtaposition of all seasonal habitats.~~ 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). ~~Sage-grouse are dependent of seasonal habitats for persistence..say something here about how critical each of these seasonal habitats are for sage-grouse persistence.~~ Loss of any of these seasonal habitats could impact the ability of sage-grouse to persist in an area (Connelly et al. 2011, pp. ? (in summary section)). 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).

~~Breeding habitat~~

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, short-grass 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

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Comment [DMD12]: This estimate is not from Pyke, instead he cites Leonard et al (2000) who reports values for migratory sage-grouse populations in Idaho and Walker et al. (2007).

Migratory populations of sage-grouse may use areas exceeding 2700 km^2 (e.g., Leonard et al. (2000)

Diurnal space use and seasonal movement patterns observed by Davis et al. (2014) exceeded estimates of individual home range size reported in previous investigations. The cumulative annual range was within a 3072 km^2 area (based on MCP).

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Comment [DMD14]: I suggest updating this with the citation from SAB, which provides a summary of site fidelity (e.g., leks, females to nesting areas).

Comment [DP15]: This is the SAB citation. It provides a rather extensive list of references supporting this concept, hence the citation stating "and references therein".

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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). ~~Leks range in size from less than 0.04 hectare (ha) (0.1 ac) to over 36 ha (90 ac) (Connelly *et al*. 2004, p. 4-3) and can host from several to hundreds of males (Johnsgard 2002, p. 112). Males defend individual territories within leks and perform elaborate displays with their specialized plumage and vocalizations to attract females for mating.~~ 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). ~~Bush *et al*. (2013, p. 33), h~~However, recent genetic analyses found that on average ~~that~~ 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 ~~more recent work~~ suggests that males and females likely engage in off-lek copulations. Males do not participate in incubation of eggs or rearing chicks.

~~Nesting habitat~~

The distance ~~F~~females travel to nest locations from leks varies across the range, ranging from 0.14 km (0.087 mi) up to ~~have been documented to travel~~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). 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, Connelly et al. 2004, Schroeder and Robb 2003). Females in highly fragmented habitats of Washington moved almost twice (Schroeder et al. 1999) as far to nest (Schroeder et al. 1999. p. ?) as females in relatively intact habitats of southeastern Idaho (Wakkinen et al. 1992, p.?; Fischer 1994, p. ?). Similarly, females from undisturbed leks in southwestern Wyoming moved an average of 2.1 km to nests while females from disturbed leks moved 4.1 km (Lyon and Anderson 2003, p.?).

~~, but~~The d~~d~~istances between a nest site and the lek on which breeding occurred is also variable (Connelly *et al*. 2004, pp. 4-5). Average distance between a female's nest and the lek on which she was first observed ranged from 3.4 km (2.1 miles) to 7.8 km (4.8 miles) 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, Wakkinen *et al*. 1992a, Fischer 1994, Schroeder *et al*. 1999, Herman-Brunson 2007). In northeastern California (Davis *et al*. 2014) the average distance between a female's nest and the nearest lek was ~~3.69~~4.67 km (2.9 mi) ~~± 2.94 SD (n = 74)~~ and ranged from 0.14(0.087) km to 14.10 km (8.76 mi). These results are consistent with other studies conducted in peripheral populations (Schroeder et al. 1999; Aldridge and Brigham 2001~~,~~, Moynahan et al. 2007; Herman-Brunson *et al*. 2009, Wiechman 2013).
Research by Bradbury *et al*. (1989, p. 22) and Wakkinen *et al*. (1992, p. 382) demonstrated that nest sites are selected independent of lek locations, but that the reverse is not true.

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 hens (Barnett and Crawford 1994, p. 116), and cover for the hen 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

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Comment [LW 16]: We can probably update that…
I'll look for a few citations.
AMY: yah, there was a recent presentation, can't remember who?? That had distances for success full nest, renest, etc.

DMD: Connelly et al. 2011 (and references therein) summarizes this on p. 62 in SAB. Davis et al. (2014) reported that the average distance females moved from lek sites of capture to initial nest locations was 4.67 km ± 4.30 SD (n = 59). This distance is within the range reported for other sage-grouse studies (0.40–29.75 km; Schroeder et al. 1999, Aldridge and Brigham 2001, Moynahan et al. 2007).

Comment [DP17]: I updated the text with the new information

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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)). ~~Published vegetation characteristics of successful nest sites included a sagebrush canopy cover of 15-25 percent, sagebrush heights of 30 – 80 cm (11.8 – 31.5 in), and grass/forb cover of 18 cm (7.1 in; Connelly *et al*. 2000a, p. 977).~~

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), as reported in the scientific literature, varies widely (reported as 15 to 86 percent of initiated nests Schroeder *et al.* 1999, p. 11; 12 to 71 percent of initiated nests in 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 ~~(based on 9 different studies)~~ 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). ~~In north-central Washington State, re-nesting contributed to 38 percent of the annual productivity of that population (Schroeder 1997, p. 937). However, the author postulated that the re-nesting efforts in this population may be greater than anywhere else in the species' range because environmental conditions allow a longer period of time to successfully rear a clutch (Schroeder 1997, p. 939).~~

Little information is available on the level of productivity (number of chicks per hen that survive to fall) that is necessary to maintain a stable population (Connelly *et al*. 2000b, p. 970). However, Connelly *et al.* (2000b, p. 970, and references therein) suggest that 2.25 chicks per hen are necessary to maintain stable to increasing populations. Long-term productivity estimates of 1.40 to 2.96 chicks per hen across the species range have been reported (Connelly and Braun 1997, p. 20). ~~Productivity declined slightly after 1985 to 1.21 to 2.19 chicks per hen (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 1973-1998 and 1993-2013 found the average number of juveniles in the harvest per female 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).

~~Brood-rearing habitat~~

Hens 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 two studies in Wyoming (Connelly *et al.* 2004, p. 4-8).

Comment [DMD19]: Davis et al. 2014. Demography, reproductive ecology, and variation in survival of greater sage-grouse in NE California. JWM DOI: 10.1002/jwmg.797

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Comment [DMD20]: Gregg et al. (2008) Temporal variation in diet and nutrition of preincubating greater sage-grouse. Rangeland Ecology and Management 61:535-542.

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Comment [DMD21]: Also see the meta-analysis by Hagen et al. (2007).

A meta-analysis for greater sage-grouse nesting and brood rearing habitats. Wildlife Biology 13:42-50.

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Comment [DMD26]: Braun et al. 2015. Fall ...

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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 ~~(sagebrush canopy cover of 10 to 25 percent; Connelly *et al.* 2000a, p. 977)~~ 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 (~~3~~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 hens 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. However, natural water bodies and reservoirs can provide mesic areas for succulent forb and insect production, thereby attracting sage-grouse hens with broods (Connelly *et al.* 2004, p. 4-12). Broodless hens and cocks will also use more mesic areas in close proximity to sagebrush cover during the late summer, often arriving before hens with broods (Connelly *et al.* 2004, p. 4-10).

~~Winter habitat~~

Sage-grouse are considered a sagebrush obligate and that designation 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).

~~Winter habitats may overlap with or be relatively close to nesting or brood-rearing habitats, or they may be totally separated, requiring significant movement to achieve (Fedy *et al.* 2012, p. 1068).~~ 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 1km (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 83 km (51.6 mi) ~~For example, sage-grouse in Idaho on average moved less than 15 km, but some individuals moved greater than 80 km to reach their winter range~~ (Connelly *et al.* 1988, p. 119;~~). The average movement of sage-grouse in Wyoming from summer to winter locations was 17.3 km, but the minimum and maximum distances recorded were 0.33 and 83km, respectively (~~Fedy *et al* 2012, p. 1067). 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.*

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Comment [DMD27]: Early and late brood-rearing periods have typically been based on observations on habitat use by hens with 6-week-old broods (Martin 1970) and information from Peterson (1970), who found a dietary change in juvenile sage-grouse approximately 6 weeks after Hatching. But see Blomberg et al. 2013

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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 supremely 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 to a diet that consists almost entirely of sagebrush (Schroeder- *et al*. 1999, p. 5).

~~Despite these challenging conditions, d~~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 actual weight gain over the winter months has been documented (Beck and Braun 1978, p. 243). During notably severe winters, however, even sage-grouse are not immune from the elements and 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% of the total landscape used by different populations ~~In northern Colorado, only 6.8 percent of the area was intensively used by sage-grouse during the winter~~ (Beck 1977, p. 20; ~~). In south-central Wyoming, only 7-18 percent of a 4,328 km[2] study area was identified as having characteristics suitable for severe winter habitat (~~Dzialak *et al*. 2013, p. 10; ~~). Similarly, winter habitat was limited in northwest Colorado and south-central Wyoming, representing only 17.1 percent of the 6,093 km2 study area (~~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 significant decline happened despite the fact that 84 percent of the total area remained unplowed~~ughed~~ 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 further decreases or even eliminates access to sagebrush (as a consequence of increasing snow depth). During such times birds become even more concentrated in the few remaining areas of exposed sagebrush 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).

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Comment [DMD29]: Smith et al. 2014. Prioritizing winter habitat quality for greater sage-grouse in a landscape influenced by energy development. Ecosphere 5:15. http://dx.doi.org/10.1890/ES13-00238.

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Seasonal Movements and Dispersal

Migratory Corridors

The distances sage-grouse move between seasonal habitats are highly variable across the occupied range (Dalke et al. 1960, Connelly et al. 1988). 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). 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 1983, Hagen 1999). Movement patterns were defined by Connelly et al. (2000b) as (1) non-migratory—sage-grouse make one-way movements <10 km (6.2 mi) between or among seasonal ranges, (2) one-stage migration—grouse move ≥10 km (6.2 mi) between two distinct seasonal ranges, and (3) two-stage migration—grouse move ≥10 km (6.2 mi) among three distinct seasonal ranges (Connelly et al. 2001, p. 59). 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).

Many populations of sage-grouse migrate between seasonal ranges in response to habitat distribution (Connelly *et al.* 2004, p. 3-5). Migration can occur between winter and breeding/summer areas, between breeding, summer and winter areas, or not at all. Migration distances of up to 161 kilometers (km) (100 mi) have been recorded (Patterson 1952, p.189); however, distances vary depending on the locations of seasonal habitats (Schroeder *et al.* 1999, p. 3). 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).

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 ± 1.3 km (2.4 mi) and 2.7 ± 0.3 km (1.7 mi), for males and females, respectively [Thompson 2012, p. 193]). 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, Leonard et al. 2000, Hausleitner 2003, Fedy et al. 2012). Moreover, the extensive movements between seasonal ranges and highly clustered distributions of sage-grouse (Hagen et al. 2001) have made estimating home range size and comparisons between studies difficult. Estimating an 'average' home range for sage-grouse is difficult due to the large variation in sage-grouse movements both within and among populations. This variation is related to the spatial availability of habitats required for seasonal use and annual recorded home ranges have varied from 4 – 615 km2 (1.5 – 237.5 mi2; Connelly *et al.* 2011a, p.60).

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Comment [LW 30]: Add in description of: nonmigratory, 1-stage, and 2-stage migratory individuals as well as that multiple can be present in any one population.

DMD: See p. 59 of SAB for description of the 3 sage-grouse movement patterns (non-migratory; on-stage; and two-state migration) cited from Connelly et al. 2000.

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Comment [DMD32]: 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, Leonard et al. 2000, Hausleitner 2003, Fedy et al. 2012). Moreover, the extensive movements between seasonal ranges and highly clustered distributions of sage-grouse (Hagen et al. 2001) have made estimating home range size and comparisons between studies difficult.

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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. ??). 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 18 km (11.2 mi) of each other had common features when compared to leks further than this distance (Knick and Hanser 2011, p. 393). 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. ?), with small decreases in lek connectivity resulting in large increases in probability of lek abandonment (Knick and Hanser, 2011, p.?). 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.?).

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. , and references therein) and, therefore, the probability of loss of genetic diversity and extirpation from stochastic events. Environmental factors such as habitat fragmentation, loss and altered habitat disturbance regimes (e.g. fire frequency), rather than stochastic events were identified as the likely primary influences on population trend (Knick and Hanser 2011, p. ?).

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) (Pritchard and Donnelly 2000, p. ??; Oyler-McCance et al. 2005, entire; Oyler-McCance and Quinn 2011). 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). The least genetically diverse grouping of sage-grouse occur in the Columbia Basin, likely as a result of habitat loss and subsequent population decline (Oyler-McCance and Quinn 2011, p. 92).

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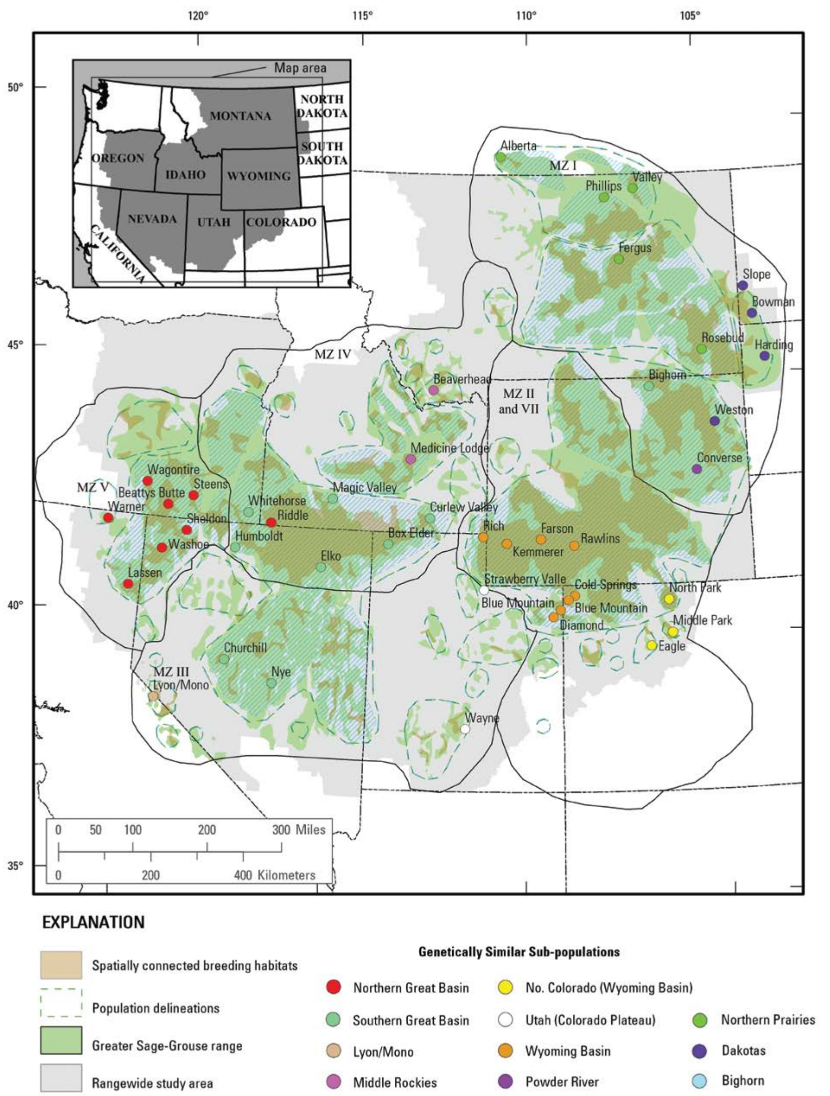

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Figure xx-xx. PLACEHOLDER – Population Connectivity and Landscape Genetics Map.

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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).

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The analyses suggested the differences were due to isolation of birds rather than the presence of unique alleles. Landscape features, such as mountains, may be important factors leading to genetic differentiation (Schulwitz et al. 2014, p. 568) as suggested in this paper, and supported by the analyses conducted of the Bi-State DPS (Oyler-McCance and Quinn 2011, p. 91). However the authors could not rule out habitat loss from anthropogenic activities as a contributing factor to genetic isolation. 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. An analysis of genetic connectivity currently being conducted by USGS may provide this information, but those results won't be available until after Sept. 2015.

Historical and Current Range and Distribution

~~Range and Distribution of Sage-Grouse and Sagebrush~~

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 also 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 habitat quality and, therefore, use by sage-grouse (Knick *et al*. 2003, p. 616).

Prior to settlement of western North America by European immigrants in the 19th century, greater sage grouse occurred in 13 States and 3 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 X-1). Sagebrush habitats that potentially supported sage-grouse occurred over approximately 1,200,483 km2 (463,509 mi2) before 1800 (Schroeder *et al*. 2004, p. 366). Currently, greater sage-grouse occur in 11 States (Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Colorado, Utah, South Dakota, and North Dakota), and 2 Canadian provinces (Alberta and Saskatchewan), occupying approximately 56 percent of their historical range (Schroeder *et al*. 2004, p. 369) (Figure X-1). Approximately 2 percent of the total range of the greater sage-grouse occurs in Canada, with the remainder in the United States (Knick ~~in press~~2011, p~~. 14~~).

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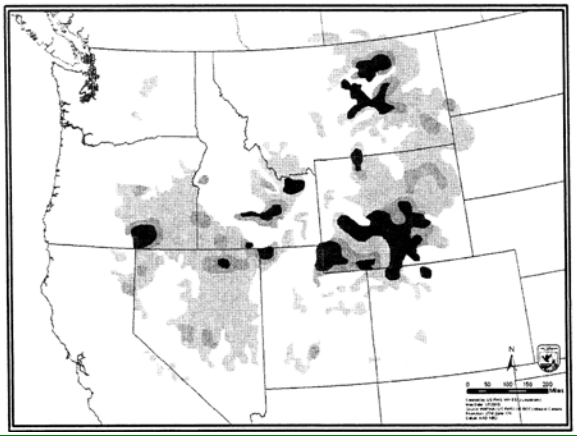
Figure 1—Greater sage-grouse population densities based on average number of males per lek (from Stiver *et al.* 2006, p. 1-12). Darker areas indicate higher breeding population densities.



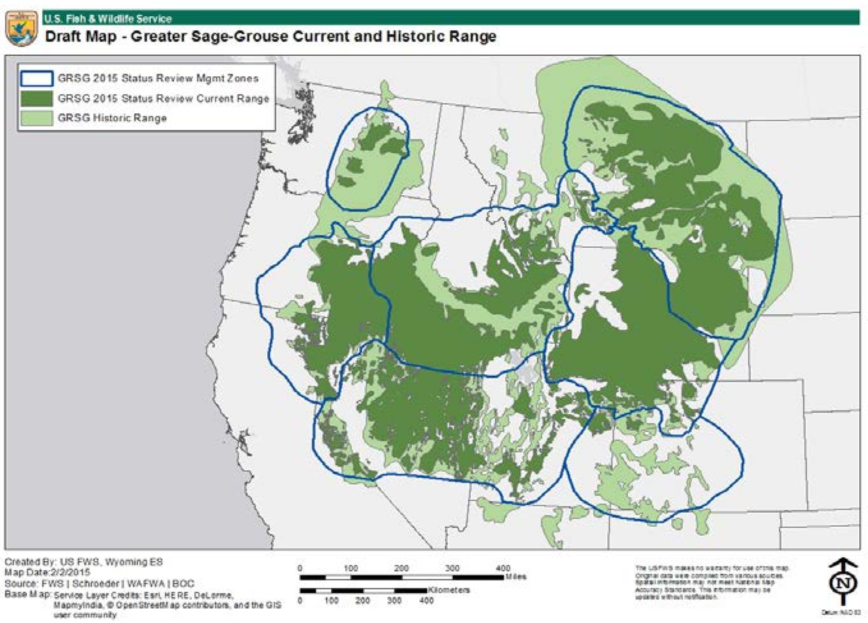


Figure 3-1. Placeholder DRAFT Map

Sage-grouse have been extirpated from Nebraska, British Columbia, and possibly Arizona (Schroeder *et al*. 1999, 2; Young *et al*. 2000 p. 445; Schroeder *et al*. 2004, p. 369). Current distribution of the greater sage-grouse is estimated at 668,412 km^2 (258,075 mi^2; Connelly *et al*. 2004, p. 6-9; Schroeder *et al*. 2004, 369). Changes from the estimated historical ~~in~~ distribution

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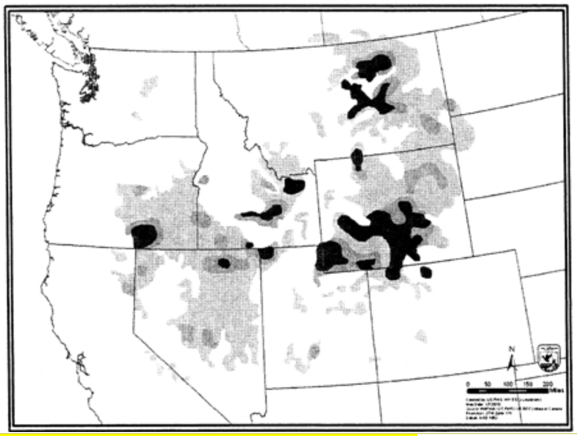
are the result of sagebrush alteration and degradation (Schroeder -*et al*. 2004, p. 363; Knick and Connelly 2011, p.).

Sage-grouse distribution is associated with sagebrush (Schroeder -*et al*. 2004; p. 364), although sagebrush is more widely distributed. However, sagebrush does not always provide suitable habitat due to fragmentation and degradation (Schroeder *et al*. 2004, pp. 369, 372). 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). There also 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 habitat quality and, therefore, use by sage-grouse (Knick -*et al*. 2003, p. 616). As such, variations in the quality of sagebrush habitats (from either abiotic or anthropogenic events) are reflected by sage-grouse distribution and densities (Figure X-placeholder map below).

Figure 1—Greater sage-grouse population densities based on average number of males per lek (from Stiver *et al.* 2006, p. 1-12). Darker areas indicate higher breeding population densities.



PLACEHOLDER: Get new density layer from Kevin

Sagebrush occurs in two natural vegetation types that are delineated by temperature and patterns of precipitation (Miller -*et al*. in press, p. 7). 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. Great Basin sagebrush occurs south of sagebrush steppe, and extends from the Colorado Plateau westward into Nevada, Utah, and California (Miller -*et al*. in press, p. 7). Other sagebrush types within greater sage-grouse range include mixed-desert shrubland in the Bighorn Basin of Wyoming, and grasslands in eastern Montana and Wyoming that also support A. cana and A. filifolia (sand sagebrush) (Miller -*et al*. in press, p. 7).

Current Range Distribution-PLACEHOLDERFundamental characteristics of sagebrush landscapes have changed from Euro-American settlement (Knick and Connelly 2011, p.). 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 and 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

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Formatted: Indent: First line: 0", Line spacing: single the presence *of Bromus tectorum* (cheatgrass; West and Young 2000, p.), whereas fire has been reduced in higher elevations facilitating the expansion of *Juniperus* spp. (junipers) and *Pinus* spp. (pinyon) woodlands. plant species (Miller and Rose 1999, p.). Habitat suitability is also affected by the presence of anthropogenic structures (such as communication towers and powerlines (Connelly et al. 2000, Beck et al. 2006). Lastly, the configuration of sagebrush mosaics across the species' range has changed (Knick and Connelly 2011, p.) Increased edges are prevalent due to the high level of infrastructure network, which can change predator movement s (Tewksbury et al. 2002), isolate populations (Saunders et al.1991, Trombulak and Frissell 2000, as cited by Knick and Connelly 2011) and facilitate the spread of exotic species (Gelbard and Belnap 2003). 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 X-2).

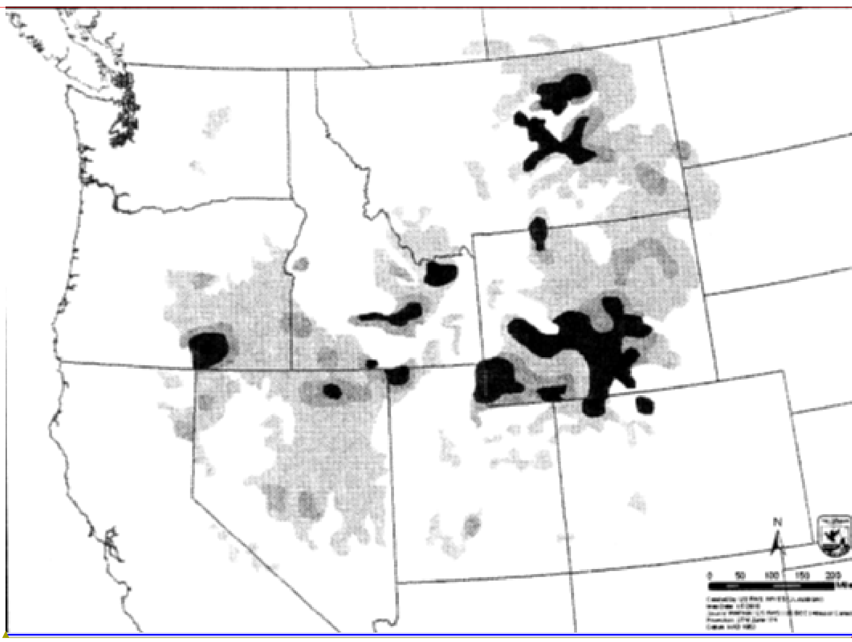

Figure xx. Sage-grouse densities. PLACEHOLDER: Get new density layer from Kevin

Sage-grouse have been delineated into forty-one populations, defined by geographic or physical barriers to movement (Knick and Connelly 2011, p). Populations at the edge of the current range increasingly are isolated from the larger interior areas (Schroeder et al. 1999, Schroeder et al. 2004).

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Comment [DP38]: Knick and Connolly did not describe the populations, but rather are describing the populations identified by WAFWA. Need to reference back to the original source.

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~~Figure 3. Updated population boundaries for greater sage-grouse, updated by FWS in coordination with BLM and WAFWA. Note: This map includes the addition of population delineations in Utah and Canada.~~

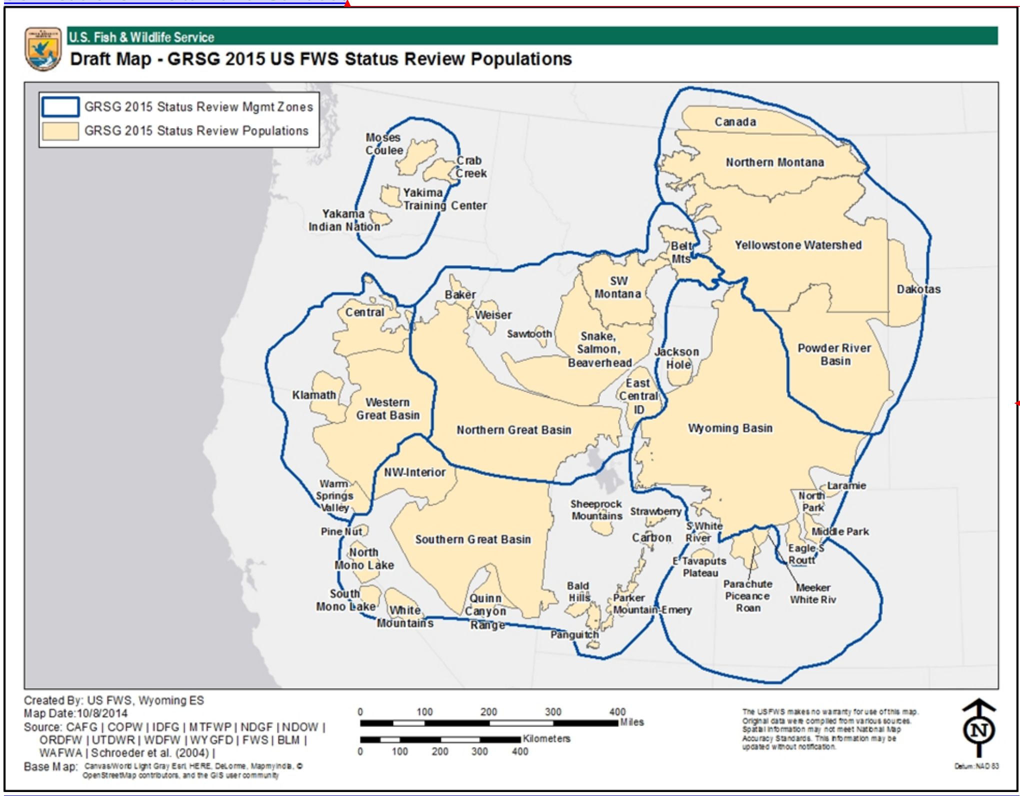

Figure 3. Updated population boundaries for greater sage-grouse, updated by FWS in coordination with BLM and WAFWA. Note: This map includes the addition of population delineations in Utah and Canada.

~~***ANNUAL LEK COUNTS/SURVEYS PLACEHOLDER***~~

~~***MANAGEMENT ZONE DISCUSSION/DESCRIPTION***~~

~~**BASIN OF WYOMING, AND GRASSLANDS IN EASTERN MONTANA AND WYOMING THAT ALSO SUPPORT A. CANA AND A. FILIFOLIA (SAND SAGEBRUSH) (MILLER ET AL. IN PRESS, P. 7).**~~

~~***CURRENT RANGE DISTRIBUTION PLACEHOLDER***~~

~~***ANNUAL LEK COUNTS/SURVEYS PLACEHOLDER***~~

MANAGEMENT ZONE ~~DISCUSSION/DESCRIPTIONS~~

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Due to differences in the ecology of sagebrush across the range of the greater sage-grouse, the Western Association of Fish and Wildlife Agencies (WAFWA) delineated seven Sage-grouse Management Zones (MZs I-VII) based primarily on floristic provinces (Figure 2;X 1-43; Table 1; Stiver *et al*. 2006, p. 1-6). The boundaries of these MZs were delineated based on their ecological and biological attributes rather than on arbitrary political boundaries (Stiver *et al*. 2006, p. 1-6). Therefore, vegetation found within a MZ is similar 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. A detailed description of WAFWA delineated MZs, along with their associated threats, can be found in Appendix X.

The sage-grouse range is often divided into two geographical areas – Great Basin and the Rocky Mountain regions. The delineation of these regions is based on groupings of MZs, and their underlying floristic and physiogeographical characteristics (e.g. soil types, precipitation regimes). In general the Great Basin portion of the range, which encompasses MZ III, IV, V and VI, is lower in elevation, experiences less precipitation, and poorer soils. 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 grasses cycle (described in detail below) is more prevalent in the Great Basin region due to lower elevations and drier conditions which facilitate spread of the invasive plants.

Scale of Analysis for the Species Report

Given that the threats to sage-grouse vary in presence and intensity across its range the scale of analysis is tiered to the biologically meaningful units for threat presence and intensity. Analyses of threats will occur at the range-wide scale, as well as regions (Rocky Mountain and Great Basin), and the WAFWA Management Zone scale. Because some threats are localized within a Management Zone, these zones were selected as the minimum extent that modeling was feasible. Where more refined information was available for qualitative analyses, those reviews were based on smaller biologically-based units, such as populations or groups of populations within a MZ. Analysis at the PAC level is complicated by the sheer number of units (> 300) and their lack of common spatial resolution given their origination with differing state mapping efforts. Nonetheless, where feasible summary statistics or narratives for each population that describe the level of threat and/or protection/conservation within the population and PACs will be presented. Losses of individual PAC polygons will be considered in determining the status of overall given population.

Table 3-1: The Management Zones of the greater sage-grouse as defined by Stiver et al. 2006, pp. 1-7, 1-11.

MZ	STATES AND PROVINCES INCLUDED	FLORISTIC REGION
I	MT, WY, ND, SD, SK, AL	Great Plains
II	ID, WY, UT, CO	Wyoming Basin

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MZ	STATES AND PROVINCES INCLUDED	FLORISTIC REGION
III	UT, NV, CA	Southern Great Basin
IV	ID, UT, NV, OR	Snake River Plain
V	OR, CA, NV	Northern Great Basin
VI	WA	Columbia Basin
VII	CO, UT	Colorado Plateau

Figure 2—The Management Zones for sage-grouse as identified by Stiver *et al.* (2006, p 1-11). (Delineation primarily based on floristic provinces and population boundaries.)

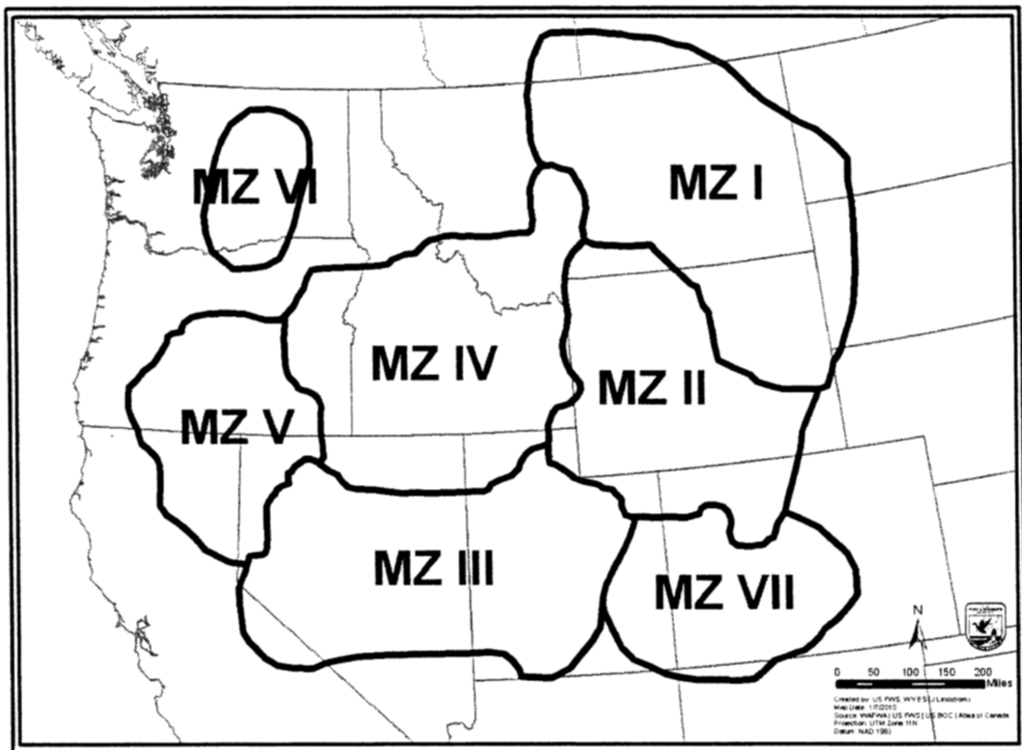

Figure 1-4. PLACEHOLDER MAP—NEED NEW MAP FROM JIM

[Figure - Distribution models by MZ]?
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[Figure – Abundance models by MZ]?
[Table - Numbers from Abundance models by MZ]?

Based on models of movement distance connectivity of sage-grouse across MZ boundaries is

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limited, with the exception of MZs I and II (Knick and Hanser 2011, p. ?). Within MZs, the Wyoming Basin (MZ II) had the highest levels of population connectivity, followed by MZ IV and MZ I (Knick and Hanser 2011. p.?). The MZ VI (Columbia Basin) and VII (Colorado Plateau) had the least internal connectivity, suggesting there was limited dispersal between leks and an existing relatively high degree of isolation (Knick and Hanser 2011, p. ?). Genetic analyses examining the level of connectivity both within and between MZs are currently in progress, but the results will not be available prior to September, 2015 (Knick pers. comm.)

[Figure – WAFWA MZs, populations, and range map]

[Figure – PACs map]

[Figure – Strongholds map]

[Figure – Distribution models by MZ]

[Table - Numbers from Distribution models by MZ]

[Figure – Abundance models by MZ]

[Table – Numbers from Abundance models by MZ]Regional Delineations

The sage-grouse range is often divided into two geographical areas – Great Basin and the Rocky Mountain regions. The delineation of these regions is based on groupings of MZs, and their underlying floristic and physiogeographical characteristics (e.g. soil types, precipitation regimes). In general the Great Basin portion of the range, which encompasses MZ III, IV, V and VI, is lower in elevation, experiences less precipitation, and poorer soils. 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 grasses cycle (described in detail below) is more prevalent in the Great Basin region due to lower elevations and drier conditions which facilitate spread of the invasive plants.

PRIORITY AREAS FOROF CONSERVATION

In December, 2011 the FWS was tasked with the development of range-wide conservation objectives for the sage-grouse. The FWS created a Conservation Objectives Team (COT) of state and FWS representatives to develop a report that defined the degree to which threats need to be reduced or ameliorated to conserve sage-grouse so that it is no longer in danger of extinction or likely to become in danger of extinction in the foreseeable future. The resulting peer-reviewed COT report (FWS 2013, entire) delineates objectives, for the conservation and survival of greater sage-grouse. One key component of the report is the identification of Priority Areas forof Conservation (PACs). PACs are key habitats that are essential for sage-grouse

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conservation, and were identified by the team based on state sage-grouse conservation plans (for each state that has such a plan), or through other sage-grouse conservation efforts (e.g. the current BLM planning effort for greater sage-grouse). The key components of conservation biology - redundancy, resilience and representation (Naeem 1998; Redford et al. 2011) were captured in these PAC delineations (FWS 2013). 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 acknowledges 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.

PLACEHOLDER
Figure xx – Priority Areas for Conservation.

POPULATION ESTIMATES AND ~~SIZE~~TRENDS

Sage-grouse population numbers are most commonly tracked by counting birds on leks. Deriving population estimates from lek data is difficult due to the large range of the species, incomplete sampling from the physical difficulty in accessing some occupied leks, and the cryptic coloration and behavior of hens making them easy to miss while conducing lek counts (Garton *et al.*2011, p. ?). Additionally, problems 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 counted) were identified by Walsh *et al.* (2006, pp. 61-64), Garton *et al.* (2011, p. ?), and Blomberg et al. (2013, p. 1584), and many of those problems still persist (Stiver *et al.* 2006, p. 3-1). Additionally, estimating population sizes using lek data is difficult as the relationship of those data to actual population size (e.g., ratio of males to females, percent unseen birds) is usually unknown (WAFWA 2008, p. 3). Several authors have criticized the efficacy of lek counts to assess population change (Beck and Braun 1980; Walsh et al. 2004). The use of harvest data, the only other consistent source of information, for estimating population numbers also is of limited value since not all areas are open to hunting (see discussion in the hunting section), hunters may not provide specific harvest collection locations, not all harvest is reported, birds may be migratory and therefore harvested in a different area than where they are counted on leks, and both harvest and the population size on which harvest is based are estimates.

Greater sage-grouse populations cycle (Rich 1985, Fedy and Doherty 2011, p. 919), further increasing the difficulty in assessing population numbers and in determining population stability. The length of the cycle appears to vary across the range, but most populations cycle on an 8 to 10 year schedule. Drivers of the cycle are unknown (Fedy and Doherty 2011, p. 921), although Rich (1985, p. 14) hypothesized that it may be associated with the amount and time of precipitation. Further research is needed to assess if synchrony in sage-grouse cycles within or

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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 analyzed by Garton et al. (2011, p. ?) demonstrated a 1- to 2-year delay in population response to habitat conditions. 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.

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). Some studies suggest that male lek counts can be viewed as useful indices of long-term population trends (Connelly et al. 2004; Johnson 2008; Johnson and Rowland 2007; Williams et al. 2004; WAFWA 2008). Lek counts have more recently been identified as a strong metric for evaluating population trajectories (Blomberg et al. 2013, p. 1590). Therefore population trends, not annual variation in lek count numbers is the current the metric for assessing sage-grouse population stability.

Historic Population Trends

Estimates of greater 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 (Hornaday 1916, pp. 181-185). ~~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 (Connelly *et al.* 2004, p. 6-9).~~ 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 (Connelly *et al.* 2004, p. 6-9).

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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, which was supported by data from several other sources (Garton *et al.* 2011, p. ?).

Population numbers are difficult to estimate due to the large range of the species, physical difficulty in accessing some areas of habitat, the cryptic coloration and behavior of hens (Garton *et al.* in press, p. 6) and survey protocols. Problems 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 counted) were identified by Walsh *et al.* (2006, pp. 61-64) and Garton *et al.* (in press, p. 6), and many of those problems still persist (Stiver *et al.* 2006, p. 3-1). Additionally, estimating population sizes using lek data is difficult as the relationship of those data to actual population size (e.g., ratio of males to females, percent unseen birds) is usually unknown (WAFWA 2008, p. 3). However, the annual counting of males on leks remains the primary approach to monitor long-term trends of populations (WAFWA 2008, p. 3), and standardized techniques are beginning to be implemented throughout the species' range (Stiver *et al.* 2006, pp. 3-1 to 3-16). The use of harvest data for estimating population numbers also is of limited value since both harvest and the population size on which harvest is based are estimates. Given the limitations of these data, States usually rely on a combination of actual counts of birds on leks and harvest data to estimate population size. Estimates of populations by State, generated from a variety of data sources, are provided in Table 4.

TABLE 4. Sage-grouse Population Estimates Based on Data From State Wildlife Agencies.

Location	**ata Year**	**Source**	**Estimated Population**
CA/NV	004	CA/NV Conservation Assessment (2004, p. 26)	88,000
CO	007	2007 CO Conservation plan, based on adjusted male lek counts (count + 1.6 multiplier, sex ratio females:males)	22,646
ID	007	Calculated based on assumption of 5% of population is harvested	98,700
MT	007	Calculated based on assumption of 5% of population is harvested	62,320
ND	007	2008 lek counts adjusted (assumes 75% of males counted at lek, & sex ratio of 2:1) (A. Robinson, NDGFD, pers. comm., 2008)	308

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L ocation	ata Year	Source	Esti mated Population
O R	003	2003 Oregon Conservation Plan Estimate (Hagen 2005, p. 27)	40,0 00
S D	007	SDGF web page (last updated in 2007)	1,50 0
U T	002	2001 UDOW Management Plan (2002, p. 13)	12,9 99
W A	003	WDFW Conservation Plan (2004, p. 21)	1,05 9
W Y	007	Calculated based on assumption of 5% of population is harvested	207, 560
C anada	008	Environment Canada web page	1,00 0

Recent Population Trends

Braun (1998, p. 141) estimated that the minimum 1998 range-wide spring population numbered about 157,000 sage-grouse, derived from numbers of males counted on leks. 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, we estimated the range-wide abundance of sage-grouse was between a minimum of 100,000 (taken from Braun 1998, p. 141) up to 500,000 birds (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, Connelly *et al.* (2004, p. 13-5) concluded that range-wide population numbers were likely much greater than the 157,000 estimated by Braun (1998, p. 141), but they were unable to generate a range-wide population estimate. Garton *et al.*, (in press, p. 2) estimated a rangewide minimum of 88,816 males counted on leks in 2007, the last year data were formally collated and reported. Estimates of historical populations range from 1,600,000 to 16,000,000 birds (65 FR 51580).

Population Trends

Although population numbers are difficult to estimate, the long-term data collected from counting males on leks provides insight to population trends. 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

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limits and season lengths as a precautionary measure (Patterson 1952, pp. 30-33; Autenrieth 1981, p. 10).

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.* (in press, p. 67) also demonstrated a pattern of significantly higher numbers of sage-grouse in the late 1960s and early 1970s, which was supported by data from several other sources (Garton *et al.* in press, p. 68).

In 2008, WAFWA conducted new population trend analyses that incorporated an additional 4 years of data beyond the Connelly *et al.* 2004 analysis. Although the WAFWA analyses used different statistical techniques, lek counts also were used. WAFWA results were similar to Connelly *et al.* (2004) in that a long-term population decline was detected during 1965 to 2007 (3.1 percent; WAFWA 2008, p. 12). WAFWA attributed the decline to the reduction in number of active leks (WAFWA 2008, p. 51). Similar to Connelly *et al.* (2004), the WAFWA analyses determined that the rate of decline lessened during 1985 to 2007 (average annual change of -1.4 percent annually) (WAFWA 2008, p. 58).

Garton *et al.* (in press, pp. 68-69) also had similar results.

Although the MZs were not formally adopted by WAFWA until 2006, the population trend analyses conducted by Connelly *et al.* (2004) included trend analyses based on the same floristic provinces used to define the zones. While the average annual rate of change was not presented, the results of those analyses suggested long-term declines in greater 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 WAFWA (2008) pand Garton *et al.* (in press) population trend analyses did consider MZs and reported that MZs I through VI had negative population trends from 1965 to 2007. All population trend analyses had similar results, with the exception of MZ VII (Table 5). However, this MZ has one of the highest proportion of inactive leks (Garton *et al.* in press, p. 65) which may imply that males numbers on the remaining leks are increasing as birds re-locate. The analysis of this MZ also suffered from small sample sizes and therefore large confidence intervals (Garton *et al.* in press, p. 217), so the treand may not actually reflect the population status. The WAFWA trend analyses (WAFWA 2008, entire) only considered data through 2007. A new population trend analysis incorporating lek data through 2013 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 WAFWA 2008 trend analysis and work by Connelly et al. (2004) despite using different statistical techniques. The percent change in number of males per lek

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and the percent change in active leks reflected population declines, and possibly habitat loss in all MZs (Garton et al. 2011, p. ?). A range-wide minimum of 88,816 males counted on leks in 2007 was estimated in this analysis (Garton et al. 2011, p. ?). A revised- estimate incorporating an additional 6 years of lek data 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 so is likely an underestimate. Updated trend analyses by Garton et al. incorporating lek data collected through 2013 is currently undergoing peer review and its availability for consideration by September 2015 is unknown.

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 X). 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/hen), 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 outbreaks. No reason for continued declines in Lassen California has been provided, but it is likely that population was severely impacted by the large Rush fire which destroyed X amount of 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.

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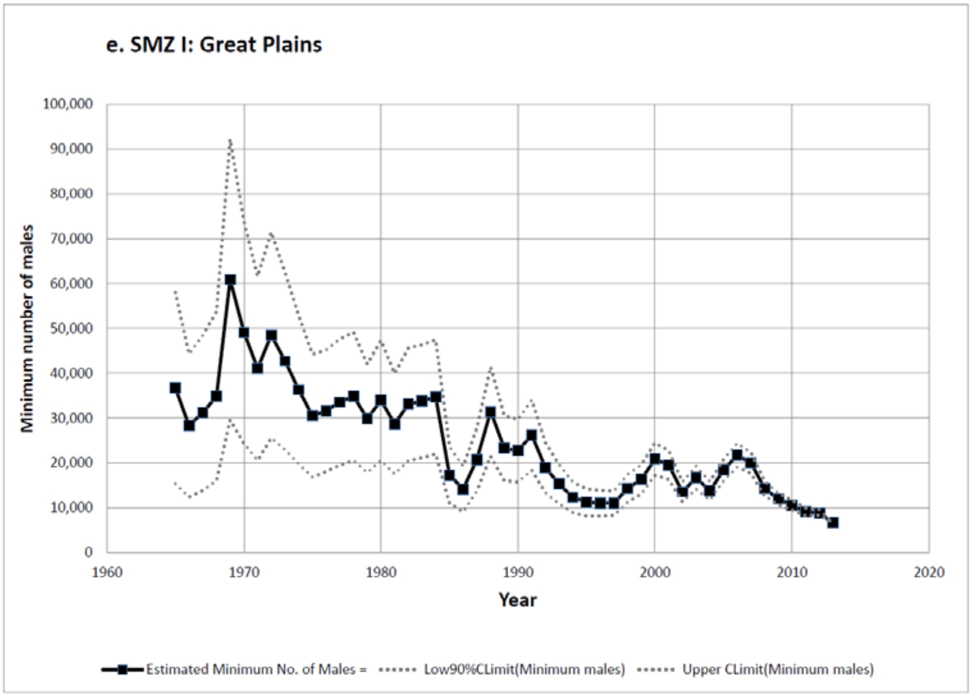
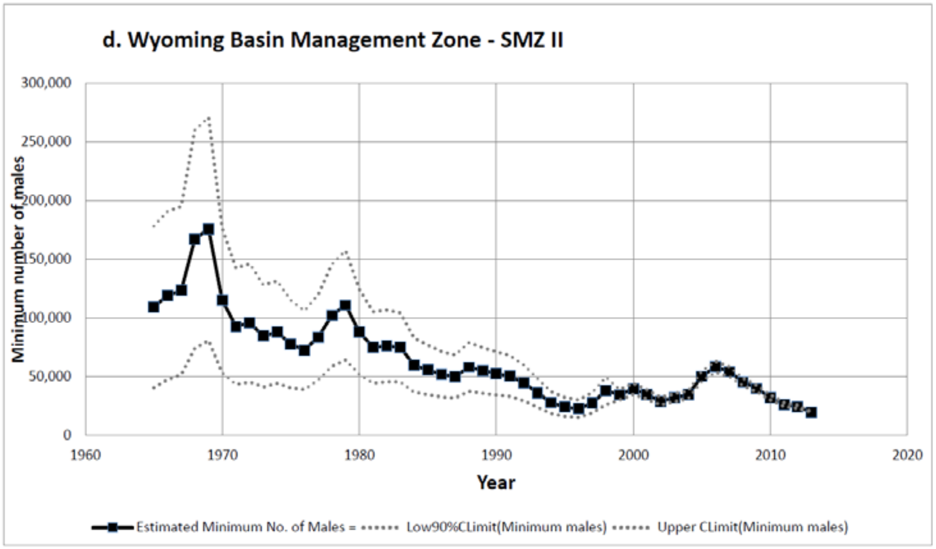
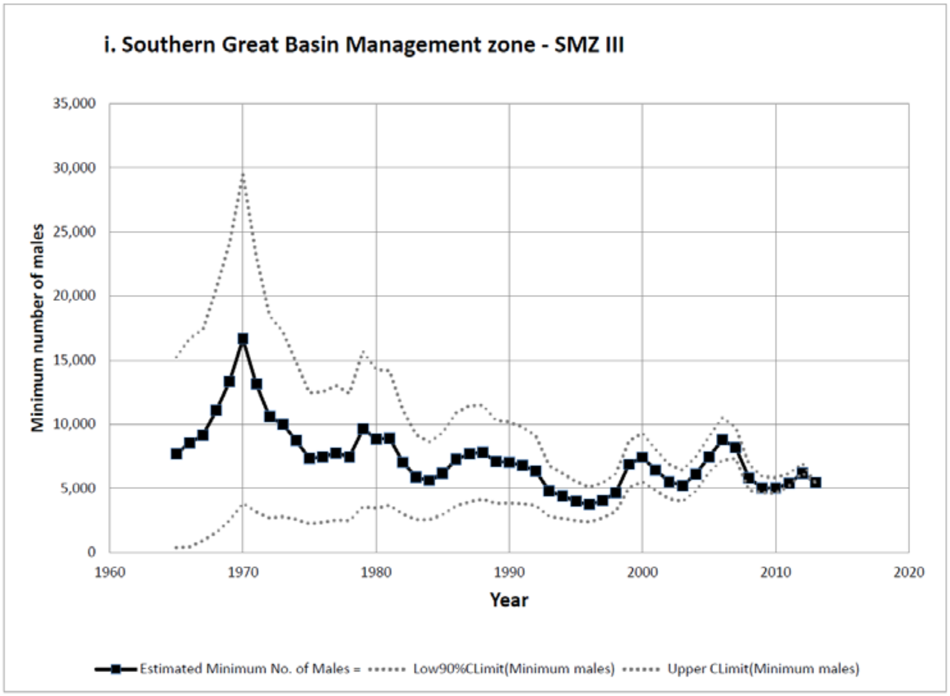
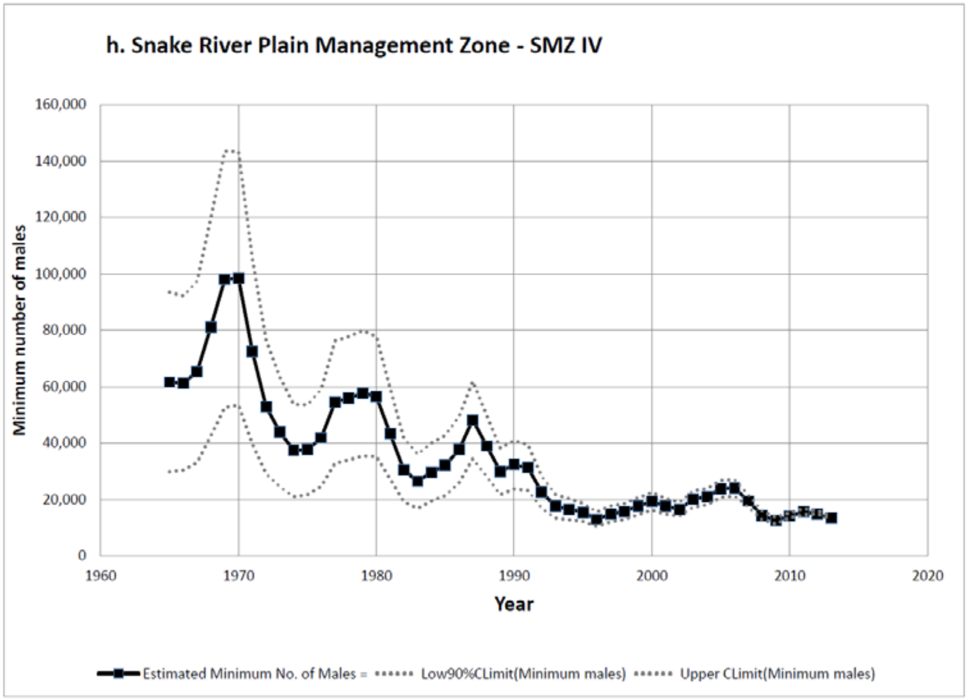
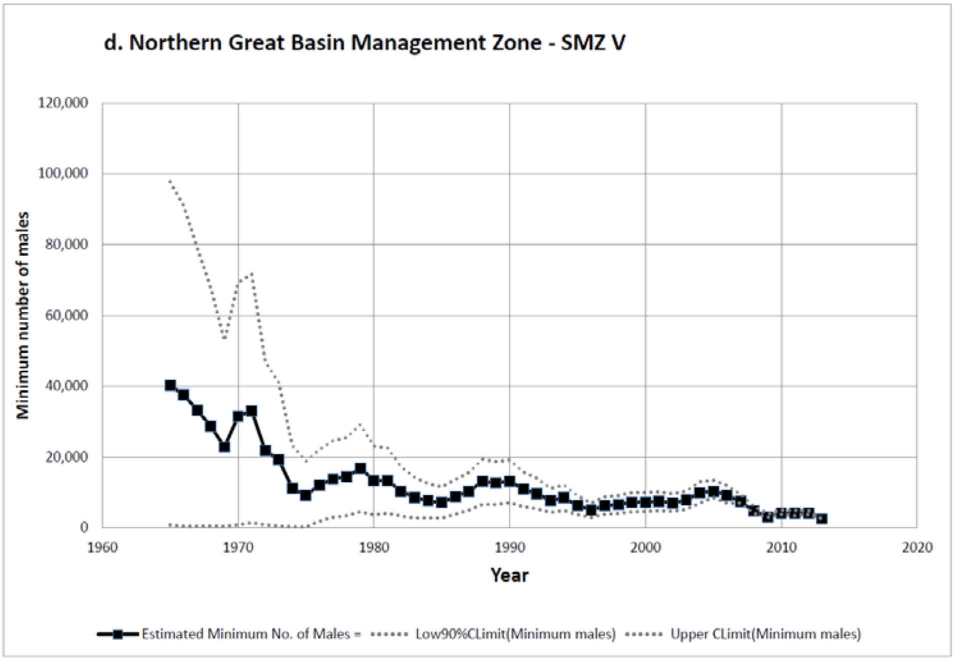
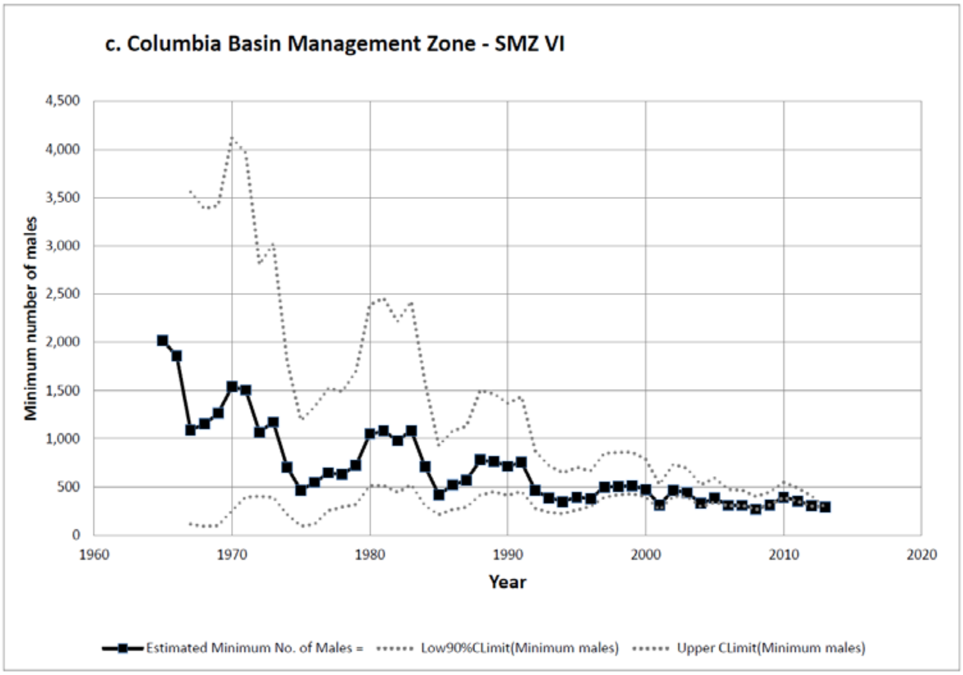

e. SMZ I: Great Plains
Minimum number of males
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1960
1970
1980
1990
2000
2010
2020
Year
Estimated Minimum No. of Males =
Low90%CLimit(Minimum males)
Upper CLimit(Minimum males)


d. Wyoming Basin Management Zone - SMZ II
Minimum number of males
300,000
250,000
200,000
150,000
100,000
50,000
0
1960
1970
1980
1990
2000
2010
2020
Year
Estimated Minimum No. of Males =
Low90%CLimit(Minimum males)
Upper CLimit(Minimum males)


i. Southern Great Basin Management zone - SMZ III
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
Minimum number of males
1960
1970
1980
1990
2000
2010
2020
Year
Estimated Minimum No. of Males = Low90%CLimit(Minimum males) Upper CLimit(Minimum males)


h. Snake River Plain Management Zone - SMZ IV
Minimum number of males
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
1960
1970
1980
1990
2000
2010
2020
Year
Estimated Minimum No. of Males =
Low90%CLimit(Minimum males)
Upper CLimit(Minimum males)


d. Northern Great Basin Management Zone - SMZ V
120,000
100,000
80,000
60,000
40,000
20,000
0
Minimum number of males
1960
1970
1980
1990
2000
2010
2020
Year
Estimated Minimum No. of Males =
Low90%CLimit(Minimum males)
Upper CLimit(Minimum males)


c. Columbia Basin Management Zone - SMZ VI
Minimum number of males
Year
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1960
1970
1980
1990
2000
2010
2020
Estimated Minimum No. of Males =
Low90%CLimit(Minimum males)
Upper CLimit(Minimum males)

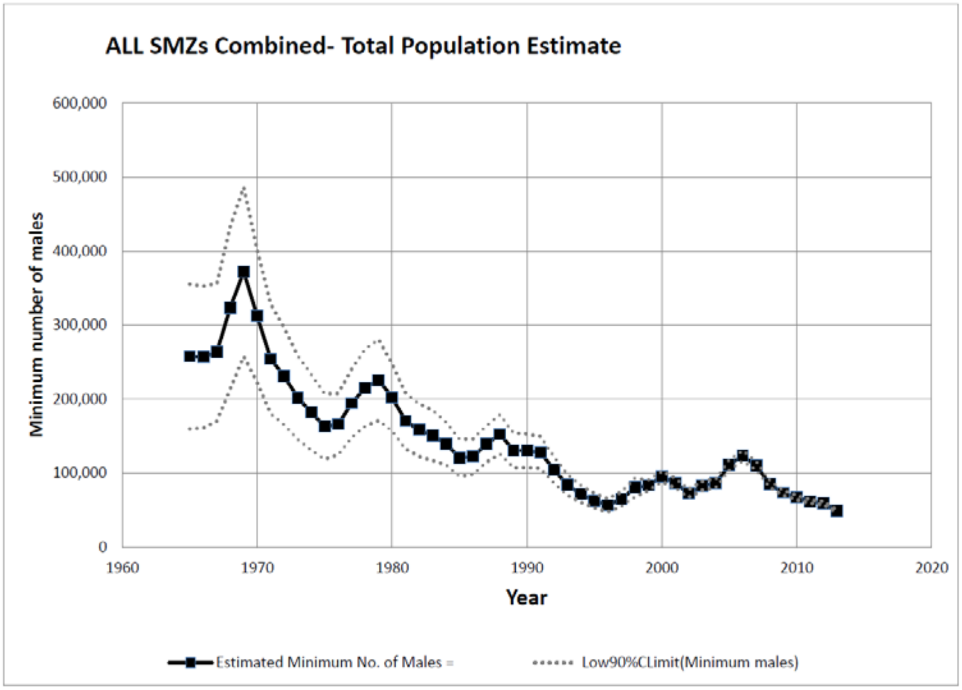


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Table X: Summary of population trends by State and Province since 2010. Given the diversity of data presentation by responding state and Provincial agencies quantitative comparisons were not possible. All information, except California, taken from data submission for 2015 status review. California lek data provided by CDFG (pers. comm).

State/Province	**Trend since 2010**	**Comments**
Alberta	Not reported	Only 4 to 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 XXX
Montana	Declining?	Declining trend through 2012; no updated

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		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.

Population forecasts modeled by Garton et al. 2011 (entire) suggested that at least 13% 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. ?: not all populations were included in the analyses due to insufficient data for the analyses). Seventy-five percent 75% of the populations and 29% of the SMZs are likely to decline below effective population sizes of 500 within 100 years (Garton et al. 2011, p. ?). These results were based on the assumptions that current conditions would persist into the future, and 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 available for our review 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 losing 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

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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.

TABLE 5. Long-term Population Trend Estimates for Greater Sage-grouse MZs.

Z	States and Provinces Included	Population Trend Estimates 1965-2003* (Stiver *et al.* 2006)	Population Trend Estimates Based on Annual Rates of Change 1965-2007 (%) (WAFWA 2008)	Population Trend Estimates Based on Annual Rates of Change 1965–2007 (%) (Garton *et al.* in press)
	MT, WY, ND, SD, SK, AL	Long-term decline	-2.9	-2.9
I	ID, WY, UT, CO	Long-term decline	-2.7	-3.5
II	UT, NV, CA	Long-term decline	-2.2	-10**
V	ID, UT, NV, OR	Long-term decline	-3.8	-4**
	OR, CA, NV	Change statistically undetectable	-3.3	-2**
I	WA	Long-term decline	-5.1	-6.5
II	CO, UT	Change statistically undetectable	No detectable trend	+34**

*Average annual rate of change was not reported.
**Due to sample inadequacies for the statistical analyses used, only data from 1995 to 2007 could be used.

Differences in the MZ trends observed between the three analyses are minimal, with the exception of MZs III, V, and VII. While the results of Connelly *et al.* (2004) and WAFWA (2008) were similar for MZ III, Garton *et al.* (in press) showed a larger rate of decline. This difference may be due to the shortened time period (12 versus 42 years) Garton *et al.* (in press) used for the analyses because some earlier data were not suitable for the statistical procedures used. This increased rate of decline was not observed for MZ IV where Garton *et al.*'s (in press) analyses also only spanned 12 years, suggesting that declines in that MZ III may have recently accelerated. No explanation was offered by WAFWA (2008) about the difference between their analyses and Connelly *et al.* (2004) for MZ V. However, Garton *et al.* (in press) results are similar to WAFWA for the same area.

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~~The difference in the annual rate of change between Connelly *et al*. (2004) and WAFWA (2008) versus Garton *et al*. (in press) in MZ VII is significant (Table 5). Garton *et al*. (in press) did not offer an explanation of this difference, but Connelly *et al*. (2004; as cited by (Stiver *et al*. 2006, p. 1-7)) indicated population trends were increasing in this MZ, although those increases were not statistically significant. However, Garton *et al*. (in press, pp. 62-63) reported that the number of leks in MZ VII declined by 39 percent during the same analysis period. The increase in annual rate of change may simply reflect increases on remaining leks as habitat became more limited.~~

~~In addition to calculating annual rates of change by MZ, Garton *et al* (in press) also reported the percent change in number of males per lek from 1965 to 2007, the percent change of active leks from 1965 to 2007, and minimum male population estimates in 2007 (Table 6). The percent change in number of males per lek and the percent change in active leks reflect population declines, and possibly habitat loss in all MZs.~~

~~TABLE 6. Minimum male greater sage-grouse population estimates in 2007, percent change in number of males per lek and percent change in number of active leks between 1965 and 2007 by MZ (from Garton *et al*. in press, pp. 22-64).~~

~~Z~~	~~Min Population Est in 2007 (# of males)~~	~~Percent Change in # of Males per Lek (1965-2007)~~	~~Percent Change of Active Leks (1965-2007)~~
	~~14,814~~	~~-17~~	~~-22~~
~~I~~	~~42,429~~	~~-30~~	~~-7~~
~~II~~	~~6,851~~	~~-24~~	~~-16 ***~~
~~V~~	~~15,761~~	~~-54~~	~~-11***~~
	~~6,925~~	~~-17**~~	~~-21**~~
~~I~~	~~315~~	~~-76~~	~~-57~~
~~II~~	~~241~~	~~-13~~	~~-39*~~

LAND OWNERSHIP AND MANAGEMENT

In this chapter we summarize surface ownership patterns across the range of sage-grouse within each Management Zone and summarize the basic management authorities and planning efforts for those lands. We also summarize ownership patterns within the modeled breeding distribution and by our population index model.

Federal Lands

Federal lands encompass the majority of the sage-grouse range (53%) and breeding distribution 61%) (Figure xx; Table xx). They are also areas of relatively high sage-grouse density (Table xx); and, thus appropriate management of these lands is crucial for sage-grouse conservation.

Comment [DP50]: this will all need to be revised with the new Garton report if available after peer review before Sept. 30

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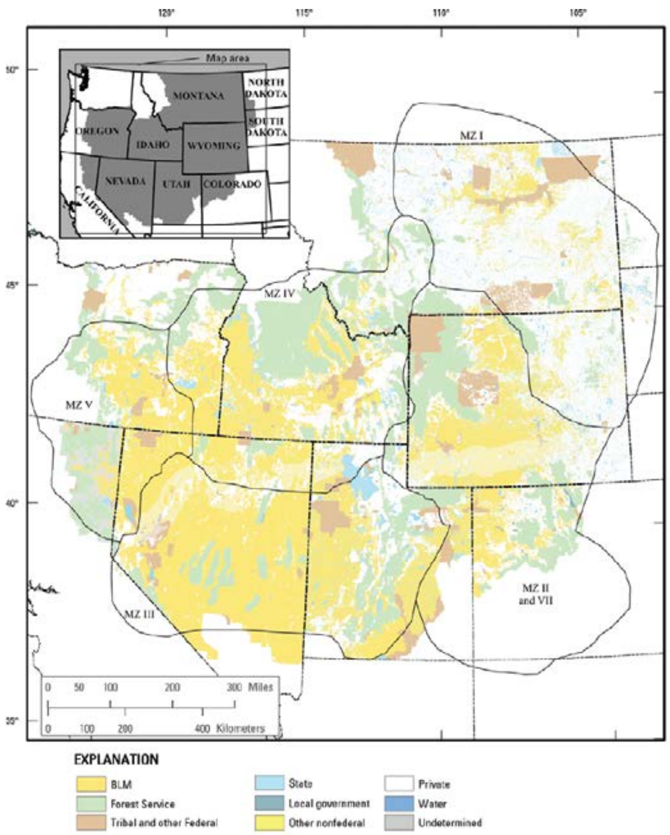

Figure xx. [Placeholder map]. Land ownership within the range of the Greater Sage-grouse.

Table xx. Percent surface ownership of the sage-grouse range.

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.

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Table xx. Percent surface ownership of the modeled sage-grouse breeding distribution.

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 xx. Percent of the population index within each sage-grouse Management Zone, by surface ownership.

Sage-grouse MZ	BLM	USFS	Other Federal	Tribal	State	Private[a]
I Great Plains[b]						
II Wyoming Basin						
III Southern Great Basin[c]						
IV Snake River Plain						
V Northern Great Basin						
VI Columbia Basin						
VII Colorado Plateau						

[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 management zones except the Great Plains and Columbia Basin MZs, where the amount of BLM land is relatively small (16% and 5% respectively) and private ownership predominates (69% and 63% respectively).

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.

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RMPs 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 lands.

In our 2010 finding we stated that, "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 U.S. Forest Service 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 amended 96 LUP within 15 planning areas[2] (Figure x-2, Appendix x) to incorporate sage-grouse conservation measures. The conservation measures include both restrictions on land uses and programs that affect GRSG, as well as measures to reduce and mitigate impacts arising from BLM and FS programs and authorized uses. The LUPs also include a rangewide monitoring strategy and an adaptive management strategy. A timeline of important events in the development of a BLM/FS sage-grouse landscape conservation strategy and LUPs is provided in Table xx. Specifics on the regulatory and non-regulatory provisions of these plans is provided in each threat chapter, and in the **Regulatory Mechanisms** and **Non-regulatory Conservation Efforts** sections, below.

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[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.

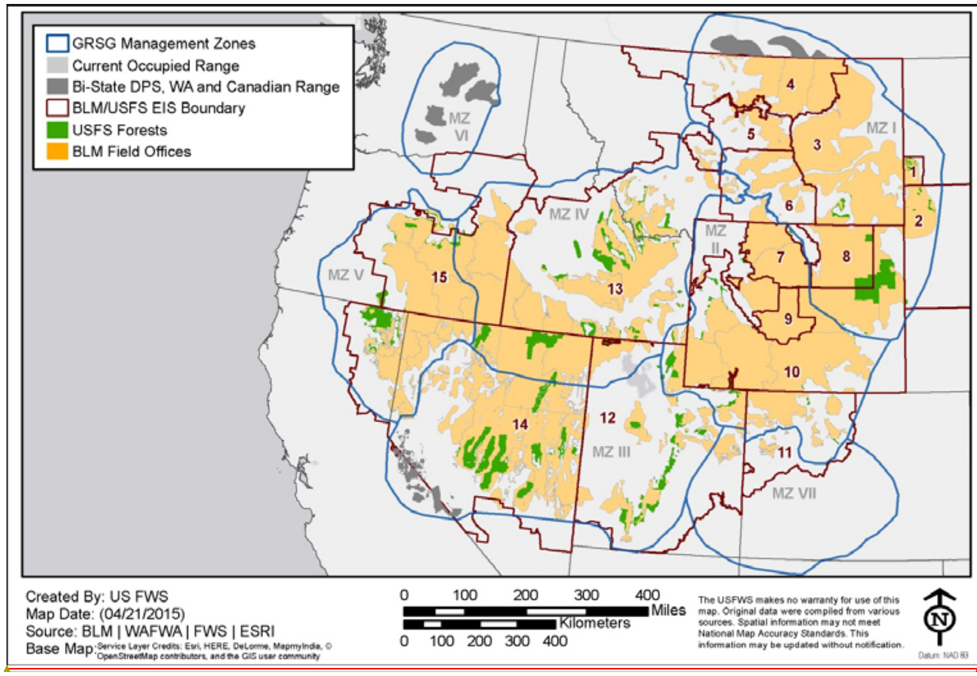

Figure xx. BLM and FS RMP and LRMP planning areas. Portions of the Sage-grouse range in Washington and the Bi-State area are undergoing separate planning processes.

Table xx. Timeline of important events in the development of a rangewide sage-grouse conservation strategy on BLM and FS lands.

Date	**Event**
March 23, 2010	FWS issues its 12-month finding indicated listing the greater sage-grouse is warranted, but precluded by higher priority listing actions. One of the key components of that decision was the lack of adequate regulatory mechanisms to conserve sage-grouse.
August 22, 2011	BLM published a planning strategy charter to outline the steps necessary to develop new or revised regulatory mechanisms, through RMPs, to conserve and restore the greater sage-grouse and its habitat on BLM-administered lands on a rangewide basis over the long term[3]. This charter established a National Policy Team (NPT), a National Technical Team (NTT), Regional Management Teams (RMT), and other teams and sideboards to lay the groundwork for revising or amending RMPs.
December 9, 2011	BLM and FS issue a joint notice of intent to address sage-grouse in management plans across their range. This included 68 BLM planning

[3] Management Zone VI (Washington State) was left off of this rangewide planning effort given the limited amount of BLM ownership in that area. Planning efforts to include sage-grouse conservation efforts in MZ VI are underway but are scheduled to be completed later than the rest of the BLM planning efforts.

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Date	Event
	areas and 9 FS LRMPs (6 BLM RMPs had already begun a programmatic EIS specific to sage-grouse prior to this NOI; total at this point was 83 planning areas undergoing amendment or revision). The notice indicates that the range will be divided into two broad planning regions, an eastern and western region.
December 21, 2011	The Sage-grouse Technical Team publishes "A Report on National Greater Sage-Grouse Conservation Measures" — also known as the NTT Report. The technical report provided recommended conservation measures for priority habitats for BLM to consider in its planning process.
December 27, 2011	The BLM Washington Office released Instructional Memorandum (IM) 2012-044, which directed all planning efforts across the GRSG range to consider all applicable conservation measures when revising or amending RMPs in GRSG habitat, including measures in the NTT report.
February 10, 2012	The FS adds 11 National Forests to its notice of intent to address sage-grouse in their management plans. This brings the total to 98 planning areas undergoing revision to include sage-grouse conservation measures. BLM renames its eastern and western regions of the sage-grouse planning areas, the Rocky Mountain (eastern) and Great Basin (western) regions.
August 6, 2012	The FS adopts a new National Forest System land management planning rule. Includes a requirement to ensure species' viability on each of its forests, grasslands, and prairies.
February 22, 2013	BLM releases Lander (Wyoming) proposed RMP and Final EIS.
May - November 2013	Draft EISs are published including several alternatives. Includes alternatives proposed by each State, environmental groups, an alternative based on the NTT report, and a BLM/FS alternative that attempts to balance several of the other alternatives.
June 3, 2013	USGS, in cooperation with BLM, publishes the Baseline Environmental Report (BER) for greater sage-grouse. The report summarizes the science, activities, programs, and policies that affect greater sage-grouse and was intended to better inform rangewide conservation planning efforts.
April 26, 2014	The NPT issues direction to all planning areas to incorporate consistent management of preliminary priority and preliminary general habitat for sage-grouse. Includes land-use allocations, monitoring, adaptive management, disturbance calculations, and mitigation.
May 21, 2014	Forest Service publishes a notice of intent to amend the Dakota Prairie Grasslands LRMP to incorporate sage-grouse conservation measures.
October 27, 2014	The FWS sends a letter and maps to the BLM identifying sage-grouse "strongholds." These were provided at the request of BLM to identify a subset of priority habitats, "most vital to the species persistence" where FWS recommended "the strongest levels of protection."

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Date	Event
November 21, 2014	USGS, at the request of the Department of Interior, publishes a review of conservation buffer distances for greater sage-grouse.
January 30, 2015	The NPT issues planning-area specific direction on development in highly important landscapes (strongholds), mitigation, mapping, calculating disturbance, adaptive management, lek buffers. In addition, the guidance provided several conservation measures to address specific threats.
February 6, 2015	BLM HQ provides "drop-in" language to be included in all plans to ensure consistency in key areas of the planning efforts.
TBD	Final EISs published
TBD	Records of Decision Signed

Management direction in the 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). PHMAs contain a large majority of known leks across the range and BLM and FS determined (in cooperation with partners) that PHMAs have the highest conservation value for maintaining viable GRSG populations (Figure xx). Therefore, PHMAs have more stringent protections than GHMAs in the LUPs (see **Impacts** section and **Regulatory Mechanisms** sections, below for more details).

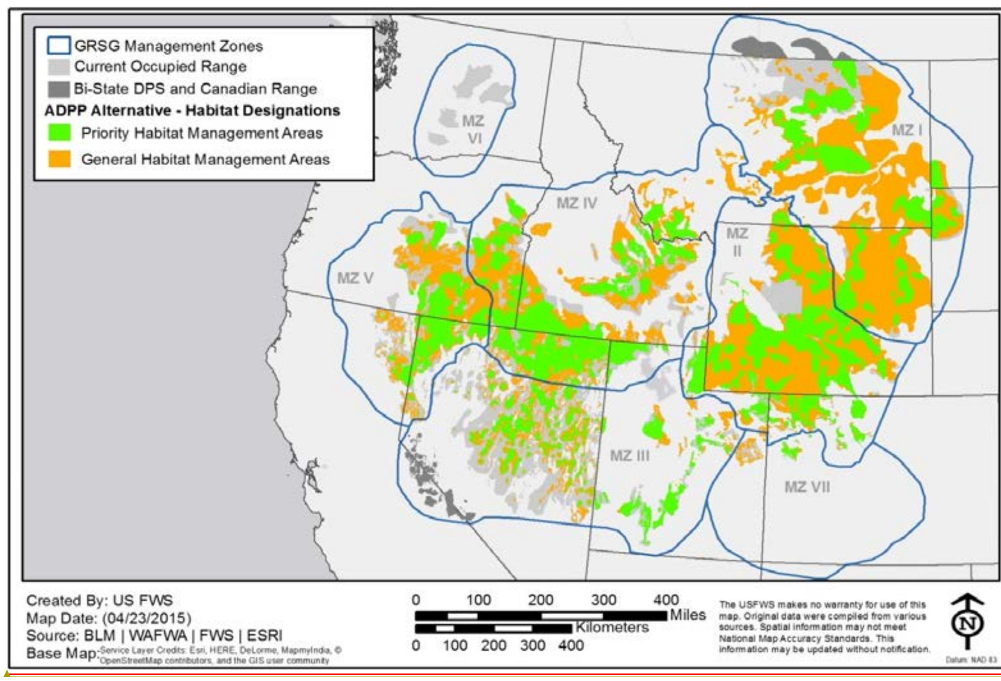

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Figure xx. Priority and General Habitat Management Areas in BLMs RMPs and FSs LRMPs. (Note: habitat management areas are shown covering more than just BLM and FS land due to management of subsurface rights that may exist in other surface ownerships).

Forest Service

Forest Service lands make up 6% of the range of the sage-grouse but only 3% of the breeding distribution. Management Zones with significant amounts of Forest Service ownership include the Southern Great Basin (14% of the range and 12% of the breeding distribution in MZ III), and the Snake River Plain (8% of the range and 3% of the breeding distribution in MZ IV) (Table xx).

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). NFMA specifies that the USFS must have a land and resource management plan (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 Forest Service 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 on greater sage-grouse we stated that, "[a]ll 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 Forest Service has undertaken an effort to update or amend all of its LRMPs within the range of the greater sage-grouse (see discussion in the *BLM* section, above; Table xx).

The new Forest Service LRMPs were developed under the 2012 planning regulations (77 FR 21162) that represented a significant shift from the 1982 regulations. According to the Forest Service the 2012 planning regulations were intended to: "…ensure that plans respond to the requirements of land management that the Agency faces today, including the need to provide sustainable benefits, services, and uses, including recreation; the need for forest restoration and conservation, watershed protections, and wildlife conservation; and the need for sound resource management under changing conditions." (77 FR 21163). These new planning regulations included a requirement that all plans include a determination as to whether the plans provide the ecological conditions necessary to: contribute to the recovery of federally listed threatened or endangered species, conserve proposed and candidate species (e.g., the greater sage-grouse), and maintain a viable population of each species of conservation concern within the plan area (36 C.F.R. §219.9). If the responsible official determines that the plan components required above are insufficient to provide such ecological conditions, then additional, species-specific plan components, including standards or guidelines, must be included in the plan to provide such

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ecological conditions in the plan area. This new viability standard is being considered in all of the revised and amended Forest Service LRMPs (see **Regulatory Mechanisms** section, below).

U.S. Fish and Wildlife Service

A total of 11 NWRs are currently known to be occupied by sage-grouse (Table xx). The FWS directly manages only 1 percent of sage-grouse habitats as part of the National Wildlife Refuge System (Knick and Connelly 2011); however, in MZ V, the Sheldon-Hart Wildlife Refuge Complex comprises 9% of the modeled sage-grouse distribution (Table xx; Figure xx).

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.

The refuges with the most modeled breeding distribution, leks, or individual sage-grouse are: Charles M. Russell NWR and UL Bend NWR (MZ I), Seedskadee NWR (MZ II), Cokeville Meadows NWR (MZ II), Sheldon-Hart Mountain NWRC (MZ V), and Clear Lake NWR (MZ V). Of these refuges, CCPs have been completed for Seedskadee (2002), Charles M. Russell NWR and UL Bend NWR CCP (2012), Sheldon CCP (2012), and Cokeville Meadows NWR (2014). CCPs are underway for Hart Mountain NWR and Clear Lake NWR. In addition, Clear Lake NWR was a partner to the development of a 2008 Sage-grouse Conservation and Recovery Strategy for the Devil's Garden/Clear Lake Population Management Unit in NE California (Clear Lake Sage-Grouse Working Group 2008). All of the completed CCPs include sage-grouse specific conservation objectives and management direction (see **Regulatory Mechanisms** section, below).

Table xx. Summary of National Wildlife Refuge System lands known to be used by sage-grouse. Source of lek data and population estimates (USFWS unpublished report 2012), unless otherwise noted.

Refuge	**MZ**	**Modeled Breeding Distribution**		**# of Leks**	**Population Estimate**
		Acres	**% of MZ**		
Charles M. Russell NWR and UL Bend NWR	I	115,226	1	40[a]	Unk - Highest single morning count was 168
Bowdoin NWRC	I	0	0	0	Unk –Individuals regularly sighted at some units
Red Rock Lakes	I	7,858	<1	2	Unk

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NWR					
Seedskadee NWR	II	0	0	0	500-1,000, seasonally (wet meadow habitat)
National Elk Refuge	II	7,967	<1	Unk	25-50
Arapaho NWRC	II	16,913	<1	1	Unk
Cokeville Meadows NWR	II	4,646	<1	Unk	200-300
Ruby Lake NWR	III	8,287	<1	Unk	60
Sheldon-Hart Mountain NWRC	V	204,132	9	132[b]	2,780[b]
Malheur NWR	V	2	<1	0	Unk - Occasional sightings
Clear Lake NWR	V	6,413	<1	Unk	200

[a] Total recorded since 1974
[b] Source: Collins (2013, 2014).

Department of Defense

There are approximately 87 Department of Defense (DoD) managed facilities distributed across the sage-grouse MZs (Connelly et al. 2004); however only 9 of these facilities overlap with the range of sage-grouse, and combined, encompass <1 percent of the currently estimated sage-grouse range.

Eight military installations have confirmed sage-grouse presence, six of which are under the control of the Army: Yakima Training Center (Washington), Dugway Proving Ground (Utah), Sheridan Training Area (Wyo.), Camp Guernsey (Wyo.), Hawthorne Army Depot (Nev.), and the Toole Army Depot (Utah). Two Air Force Bases (AFB) manage for known populations: Nellis AFB in Nevada and Mountain Home AFB, which administers the Saylor Creek and Juniper Butte Ranges in Idaho (U.S. Department of Defense and U.S. Fish and Wildlife Service, 2006). With the exception of MZ VI, DoD lands represent less than 0.5% of the land within the range of sage-grouse within each MZ. Within MZ VI, the Joint Lewis-McChord Yakima Training Center (JBLM YTC), formerly called the Yakima Training Center, makes up 11.8% of the range of sage-grouse in MZ VI and 17.1 of the distribution of sage-grouse in that MZ.

The U.S. Department of Defense (DoD), with the assistance of the U.S. Fish and Wildlife Service (FWS) and the states, is responsible under the Sikes Act (16 U.S.C. 670a-670f, as amended) for carrying out programs and implementing management strategies to conserve and protect biological resources on its lands. Because military lands and waters often are protected from human access and impact, they contain some of our nation's most significant remaining large tracts of land with valuable natural resources. Congress established the Sikes Act in 1960 to manage these lands for wildlife conservation and human access. The Sikes Act was amended in 1997 to develop and implement mutually agreed upon Integrated Natural Resource Management Plans (INRMPs) through voluntary cooperative agreements between the DoD installation, FWS, and the respective state fish and wildlife agencies.

INRMPs are planning documents that allow DoD installations to implement landscape-level management of their natural resources while coordinating with various stakeholders. They help ensure military operations and natural resources conservation are integrated and consistent with stewardship and legal requirements. Management of greater sage-grouse and its habitat at JBLM

YTC is dictated by management direction described in their Western Sage Grouse Management Plan (1998 ENRD YTC), which is tiered to their Cultural and Natural Resource Management Plan (CNRMP) (2002 ENRD YTC), combined with changes contained in the Fort Lewis Army Growth and Force Structure Realignment Record of Decision (2011) (also known as "Grow The Army" or GTA). The 2002 CNRMP is currently being updated into a newer Integrated Natural Resource Management Plan, but is not yet final. Provisions in the draft INRMP that offset threats for JBLM YTC are provided in the **Military Activities** and **Regulatory Mechanisms** sections, below.

Department of Energy

There are only two DOE facilities within the range of the greater 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 (2,603 acres) and overlays <1,000 acres of modeled breeding distribution, whereas the INEL covers over 0.5 million acres with 1.5% of the modeled breeding distribution in MZ IV.

The INL developed a Sage-grouse Conservation Framework in cooperation with the State of Idaho, Sage-grouse local working groups, and FWS. The Conservation Framework designates a Sage-grouse Conservation Area (SGCA) and associated conservation measures that address threats to GRSG on the INL. The SGCA encompasses 326,229 acres or approximately 57 percent of the INEL lands, protecting 74 % of the breeding males. We worked with INEL to formalize this Conservation Framework in a Candidate Conservation Agreement, which was completed in October 2014. While there are minor differences in conservation measures from those proposed in the Idaho and Southwest Montana Subregional EIS, the INL CCA ensures that there will be consistent conservation outcomes where INL jurisdiction ends and BLM jurisdiction begins. The CCA also employs monitoring methods, and adaptive management strategies similar to those described in the BLM's RMPs, and includes a commitment to retain greater than 80 percent of the sagebrush cover within the SGCA.

National Park Service

There are 11 National Park System units that intersect with the range of the greater sage-grouse, but only 6 that overlap with the modeled breeding distribution of sage-grouse (Table xx). 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 40,000 acres), and Craters of the Moon National Monument and Preserve (>200,000 acres of modeled breeding habitat; part of which is managed by BLM). Grand Teton National Park only comprised 0.3% of modeled distribution of sage-grouse in MZ II, while Craters of the Moon

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National Monument and Preserve comprised 2% of the modeled distribution of sage-grouse in MZ IV.

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Wilderness and Protected Areas

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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 (see below), but make up less than 1% of the occupied range of greater sage-grouse (Knick 2011, p. 28).

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Wilderness

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Lands under various federal ownerships (e.g., BLM land, National Forests, National Parks and Monuments, or USFWS refuges) can be designated wilderness under The Wilderness Act of 1964 (Public Law 88-777 (16 U.S.C. 1131-1136)). According to The Wilderness Act, a wilderness, in contrast with those areas where man and his works dominate the landscape, is recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value. With limited exceptions, and subject to existing private rights, wilderness designations prohibit development, commercial operations, roads, and use of motorized equipment.

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Wilderness Study Areas

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Wilderness Study Areas (WSAs) contain undeveloped lands that retain their primeval character without human habitation, and are managed to preserve their natural character until congress acts to either designate these lands as wilderness or remove the protective management. The BLM is required by Congress to manage each WSA consistent with the direction provided in Section 603(c) of FLPMA (commonly called the "Interim Management Policy for Lands Under Wilderness Review (or IMP)). In general, BLM is required to maintain the wilderness characteristics of each WSA until Congress decides whether it should either be designated as wilderness or should be released for other purposes.

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The guidance for managing each WSA is provided in the IMP Manual (8550, July 5, 1995). The general management standard is that the suitability of the WSAs for preservation as wilderness must not be impaired. Valid existing rights are recognized, and grandfathered uses such as grazing and mineral uses are allowed but restricted to the same manner and degree as on the date FLPMA was approved. While many activities are allowed within WSAs, some have specific restrictions. For example, recreation vehicle use off existing travel routes and issuing new

Formatted: Font: Times New Roman, 12 pt mineral leases are not allowed. Most primitive recreation activities are allowed and are encouraged. These include hiking and camping, backpacking, fishing and hunting, rock hounding, boating (with or without motors), horseback riding, and the use of pack animals.

National Monuments

The Antiquities Act of 1906 grants the President authority to designate national monuments in order to protect "objects of historic or scientific interest." While most national monuments are established by the President, Congress has also occasionally established national monuments protecting natural or historic features. Most monuments are managed by the National Park Service (NPS), however, both Congress and the President have created monuments managed by other agencies.

The overriding management goal for all monuments is protection of the objects described in the proclamations. Monument designation can limit or prohibit land uses, such as development or recreational uses. Limitations or prohibitions may be included in the proclamations themselves, accompanying administration statements, management plans developed by the agencies to govern monument lands, agency policies, or other sources. In general, existing uses of the land that are not precluded by the proclamations, and do not conflict with the purposes of the monument may continue.

Most of these monument proclamations have barred *new* mineral leases, mining claims, prospecting or exploration activities, and oil, gas, and geothermal leases, subject to valid existing rights (Congressional Research Service 2010). This has been accomplished by language to withdraw the lands within the monuments from entry, location, selection, sale, leasing, or other disposition under the public land laws, mining laws, and mineral and geothermal leasing laws. However, other uses have continued at some national monuments – for example, grazing is still permitted on BLM-managed lands in Craters of the Moon National Monument.

Tribal Lands

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

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State Lands

State lands cover approximately 5% of the current sage-grouse range. MZs with the greatest percent of state land within the range of the sage-grouse are the Colorado Plateau (11%), Great Plains (8%), Columbia Basin(7%), Wyoming Basin (6%), and Snake River Plain (5%).

State lands are subdivided into several categories, including State Trust Lands, State Parks, State Wildlife Areas, all of which have different management goals and objectives. State trust lands are the most common form of state-owned land within the range of sage-grouse. Trust lands are the result of land grants made by the federal government to western states, mostly at the time of statehood, for the purpose of generating revenue to support schools and other public institutions (Culp et al. 2006, p.14). In California and Wyoming neither their enabling acts nor their constitution impose any trust responsibilities on the state, although Wyoming holds its lands in trust pursuant to the direction of the state legislature (Culp et al. 2006, p. 17). The land grants usually consisted of several one-square-mile sections in each township, creating a checkerboard pattern of state trust lands throughout the West (Culp et al. 2006, pp. 4-5; Figures xx-xx).

State trust lands in the western U.S. are primarily used for grazing or agriculture (Culp et al. 2006, p. 12). Other uses include: timber harvest, and oil and gas leases (Culp et al. 2006, p. 14). The traditional sole emphasis on maximizing short-term revenues has, in some cases, given way to recognition of non-financial returns (e.g., ecosystem services), that can directly or indirectly provide some protection to natural resources (Loomis 2002, p. 29). However, landscape-scale information on the various uses across state trust land parcels in the western U.S. has not been compiled, so without regulatory mechanisms that explicitly prohibit certain activities, it is not possible to summarize whether threats to sage-grouse and their habitat on these lands have been ameliorated (see **Regulatory Mechanisms** section, below).

State Wildlife Areas are generally established to protect wildlife habitat but remain available for hunting, fishing and other public enjoyment of wildlife. Congress made it possible to protect these habitats and secure public access with passage of the Pittman-Robertson Act in the late 1930's, which placed a federal manufacturer's excise tax on hunting arms and ammunition. These funds are allocated to each state based on the number of hunting licenses sold and size of the state. Although many areas offer a variety of non-hunting opportunities such as hiking, viewing and fishing, most funding is provided through the federal Pittman-Robertson program financed by hunters and shooting sports enthusiasts.

State Parks management varies by state, but these areas were generally established to protect and restore native ecosystems while providing recreational opportunities.

Private Lands

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

Settlers in the arid west overwhelmingly selected land that held temporary or persistent wet habitats (Sage Grouse Initiative 2014). Privately owned lands are characterized by deeper soils and greater ability to store water in each management zone when compared with public lands (Knick 2011, p. 24). A landscape study in Oregon, California, and western Nevada in sage-grouse habitat showed that while wet habitats made up only 1 to 2% of the land area, 81% of that area was in private ownership (Sage Grouse Initiative 2014). Furthermore, the study found that in many areas, private lands provide key sage-grouse habitat components that are not available on adjacent public lands (Sage Grouse Initiative 2014). Thus, although private land is not the predominant ownership category in four of the seven management zones, these areas can be crucial for sage-grouse persistence because sage-grouse require these areas to complete their life-cycle (see **Sage-grouse Biology** section, above).

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 xx-xx) 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 10 mi^2 of land, to be distributed in alternate sections on each side of the track, for every 1 mile 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 20 mi^2 for each mile 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 below). Planning efforts that address private land management in sage-grouse habitats for other States are ongoing (see **Regulatory Mechanisms** section below).

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, and Candidate Conservation Agreements with Assurances (CCAAs). See the **Non-regulatory Conservation Efforts** section, below, for details regarding these programs.

Summary of Land Ownership by Management Zone

Management Zone I

Management Zone I spans eastern Montana, NE Wyoming, the Dakotas, Alberta, and Saskatchewan and is almost 70% in private ownership (Figure xx). Interspersed among the private lands are a checkerboard of state trust lands. Two large tribal reservations are present in the northern portion of the MZ, Fort Peck and Fort Belknap, making up almost 5% of the range of sage-grouse in the MZ; however, these reservations contain only about 0.05% of the modeled

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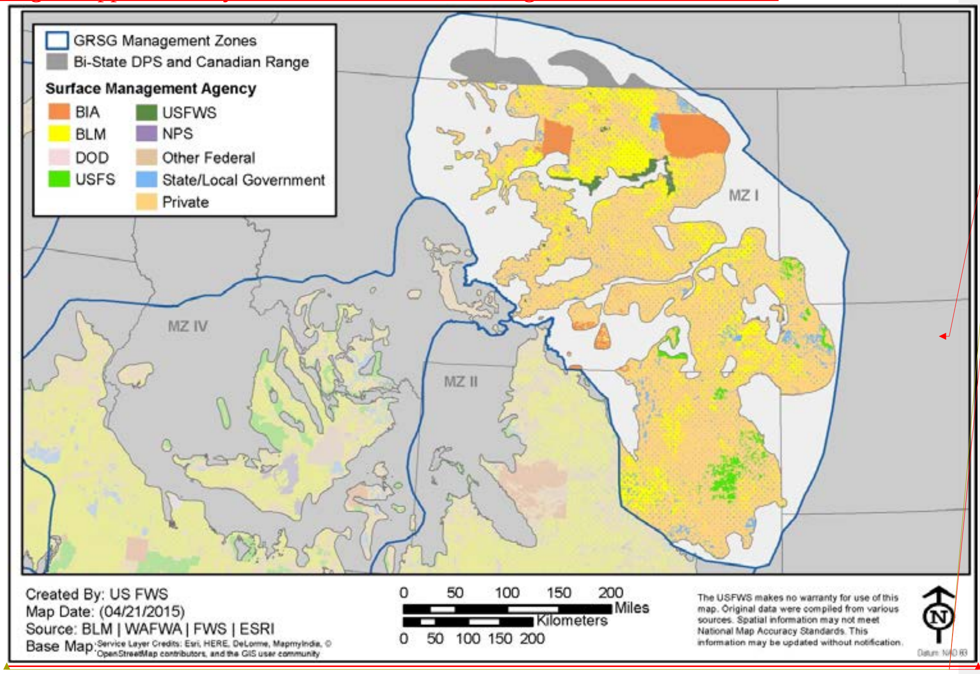
breeding distribution of sage-grouse within the MZ. BLM lands make up only 15% of the range of sage-grouse in the MZ, but account for 27% of the modeled breeding distribution in the MZ. The Charles M. Russell National Wildlife Refuge borders the Missouri River in this MZ, accounting for approximately 1% of the modeled breeding distribution in the MZ.



Management Zone II

MZ II includes central and southwest Wyoming, a small portion of southern Montana, northeast Utah, and northwest Colorado, with almost half of the land owned by BLM. Private lands predominate on the edges of this MZ and a checkerboard pattern of state trust lands is interspersed with BLM and private ownership. Along the Central Pacific Railroad corridor in southern Wyoming and northeast Utah, an even finer checkerboard pattern of private and BLM land is evident. The Wind River Indian Reservation, in central Wyoming, covers over 3% of the range of sage-grouse in the MZ, but encompasses <1% of the modeled breeding distribution of sage-grouse in the MZ. In west-central Wyoming, land occupied by the isolated Jackson Hole population is predominately within Grand Teton National Park, the Elk National Refuge (managed by USFWS), and the Bridger-Teton National Forest.

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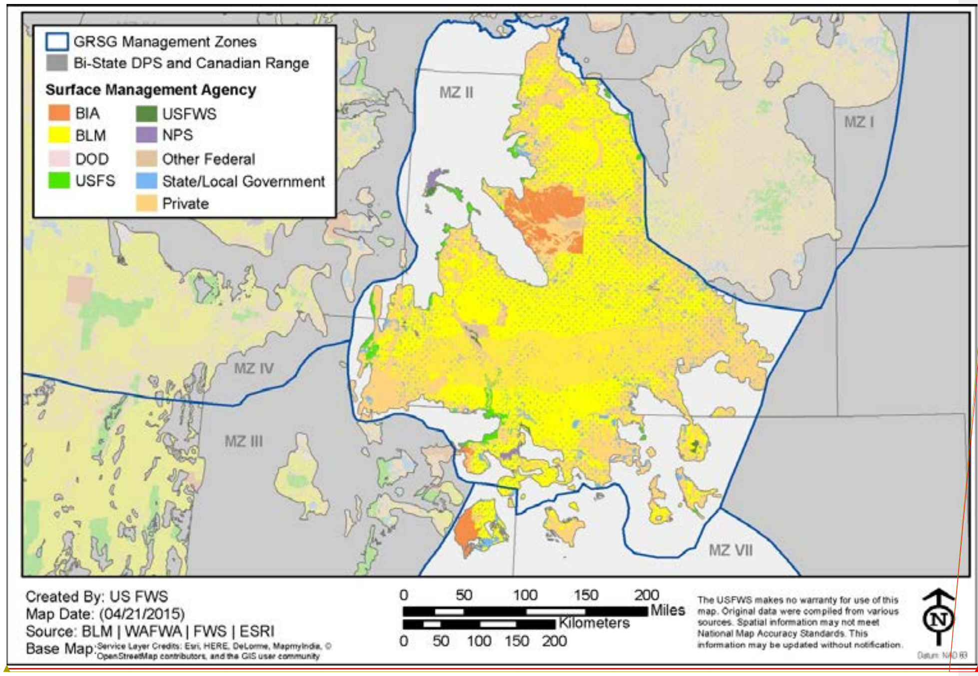

Management Zone III

Management Zone III includes portions of Nevada and Utah with 83% of the range of sage-grouse in the MZ owned by BLM and FS. Private lands in the MZ are limited to checkerboard ownership along the Central Pacific Railroad corridor in northern Nevada, and a few larger blocks of private ownership in northern and eastern Utah. State trust lands are interspersed in a checkerboard pattern with BLM lands in Utah, but not in Nevada. In addition there is a relatively large tract of state trust land in south-central Utah, called Parker Mountain, that provides habitat and population connectivity to one of the largest populations of sage-grouse in southern Utah. One of the few DoD facilities that overlap sage-grouse range is located at the southern edge of the MZ in Nevada, but this area contains little modeled sage-grouse breeding habitat. There are also a few tribal reservations in this MZ, but these lands are at the edges of the species' range within the MZ and provide little modeled breeding habitat.

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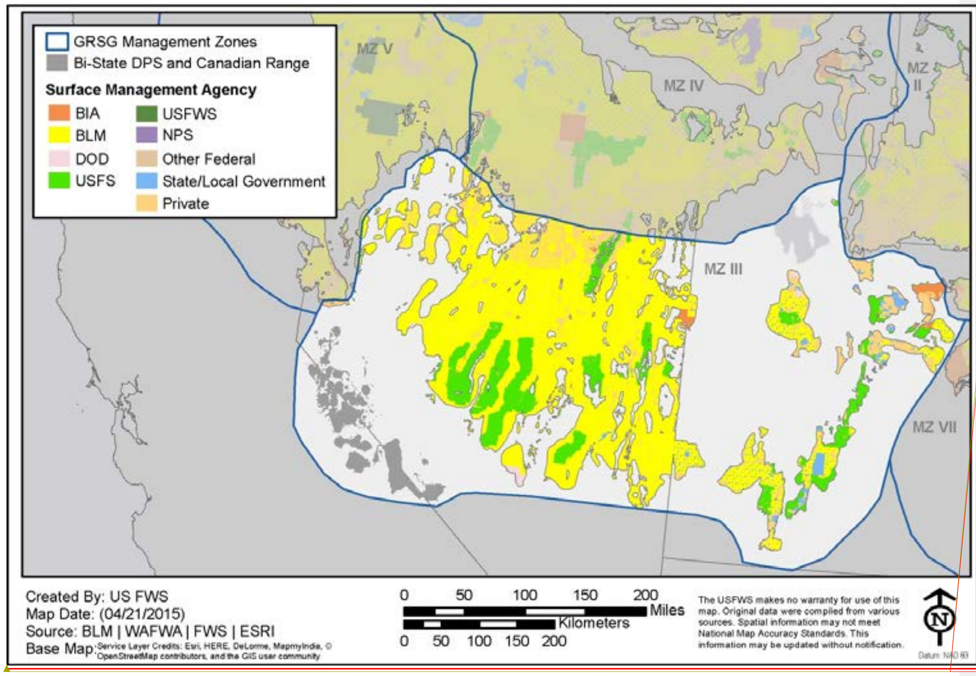

Management Zone IV

Management Zone IV spans six states and arguably has the most complex pattern of ownership among the sage-grouse MZs. Across the MZ, 63% of the range of sage-grouse in the MZ and 70% of the modeled breeding distribution in the MZ are in Federal ownership. However, the Belt Mountains, in the northeastern corner of the MZ (in Montana) are predominately privately owned, with State trust lands mixed in a checkerboard fashion. Southwest Montana and the Snake-Salmon Beaverhead populations (SW Montana and central Idaho) consist of a matrix of BLM lands mixed with some FS and private lands with State trust lands checkerboarded throughout; In addition, the Idaho National Energy Laboratory and Craters of the Moon National Preserve and Monument are two large landowners within this portion of the MZ. The area occupied by the relatively isolated Sawtooth population is almost entirely part of the Sawtooth National Recreation Area, owned by the FS. The East-central Idaho population, at the southeast corner of the MZ is a fragmented mix of private, State, tribal, and FS lands. The Weiser and Baker populations, located in west-central Idaho and northeast Oregon, respectively, are primarily comprised of private ownership mixed with some BLM lands. The largest population in the MZ, the Northern Great Basin population, spans southern Idaho, southeast Oregon, northern Nevada, and northwest Utah; this population is primarily in BLM ownership, with a checkerboard of State ownership in southern Idaho and northwest Utah, and several large tracts of FS lands. In addition this portion of the MZ also contains the Duck Valley Indian Reservation and a few large blocks of State ownership. The private/Federal checkerboard pattern of ownership along the Central Pacific Railroad corridor is also evident in Northern Nevada and northwest Utah.

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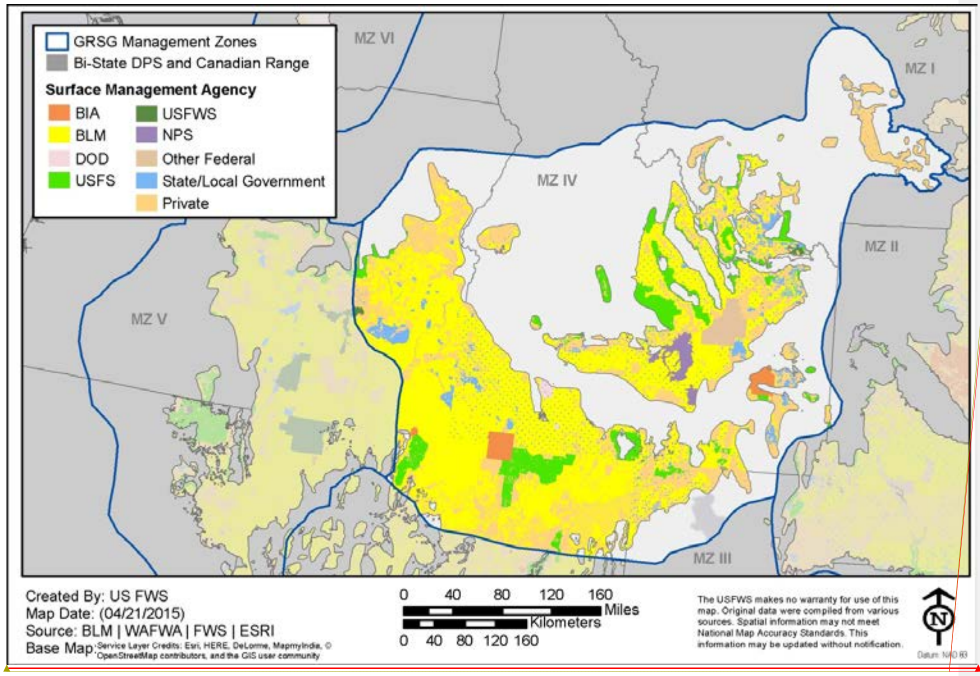

Figure xx. Surface land-ownership in MZ IV.

Management Zone V

Management Zone IV includes portions of southeast Oregon, northeast California, and northwest Nevada. It consists mostly of BLM and FS ownership, which covers almost 70% of the range of sage-grouse in the MZ and almost 80% of the modeled breeding distribution in the MZ. National Wildlife Refuge lands are an important and central components of this MZ, comprising approximately 5% of the range in the MZ and 9% of the modeled breeding distribution, most of which is due to Sheldon-Hart National Wildlife Refuge Complex. The Modoc National Forest, in northeast California, forms the most contiguous expanse of FS land in the MZ, with a few smaller and more fragmented patches of FS ownership located in Oregon. Private ownership is scattered throughout the MZ, with several large ranches in southeastern Oregon. State and Tribal lands collectively comprise <4% of the range of sage-grouse in the MZ and less than 2% of the breeding distribution.

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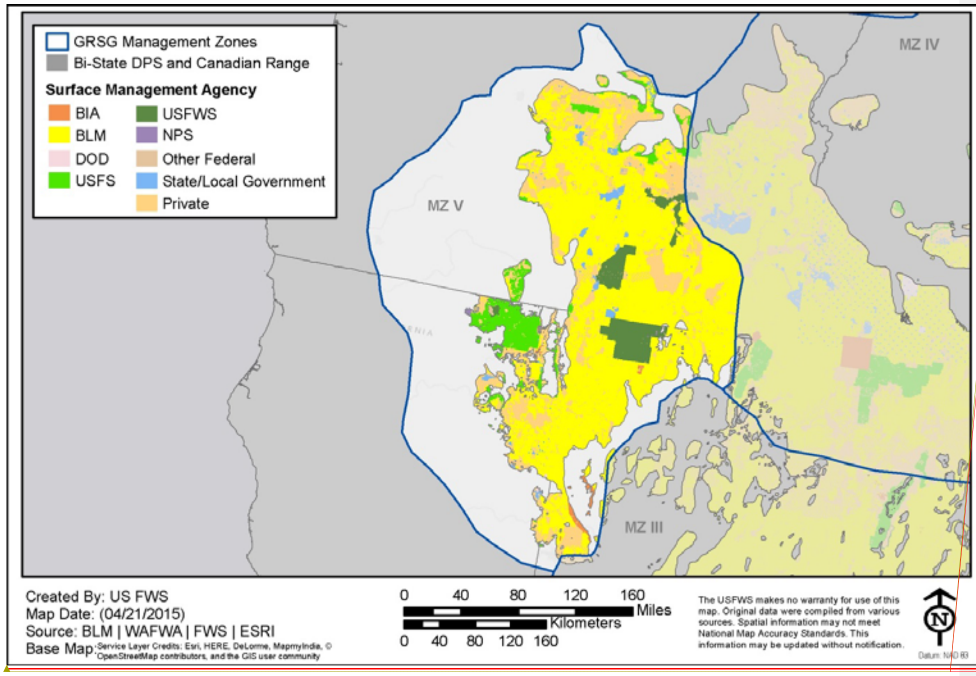

Management Zone VI

The range of sage-grouse in MZ VI is entirely within the state of Washington and is comprised of four units. The two northern units are predominately private land, with some state and BLM lands scattered throughout. The southern units consist almost entirely of the Yakima Training Center, owned by DoD, and the Yakama Indian Nation.

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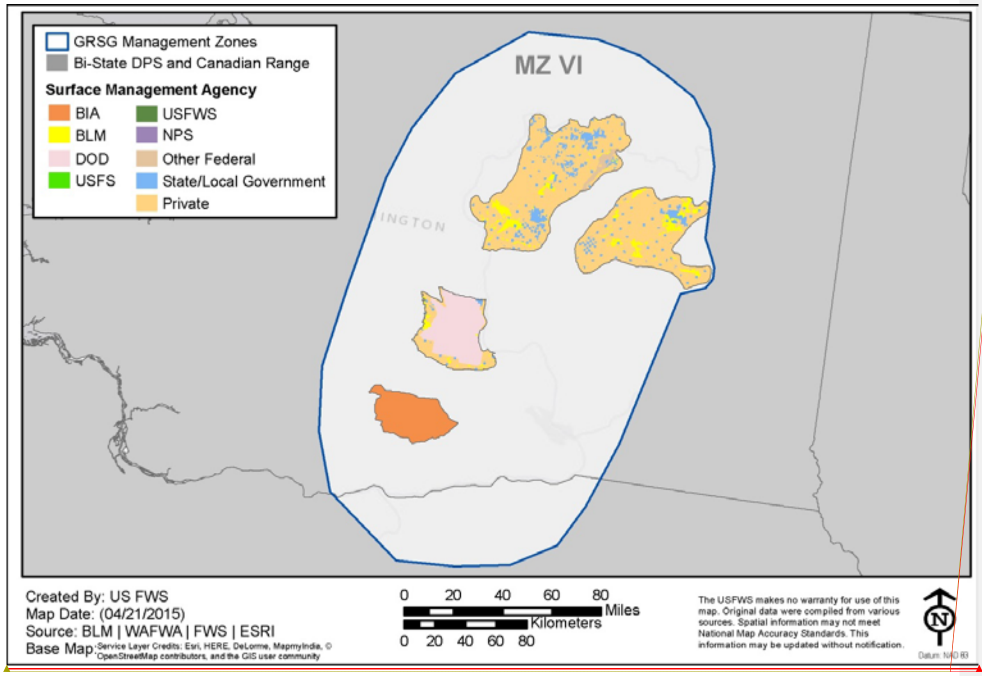

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Management Zone VII

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Management Zone VII, located in eastern Utah and northwest Colorado, contains only a small amount of the Greater Sage-grouse range. In Utah, this MZ is almost entirely in Tribal (Uintah and Ouray Indian Reservation), BLM, and State ownership, whereas in Colorado, the MZ is mostly in private ownership, although BLM also owns some land in this portion of the MZ. When viewed together, almost 70% of the modeled breeding distribution of sage-grouse in this MZ is in private ownership, and almost 20% is owned by BLM.

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APPENDIX

The National BLM/FS planning effort will amend or revise the following Resource Management Plans (RMP) and Land and Resource Management Plans (LRMP):

* indicates plans that are in the process of an amendment or revision but which have an anticipated completion date after September 2015 because they were not part of the national planning effort.

Great Basin Region

California

- Alturas RMP (2008)
- Eagle Lake RMP (2008)
- Surprise RMP (2008)

Idaho

- Birds of Prey NCA RMP (2008)
- Bruneau RMP (1983 Bruneau MFP)
- Challis RMP (1999)
- Craters of the Moon NM RMP (2006)
- Four Rivers RMP (revising 1988 Cascade and 1983 Kuna and Bruneau MFPs)
- Jarbidge RMP (1987)
- Lemhi RMP (1987)
- Owyhee RMP (1999)
- Pocatello RMP revision
- Shoshone-Burley RMP revision (revising 1980 Bennett Hills/Timmerman Hills, 1985 Cassia, 1975 Magic, 1985 Monument, 1981 Sun Valley, and 1982 Twin Falls MFPs/RMPs)
- Upper Snake RMP revision (and existing 1983 Big Lost, 1985 Medicine Lodge, 1981 Big Desert, and 1981 Little Lost-Birch Creek MFPs/RMPs)
- Boise National Forest LRMP (2003)
- Curlew National Grassland Management Plan (2002)
- Caribou National Forest Revised LRMP (2003)
- Caribou-Targhee National Forest, Targhee National Forest LRMP (1997)
- Salmon-Challis National Forest, Challis National Forest LRMP (1987)
- Salmon-Challis National Forest, Salmon National Forest LRMP (1988)
- Sawtooth National Forest Revised LRMP (2003)

Montana

- Dillon RMP (2006)
- Beaverhead-Deerlodge National Forest LRMP (2009)

Nevada

- Battle Mountain RMP revision (and existing 1997 Tonopah and 1986 Shoshone-Eureka RMPs)
- Black Rock Desert-High Rock Canyon NCA RMP (2004)

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- Carson City RMP revision (and existing 2001 Carson City Consolidated RMP)
- Elko RMP (1987)
- Ely RMP (2008)
- Wells RMP (1985)
- Winnemucca RMP revision (and existing 1982 Paradise-Denio MFP and 1982 Sonoma-Gerlach RMP)
- Humboldt National Forest LRMP (1986)
- Toiyabe National Forest LRMP (1986)

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Oregon

- Andrews RMP (2005)
- Baker RMP revision (and existing 1989 Baker RMP)
- Brothers-LaPine RMP (1989)
- Lakeview RMP amendment (and existing 2003 Lakeview RMP)
- Southeastern Oregon RMP amendment (and existing 2003 Southeastern Oregon RMP)
- Steens RMP (2005)
- Three Rivers RMP (1992)
- Upper Deschutes RMP (2005)

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Washington

- Eastern Washington RMP (revising 1987 Spokane RMP)*

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Utah

- Box Elder RMP (1986)
- Cedar/Beaver/Garfield/ Antimony RMP (1986)
- Grand Staircase-Escalante National Monument Management Plan (2000)
- House Range RMP (1987)
- Kanab RMP (2008)
- Park City Management Framework Plan (MFP) (1975)
- Pinyon MFP (1978)
- Pony Express RMP (1990)
- Price RMP (2008)
- Randolph MFP (1980)
- Richfield RMP (2008)
- Salt Lake District Isolated Tracts Planning Analysis (1985)
- Vernal RMP (2008)
- Warm Springs RMP (1987)
- Dixie National Forest LRMP (1986)
- Fishlake National Forest LRMP (1986)
- Uinta National Forest Revised LRMP (2003)
- Wasatch-Cache National Forest Revised LRMP (2003)
- Ashley National Forest LRMP (1986)
- Manti-La Sal National Forest LRMP (1986)

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Rocky Mountain Region

Wyoming

- Casper RMP (2007)
- Kemmerer RMP (2010)
- Newcastle RMP (2000)
- Pinedale RMP (2008)
- Rawlins RMP (2008)
- Green River RMP (1997) (being revised under the Rock Springs RMP)
- Bridger-Teton National Forest LRMP (1990)
- Medicine Bow National Forest LRMP (2003)
- Thunder Basin National Grassland LRMP (2002)
- Buffalo RMP (1985)
- Bighorn RMP (2011)
- Lander RMP (1987)

Colorado

- Glenwood Springs RMP (1984)
- Grand Junction RMP (1987)
- Kremmling RMP (1984)
- Little Snake RMP (2011)
- White River RMP (1997)
- Routt National Forest LRMP (1997)

Montana

- Lewiston RMP (amending Judith RMP (1994) and Headwaters RMP (1984))
- Billings and Pompeys Pillar National Monument RMP (amends Billings RMP (1984))
- HiLine RMP (amends Judith Valley Phillips RMP (1994) and West HiLine RMP (1988))
- Miles City RMP (amends Big Dry RMP (1996) and Powder River RMP (1985))

The Dakotas

- North Dakota RMP (1988)
- South Dakota RMP (1986)
- Dakota Prairie Grassland LRMP (2001)*

~~*1995 to 2007 - due to sample sizes, only data from this time period were used.~~
~~1985 to 2007 - due to sample sizes, only data from this time period were used.~~**
~~*1975 to 2007 - due to sample sizes, only data from this time period were used.~~**

~~Garton *et al*.'s (in press, p. 71) analyses indicated that estimates of populations of sage-grouse were 20 to 80 percent larger than the estimated carrying capacities (where population size statistically has a growth rate of 0 (Garton *et al*. in press, p. 17)) for those areas. This may be the result of a carrying capacity estimate that is not an absolute upper limit of growth rate, but rather a range of in which growth rates may fluctuate, distribution being skewed or reflect a delayed density-dependent response by the populations (Garton *et al*. in press, p. 71). Several populations analyzed by Garton *et al*. (in press, p. 71) demonstrated a 1- to 2-year delay in population response to habitat conditions. This result is consistent with field observations in Montana and Wyoming where sage-~~

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grouse continued to be observed for 3 to 4 years after disturbance resulted in unsuitable habitat conditions (Walker *et al*. 2007a, p. 2652). The delayed response is likely the result of the high site fidelity demonstrated by sage-grouse.

In summary, since neither pre-settlement nor current numbers of sage-grouse are accurately known, the actual rate and magnitude of decline since pre-settlement times is uncertain. However, three groups of researchers using different statistical methods (but the same lek count data) concluded that rangewide greater sage-grouse have experienced 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). A recent increase in the annual rate of change for MZ VII may simply be an anomaly of small population numbers, as other indicators suggest this area is suffering habitat losses. A delayed response of sage-grouse to changes in carrying capacity was identified by Garton *et al*. (in press, p.71).

Scale of Analysis for the Species Report

Given that the threats to sage-grouse vary in presence and intensity across its range the scale of analysis is tiered to the biologically meaningful units for threat presence and intensity. Analyses of threats will occur at the range-wide scale, as well as regions (Rocky Mountain and Great Basin), and the WAFWA Management Zone scale. Because some threats are localized within a Management Zone, these zones were selected as the minimum extent that modeling was feasible. Where more refined information was available for qualitative analyses, those reviews were based on smaller biologically-based units, such as populations or groups of populations within a MZ. Analysis at the PAC level is complicated by the sheer number of units (> 300) and their lack of common spatial resolution given their origination with differing state mapping efforts. Nonetheless, where feasible summary statistics or narratives for each population that describe the level of threat and/or protection/conservation within the population and PACs will be presented. Losses of individual PAC polygons will be considered in determining the status of overall given population.

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