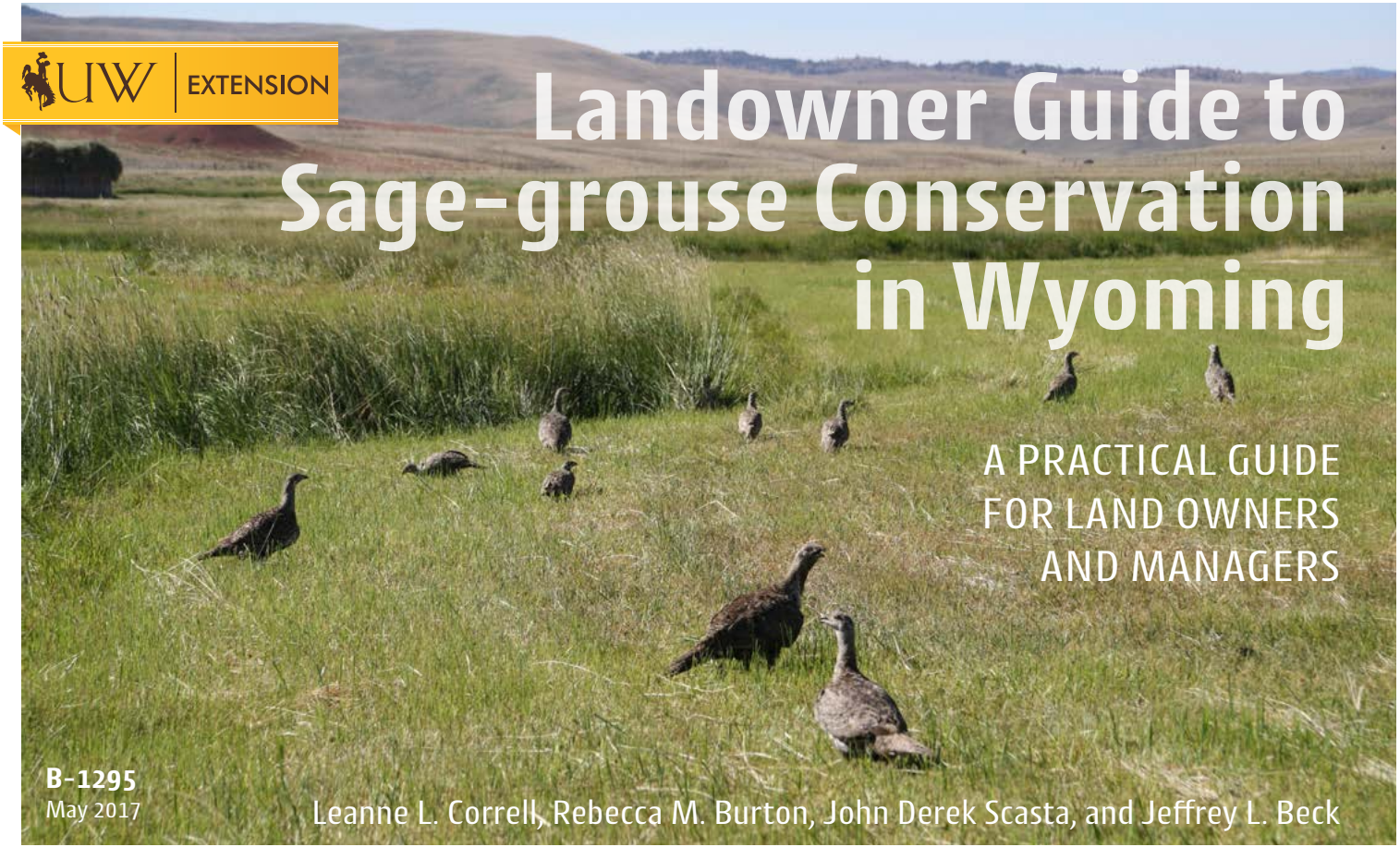

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Landowner Guide to Sage-grouse Conservation in Wyoming

A PRACTICAL GUIDE FOR LAND OWNERS AND MANAGERS

B-1295
May 2017

Leanne L. Correll, Rebecca M. Burton, John Derek Scasta, and Jeffrey L. Beck

Acknowledgments

Our experience working with Wyoming landowners and land managers while implementing the Greater Sage-Grouse Umbrella Candidate Conservation Agreement with Assurances for Wyoming Ranch Management was our catalyst for developing this guide. Furthermore, sage-grouse conservationists in Wyoming were using the *Idaho Sage-Grouse Habitat in Idaho: A Practical Guide for Landowners*. We thus made the decision to develop a guide for Wyoming patterned after guides created for Idaho.

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Cover photo: Sage-grouse broods along irrigation ditches in cut hay (Leanne Correll)

Contents

Males and females on a lek

Leanne Correll

Foreword

The greater sage-grouse is a charismatic bird of the West that has become an iconic symbol for the health of critical western sagebrush habitats that span 173 million acres. Sage-grouse are dependent on the sagebrush ecosystem for every life stage. They occupy large landscapes with some migratory birds moving tens of miles between seasonal ranges. Wyoming is a stronghold for this umbrella species with 25% of the range-wide habitat and 37% of the known range-wide male populations – the most for any state. Wyoming also has more leks (i.e., strutting or breeding grounds) than any other state. From a ranch management standpoint, maintaining functioning sagebrush steppe is good for ranches, sage-grouse conservation, for rural western economies, and for many other sagebrush ecosystem organisms, such as songbirds and small mammals. Approximately 350 vertebrate wildlife species that inhabit sagebrush may also benefit from greater sage-grouse conservation.

Sagebrush ecosystems are complex and so are the efforts to conserve sage-grouse. Those who own or manage sage-grouse habitat play a critical role in conserving this species in Wyoming, and this guide is intended to provide a concise source of science-based information about the greater sage-grouse and the habitat required for its continued survival in a dynamic human-impacted environment.

The number of publications and resources on greater sage-grouse is extensive. Select references for more detailed information are included only as a guide and do not represent an exhaustive list.

Identification

Wyoming is home to eight gamebird species in the family *Phasianidae*, which broadly includes grouse, partridges, pheasants, quails, and turkeys. This avian family includes important upland birds, many of which are notable for their elaborate courtship displays and many hold special interest for recreationists.

Within Wyoming, one may observe chukar (*Alectoris chukar*), dusky grouse (*Dendragapus obscurus*), gray partridge (*Perdix perdix*), greater sage-grouse (*Centrocercus urophasianus*), ring-necked pheasant (*Phasianus colchicus*), ruffed grouse (*Bonasa umbellus*), sharp-tailed grouse (*Tympanuchus phasianellus*), and wild turkey (*Meleagris gallopavo*) (Orabona et al. 2012).

White-tailed ptarmigan (*Lagopus leucurus*) were once found in the Snowy Mountains of southeastern Wyoming. Chukar, gray partridge, and ring-necked pheasant are not native to North America but were introduced to the state. Wild turkey are native to North America but were first introduced to Wyoming in 1935 from New Mexico (WGFD 2016). Two subspecies of sharp-tailed grouse are found in Wyoming. Plains sharp-tailed grouse (*T. p. jamesi*) occur in grasslands in eastern Wyoming and populations of Columbian sharp-tailed grouse (*T. p. columbianus*) occupy habitat in Carbon County in south-central Wyoming and along the Idaho border in Teton County.

GREATER SAGE-GROUSE

The greater sage-grouse (*Centrocercus urophasianus*) is the largest species of grouse in North America. They are dark brownish-gray and speckled overall with a pale breast and black belly. Females are drab gray and plainly colored, while males have a more distinguishable black throat and black belly separated by a distinct white breast. Long, pointed tails are characteristic of both sexes. Females are typically smaller than males, weighing roughly 3 pounds, while adult males may weigh over 6 pounds.

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Female greater sage-grouse

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Strutting male greater sage-grouse

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Non-strutting male greater sage-grouse

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Greater sage-grouse tracks (L) and feather marks (R) in the snow

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Greater sage-grouse fecal pellets

Christopher P. Kirol

Greater sage-grouse nest

LOOK-ALIKES

National Park Service

Dusky Grouse *(Dendragapus obscurus)*

The dusky grouse is a large grouse but smaller than greater sage-grouse. They have a uniform grayish-blue color. Dusky grouse have a darker, rounded tail rather than a pointed tail like sage-grouse.

Prefers mixed forests with conifers and aspen, as well as clearings with understory shrubs. Inhabits northwest, southwest, and southeast Wyoming.

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Ruffed Grouse *(Bonasa umbellus)*

The ruffed grouse is a long-tailed, slender grouse. They have dark bars on flanks and a dark tail-band. Their color varies from gray to rufous, but bold bars are distinct.

Found in mixed wooded or deciduous areas with scattered clearings of dense brush. Also found near wet areas with dense understory. Inhabits northwest, southwest, and Black Hills of Wyoming.

Colorado Parks and Wildlife

Columbian Sharp-tailed Grouse *(Tympanuchus phasianellus columbianus)*

The Columbian sharp-tailed grouse is a medium-sized grouse with brownish-gray coloration and small white markings. They have a mostly white, wedge-shaped tail.

Prefers sagebrush-snowberry and mountain-foothills shrub habitat in the transitional zone (or ecotone) between forested and sagebrush-grass plant communities. Inhabits south-central Wyoming in southern Carbon County and a smaller population occurs in Teton County near Jackson along the Idaho border.

Royal Alberta Museum (NRCS)

Plains Sharp-tailed Grouse *(Tympanuchus phasianellus)*

Sharp-tailed grouse are smaller than female ring-necked pheasants. They have a pale, whitish pointed tail. Plumage pattern is spots, rather than bars.

Prefer grassy habitat where woodlands and prairies mix. Found in open grasslands near tree patches, especially aspen. Inhabit northeast, southeast, and north-central Wyoming.

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Female Ring-necked Pheasant *(Phasianus colchicus)*

Female pheasants are smaller than sage-grouse and have pale, sandy-brown coloration and a pale, unpatterned head. They have a long, pointed tail and unfeathered legs.

Found in large, open grassy areas and especially dry or irrigated agricultural fields. Inhabits suitable habitat across the state, with concentrations in northeast, southeast, and central Wyoming.

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Chukar Partridge *(Alectoris chukar)*

Chukar are much smaller than greater sage-grouse. They are pale gray with bold black bars on flanks and a black border on the throat. Red bill and legs with rufous outer tail feathers.

Prefers dry, rocky slopes with scattered grass and brush. Inhabits suitable habitat in western and north-central Wyoming and portions of eastern Wyoming near Buffalo and Kaycee.

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Gray Partridge *(Perdix perdix)*

The gray partridge is medium-sized, slightly smaller than a chukar and much smaller than a greater sage-grouse, but larger than a quail. They are gray-brown with cinnamon-colored bars on flanks and a dark belly patch. Outer tail feathers are orange-rufous colored.

Found in disturbed prairies and agricultural land. Inhabits northeast, central, and into southeast Wyoming.

For more information on bird biology and range, see WGFD 2010, Orabona et al. 2012, Sibley 2014 or Audubon Guide to North American Birds (http://www.audubon.org/field-guide/bird/).

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Greater Sage-Grouse and Conservation Planning

HISTORIC AND CURRENT RANGE

The greater sage-grouse inhabits portions of 11 western states (California, Colorado, Idaho, Montana, North Dakota, South Dakota, Nevada, Oregon, Utah, Washington, and Wyoming) and two Canadian provinces (Alberta and Saskatchewan).

The total historical habitat may have encompassed more than 463,509 square miles (Figure 1). One estimate suggests sage-grouse habitat has decreased by roughly 56% from its historic range (Schroeder et al. 2004). This decline is due to a variety of factors, but the main threat is habitat loss due to fragmentation and surface disturbance. Figure 2 identifies the surface ownership or management of Wyoming lands.

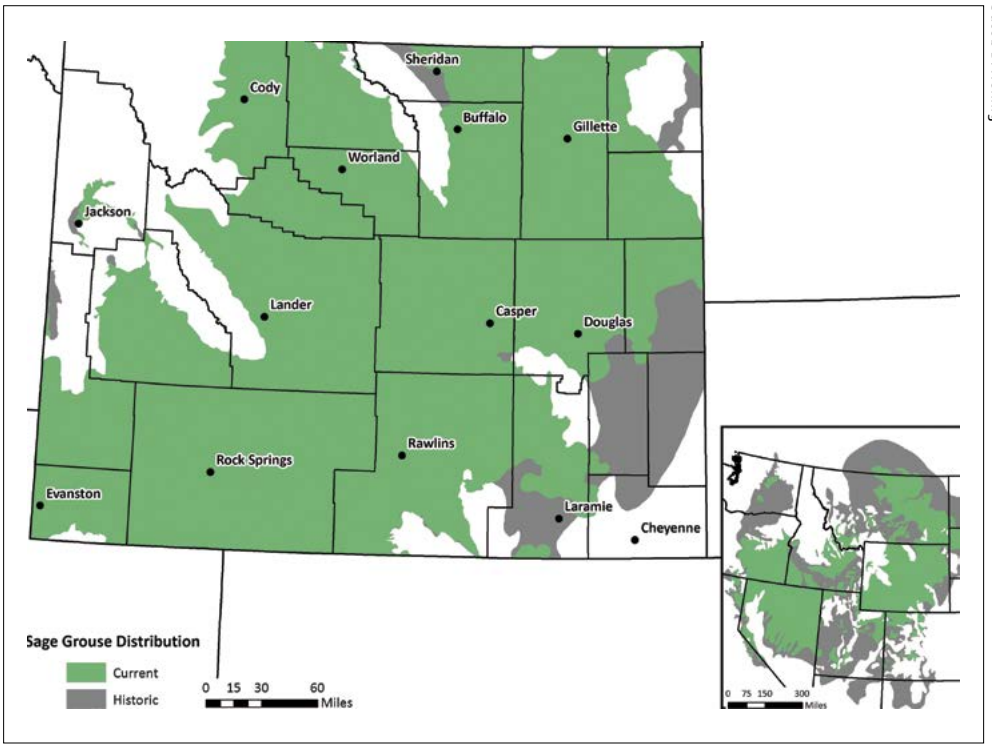

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Figure 1. Current (green) and historic (gray) range of greater sage-grouse in Wyoming. Inset shows rangewide distribution.

POPULATION DECLINE AND THREATS IN WYOMING

Sage-grouse habitat has remained relatively intact in Wyoming, allowing the species to remain widespread across the state; however, as in other western states, populations have declined. Habitat fragmentation – the overall loss of habitat caused by the division of large, continuous habitat into smaller, isolated pieces – is considered the primary cause for greater sage-grouse decline across its range, as well as in Wyoming.

Historically, sagebrush ecosystems were lost to agriculture conversion, infrastructure associated with human development, improper livestock grazing, direct removal of sagebrush, infrastructure associated with energy development, and dam construction, all of which are important to local and state economies. Ecological change associated with reduced fire frequency has also led to considerable loss of sage-grouse habitats, particularly in the western portion of sage-grouse range. Altered fire frequency has led to conifer encroachment into sagebrush at higher elevations and invasion of

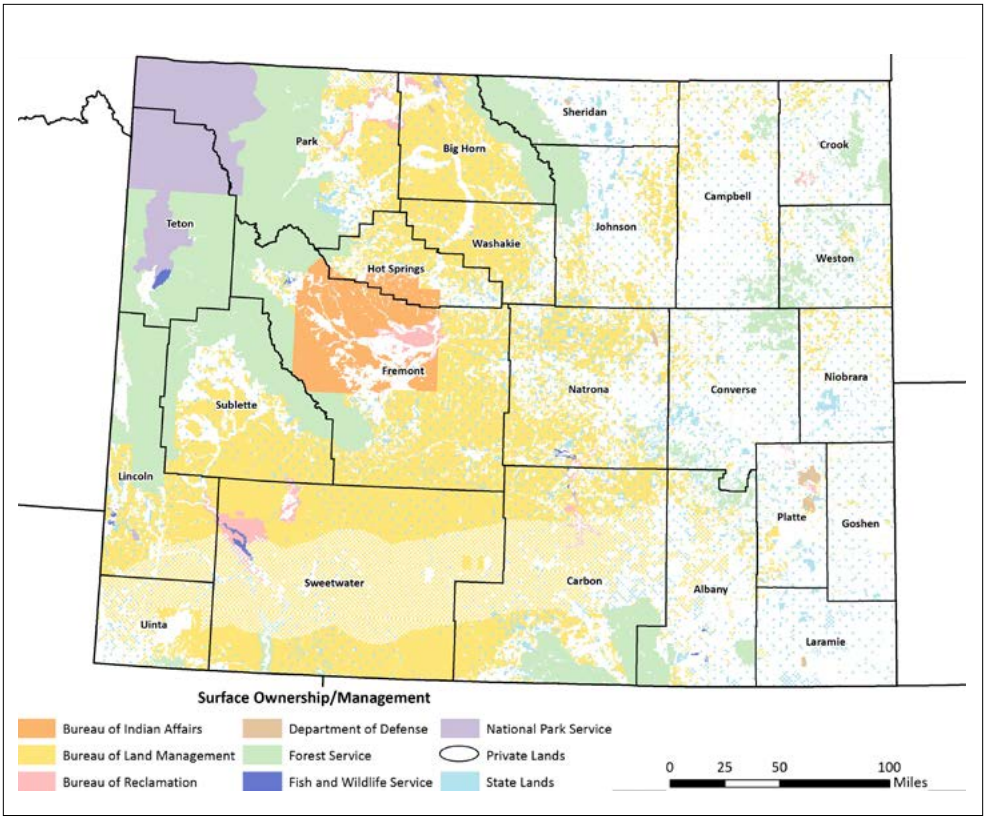

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Figure 2. Wyoming surface ownership / management

cheatgrass and other annuals fueling increased fire frequencies in lower elevation sagebrush (Davies et al. 2011, Chambers et al. 2014).

Nearly half the state's surface is privately owned, 6% is owned by the state of Wyoming, and the remainder is owned by the federal government. Challenges for landscape-level conservation exist, as land management goals and greater sage-grouse conservation actions may be viewed differently from one land owner to another, which is an ongoing concern.

Infrastructure

Increasing human populations have led to a higher demand for extractive resources, exurban and other development, and thus, more infrastructure across landscapes. Infrastructure created for energy development can negatively impact greater sage-grouse populations through direct habitat loss and fragmentation caused by well pads and linear features such as roads, fences, pipelines, and transmission lines.

Roads cause direct mortality through collisions, create barriers to movement, and increase human access to areas and therefore, increase

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Fragmentation – Jonah natural gas field south of Pinedale, Wyoming. Image date: 7/6/2016

Google Earth

Fragmentation - Urbanization in the Daniel greater sage-grouse Core Area north of Daniel, Wyoming. Image date: 7/22/2014

Google Earth

Fragmentation – Jonah natural gas field south of Pinedale, Wyoming. Image date: 6/1/2014

dust and noise disturbance. In addition, ground predators often hunt along roads, providing easier access to sage-grouse nests, chicks, and adults in highly disturbed landscapes.

Transmission and electrical distribution lines create collision and electrocution hazards, can negatively impact lek attendance, and provide perch sites for avian predators such as ravens and raptors. Courtship behaviors and successful mating are indirectly affected by noise associated with anthropogenic (man-made) features. Some fences create a collision hazard as sage-grouse often fly low across sagebrush. Increased exurban housing development also fragments sage-grouse habitat and adds to potential predation from human-associated predators.

Disturbed habitat

Invasive species and fire cycle

Invasive plant species compete with native plant species, reducing space, nutrients, water, and light. Cheatgrass (*Bromus tectorum*) and medusahead wildrye (*Taeniatherum caput-medusae*), for example, directly contribute to sagebrush habitat loss for sage-grouse (Chambers et al. 2014, 2016). Higher precipitation decreases the ability of cheatgrass to compete with native plants for nutrients and moisture.

Fire can be harmful to sage-grouse habitat. Sagebrush (*Artemisia* spp.), which is critically important for sagebrush-obligate species such as sage-grouse, is extremely sensitive to fire. Most sagebrush dies when burned and can take many decades to re-establish. Thus, sage-grouse nesting and brood-rearing habitat is negatively altered by fire.

In general, as a sagebrush-obligate species, sage-grouse require large areas of sagebrush habitat to survive. Wildfire, amplified by cheatgrass, has converted ecosystems of sagebrush and native grasses into cheatgrass-dominated landscapes. This is an especially large problem in grassland areas of northeast Wyoming and portions of the Bighorn Basin where soils are less resilient to disturbance and less resistant to annual grass invasion (Chambers et al. 2016).

Prescribed fire has been implemented in some regions to enhance habitat for nesting and early brood-rearing, but it decreases important Wyoming big sagebrush cover for at least a few decades and does not provide long-term enhancement of forbs and grasses (Beck et al. 2011). The peak fire season in Wyoming generally is June through October, which overlaps with sage-grouse nesting and brood-rearing seasons.

Grazing

Properly managed livestock grazing is not a threat to sage-grouse and may benefit sage-grouse habitat. Sage-grouse have lived with domestic grazers in sagebrush ecosystems since the mid-to-late 1800s and with large native grazers, such as bison, for millennia. In the U.S. Fish and Wildlife Service's March 23, 2010, listing decision (75 FR 13910), it was determined that improper livestock grazing, as determined by local ecological conditions, may have negative impacts on greater sage-grouse seasonal habitats.

Mismanaged grazing seasons, stocking rates, and utilization levels are the main ways grazing can negatively impact sage-grouse. Improper grazing can degrade sagebrush systems by altering plant communities and soils. Overgrazing reduces perennial grass height and screening cover, which can increase

nest depredation. The consumption of forbs by grazers may reduce the amount of food available to hens prior to nesting; forbs provide food and cover for insects sage-grouse eat, as well as nutrients necessary for successful laying and rearing of chicks.

Managing grazing to ensure sagebrush persists, perennial bunchgrasses grow tall enough for screening cover, and forbs remain available will provide suitable habitat for sage-grouse. Properly managed grazing can be a valuable tool to maintain perennial vegetation, control invasive species and woody plant encroachment, and reduce wildfire risks. Sagebrush canopy with a healthy understory is crucial to successful sage-grouse nesting and brood-rearing.

For more information on grazing and grouse research, see Beck and Mitchell 2000; Crawford et al. 2004; Connelly et al. 2004; Cagney et al. 2010; Boyd et al. 2014.

Conifer encroachment

Conifer encroachment is an important factor contributing to the loss of sagebrush habitat in many areas of the West. Besides directly

John D. Scasta

Greater sage-grouse broods and livestock co-occurring in riparian habitat

reducing sagebrush habitat, the presence of conifers can cause indirect loss as sage-grouse avoid otherwise suitable habitat.

Conifer encroachment does not currently appear to be a significant factor affecting sage-grouse in most of Wyoming, except in localized areas, including the Bighorn Basin and southern and southwest Wyoming. Research has indicated, however, that sage-grouse across Wyoming tend to avoid conifer and other forested habitats during all seasons.

West Nile Virus

West Nile Virus (WNV) (family Flaviviridae, *Flavivirus*) is a relatively new source of mortality for greater sage-grouse. WNV was first detected within their range in 2002 and a mortality from a WNV-positive Wyoming greater sage-grouse was documented that same year. Sage-grouse show little resistance to WNV and some localized outbreaks have been devastating. WNV can simultaneously reduce chick, yearling, and adult populations.

The dominant vector for WNV transmission in sagebrush habitats is the mosquito *Culex tarsalis*. Many other species of mosquitoes are not vectors. Development and addition of artificial water sources, or those that create mesic (moist) zones around stock tanks or ponds, may contribute to an increase in WNV vectors but can be constructed or modified to reduce mosquito production. Chemical and biological mosquito control options are also available.

For more information on West Nile virus research, see Goddard et al. 2003; Naugle et al. 2004; Doherty 2007; Kilpatrick et al. 2007.

IMPORTANCE OF GREATER SAGE-GROUSE CONSERVATION

The greater sage-grouse is part of the fabric of our western culture, heritage, and landscape. They are an indicator of healthy, functioning sagebrush ecosystems. Sage-grouse are considered an umbrella species in sagebrush habitats because conserving their populations and habitats benefits some 350 other species, including songbirds, small mammals, and ungulates, in the sagebrush ecosystem.

Effective management of the bird is beneficial to grazers. A common saying across the West is "What's good for the bird is good for the herd." In many ways, the greater sage-grouse is the canary in the coal mine of the sagebrush ecosystem. Wyoming has the greatest population of greater sage-grouse across the range, supporting approximately 37% of the range-wide population (Doherty et al. 2010).

Wyoming has some of the largest leks, with as many as 400 males documented attending single leks (Patterson 1952); however, most leks have far fewer males in attendance. Figure 3 shows observed male attendance on leks in spring 2015 (all counts and surveys) averaged 30.8 males per lek, a 66% increase from 2014 but still 26% below the most recent peak in average male lek attendance in 2006 (WGFD 2015).

The groundwork for greater sage-grouse conservation in the West began in 1954 when the Western Association of Fish and Wildlife Agencies (WAFWA) formed a technical committee to monitor the distribution and abundance of sage-grouse. Formalized work for interstate coordination and cooperation began in 1995, with a full two-phase assessment completed in 2006 (Stiver et al. 2006). The resulting WAFWA Greater Sage-Grouse Conservation Strategy identified seven biologically-based greater sage-grouse management zones

(Figure 4), each with a unique management plan calling for continued collaboration and coordination across jurisdictional boundaries to support sage-grouse populations and habitats upon which they depend.

Management Zone II, Wyoming Basin, includes a substantial portion of Wyoming and the edges of four other states (Colorado, Idaho, Montana, and Utah). This area has been identified as one of two areas with the highest population connectivity (Knick and Hanser 2011). The U.S. Fish and Wildlife Service has identified this area as a stronghold for the species (USFWS 2014), with 37% of the rangewide population (Doherty et al. 2015).

The Powder River Basin and Thunder Basin in eastern Wyoming are part of Management Zone I, Northern Great Plains. Approximately 12% of the rangewide population occupies this area (Doherty et al. 2015).

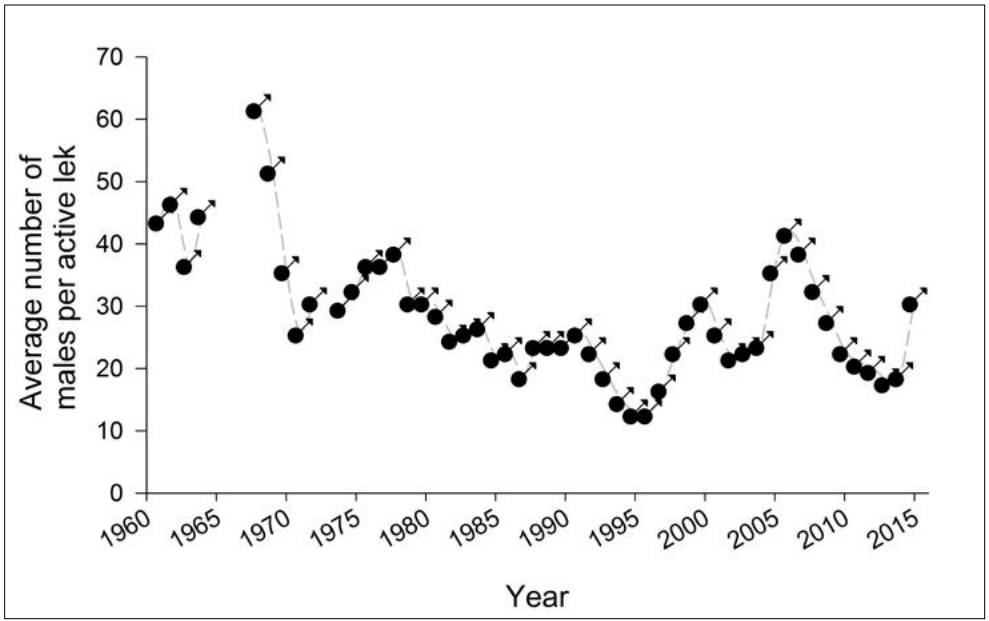

Figure 3. Long-term (1960–2015) trend in average number of male sage-grouse per lek with a minimum of 100 leks checked annually. Data not available for 1965, 1966, 1967, or 1973. (WGFD 2015)

WYOMING CONSERVATION PLANNING BACKGROUND

Wyoming took a leading approach to greater sage-grouse conservation in July 2000 when the Wyoming Sage-Grouse Working Group

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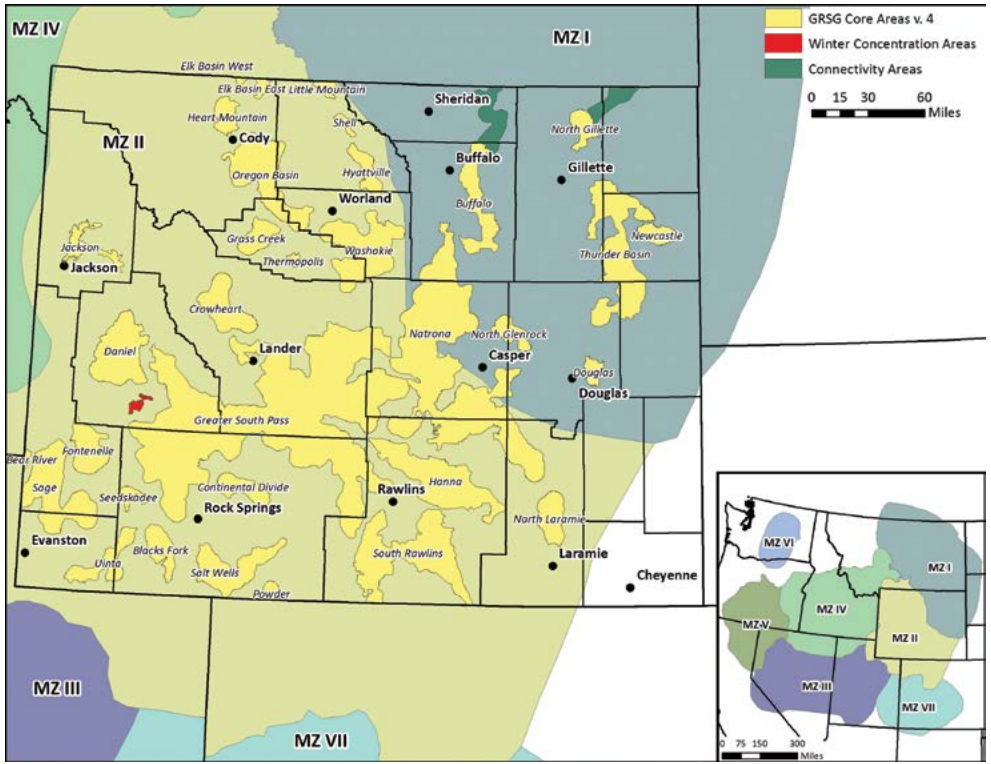

Figure 4. WAFWA management zones, Wyoming Core Areas v. 4, and greater sage-grouse connectivity and winter concentration areas

was formed to develop a statewide strategy for sage-grouse conservation. Innovative thinking and planning have occurred on public, state, and privately owned lands and many results distinguish Wyoming's landscape-scale approach to greater sage-grouse management and conservation. These include the following:

- The 2003 Wyoming Greater Sage-Grouse Conservation Plan
- Initiation of Local Working Groups
- The 2008 "Core Area" strategy (updated in 2010, 2011, and 2015)
- Density Disturbance Calculation Tool (DDCT)
- Statewide Greater Sage-Grouse Umbrella Candidate Conservation Agreement with Assurances (Umbrella CCAA) for Wyoming Ranch Management
- Statewide Greater Sage-Grouse Candidate Conservation Agreement for Range Management on Bureau of Land Management Lands in Wyoming (BLM CCA)

- Statewide Greater Sage-Grouse Candidate Conservation Agreement for Range Management on Lands Managed in Wyoming by the USDA Forest Service, Rocky Mountain Region (USFS CCA)
- Coordinated public lands management.

2003 Wyoming Greater Sage-Grouse Conservation Plan

Conservation planning efforts were initiated to an outline what is required to sustain or perpetuate populations. A Wyoming statewide comprehensive document was created by individuals representing many interests. The Wyoming strategy focused on implementation by Local Working Groups which later developed local plans. Goals, tasks, and Recommended Management Practices (RMPs) found in the 2003 Wyoming Plan were intended to guide planning and management efforts.

Local Working Groups

The role of the eight Local Working Groups (LWG) (Figure 5), after their formation was to adapt the statewide plan to the local area, accessed at https://wgfd.wyo.gov/Habitat/Sage-Grouse-Management, identify issues

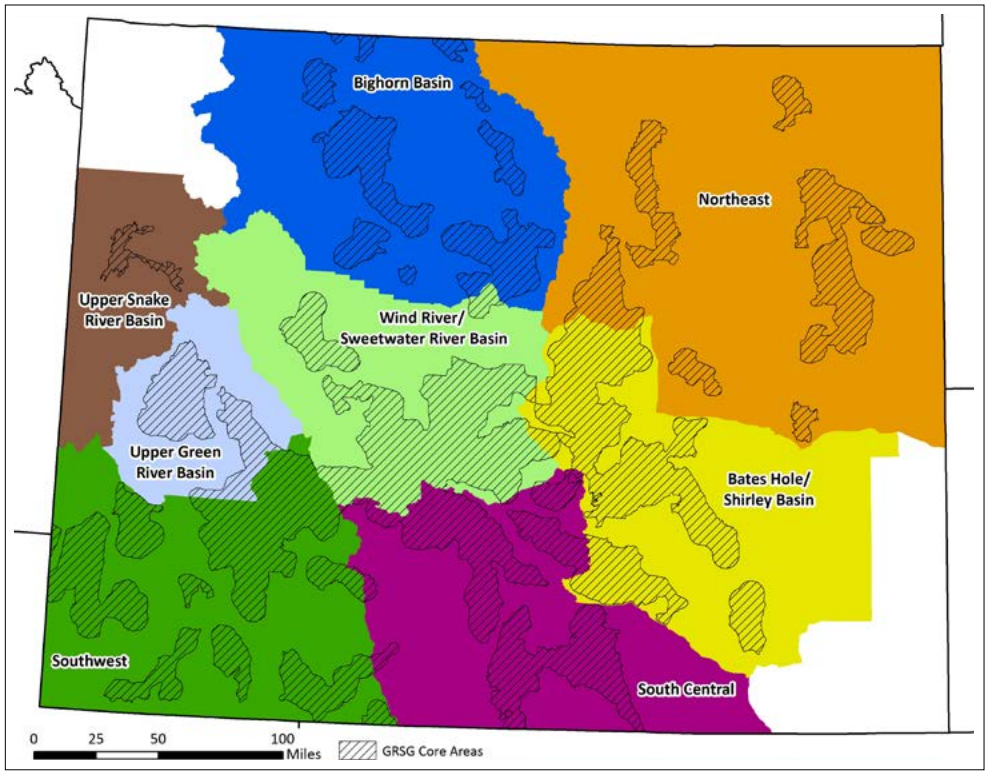

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Figure 5. Wyoming Greater Sage-Grouse Local Working Groups

that potentially impact greater sage-grouse populations on a local scale, and recommend steps to minimize those impacts. The LWGs have advanced and continue to advance the knowledge and conservation efforts both individually and collectively. The Wyoming Game and Fish (WGFD) provides yearly job completion report for each LWG area that are compiled with a state-wide report available on the WGFD website.

Core area strategy

To maintain and enhance greater sage-grouse populations and adequate sagebrush habitat, Wyoming developed and implemented a greater sage-grouse Core Population Area Protection strategy. An extensive process was used to identify areas where greater sage-grouse and their habitats could be most effectively conserved. Greater sage-grouse core population areas were identified that encompassed approximately 82% of the greater sage-grouse population on approximately 24% of the surface area of the state of Wyoming (unpublished data, WGFD, Gamo et al. 2013). Additionally, connectivity corridors and one winter concentration area important for continued sage-grouse populations were identified (Figure 4).

The "Core Area" strategy was initiated in 2008 and updated in 2010, 2011, and 2015. The Wyoming Game and Fish Department has management authority over greater sage-grouse populations in the state. Wyoming continues its commitment to conserve greater sage-grouse both logistically and financially. The U.S. Fish and Wildlife Service confirmed that the "core population area strategy… is a sound framework for a policy by which to conserve greater sage-grouse in Wyoming."

Wyoming's Sage-Grouse Implementation Team (SGIT) serves as the oversight body in implementing the Greater Sage-Grouse Core Area Protection Executive Order. The SGIT recommends actions necessary to maintain or enhance greater sage-grouse populations and their habitats in Wyoming.

Density Disturbance Calculation Tool (DDCT)

The DDCT (ddct.wygisc.org) is a spatially based tool created as a result of the Wyoming Greater Sage-Grouse Core Area Protection Executive Order. The DDCT process is used to determine the level of disturbance in greater sage-grouse Core Population Areas prior to permitting proposed projects causing any disruptive activity or surface disturbance. The process is intended to aid in the protection of suitable habitats and minimize habitat fragmentation.

Private Land Management Programs – Candidate Conservation Agreement with Assurances (CCAA) and complementary BLM/USFS grazing allotment CCAs

Voluntary greater sage-grouse conservation efforts on private lands are extensive and mostly undocumented. Privately owned lands provide critical seasonal habitats for greater sage-grouse in Wyoming and across their range. Establishment of formalized greater sage-grouse conservation commitments for private land include voluntary individual ranch CCAAs under the Umbrella CCAA and participation in the national Sage Grouse Initiative (SGI) program. Complementary voluntary conservation commitments on public land grazing allotments are accomplished through an individual BLM CCA or USFS CCA.

Coordinated public lands management

The State of Wyoming, the Bureau of Land Management, the U.S. Forest Service, and other land management agencies have coordinated greater sage-grouse Core Area Protection conservation actions across their boundaries, which encompass approximately 15 million acres of greater sage-grouse habitat in Wyoming.

The Bureau of Land Management and the U.S. Forest Service amended or revised their respective Land and Resource Management Plans (Plans) to prioritize conservation of greater sage-grouse and their habitats. As a part of these Plans, three levels of habitat management areas were identified (Figure 6) to provide direction on the priority areas for greater sage-grouse conservation on federally managed lands. Private lands are included in the landscape scale of prioritization. The Land and Resource Management Plans call for grazing to benefit or be neutral to sage-grouse, including in times of drought (USFWS 2015; USDOI 2015).

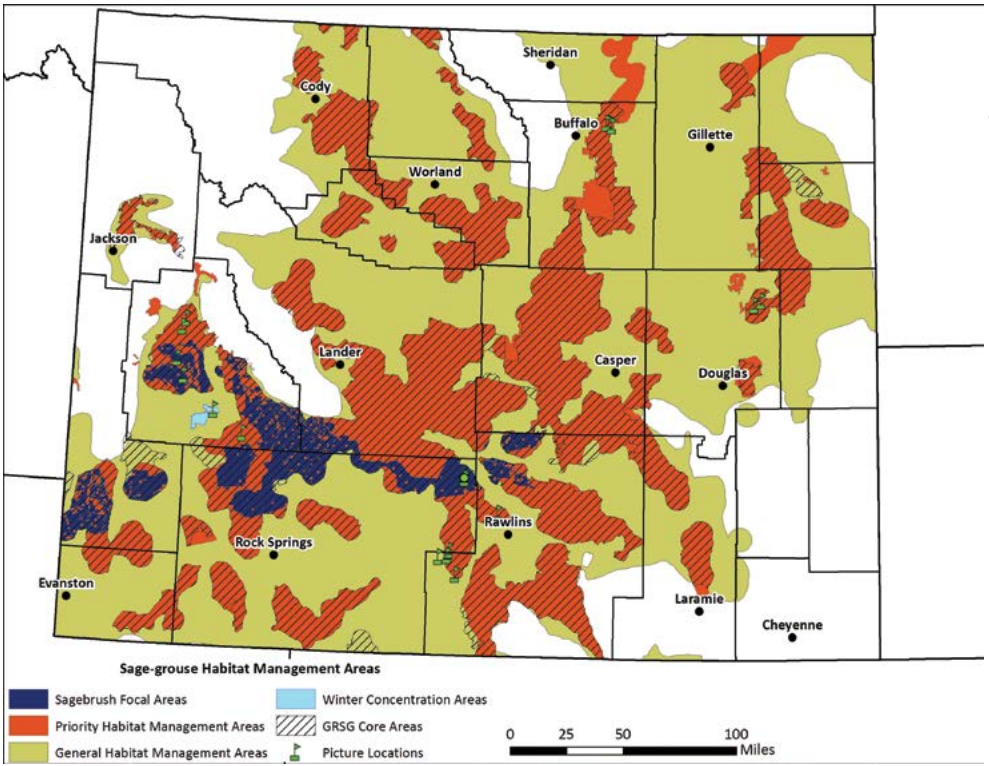

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Figure 6. Wyoming Habitat Management Areas identified in the recent Land and Resource Management Plan Amendments for greater sage-grouse conservation

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Important Habitat Components

Habitat includes all features needed for survival of an organism. Greater sage-grouse have diverse needs and specific seasonal requirements. In general, they need food, water, shelter, and environmental elements allowing for successful reproduction and population persistence. Numerous studies on greater sage-grouse habitat requirements spanning more than seven decades have concluded they are dependent on sagebrush for cover and food throughout the year (Patterson 1952; Dalke et al. 1963; Connelly et al. 2000, 2004). Unlike most other game birds that can spend their entire lives on less than one square mile, sage-grouse occupy large landscapes. Some migratory birds move tens of miles between seasonal ranges. Even non-migratory birds will move several miles. Most populations have both migratory and non-migratory individuals.

SAGEBRUSH

Sage-grouse are sagebrush obligates, depending on shrubs in the genus *Artemisia* for food and cover during all life stages. Sage-grouse use sagebrush for cover and eat sagebrush leaves

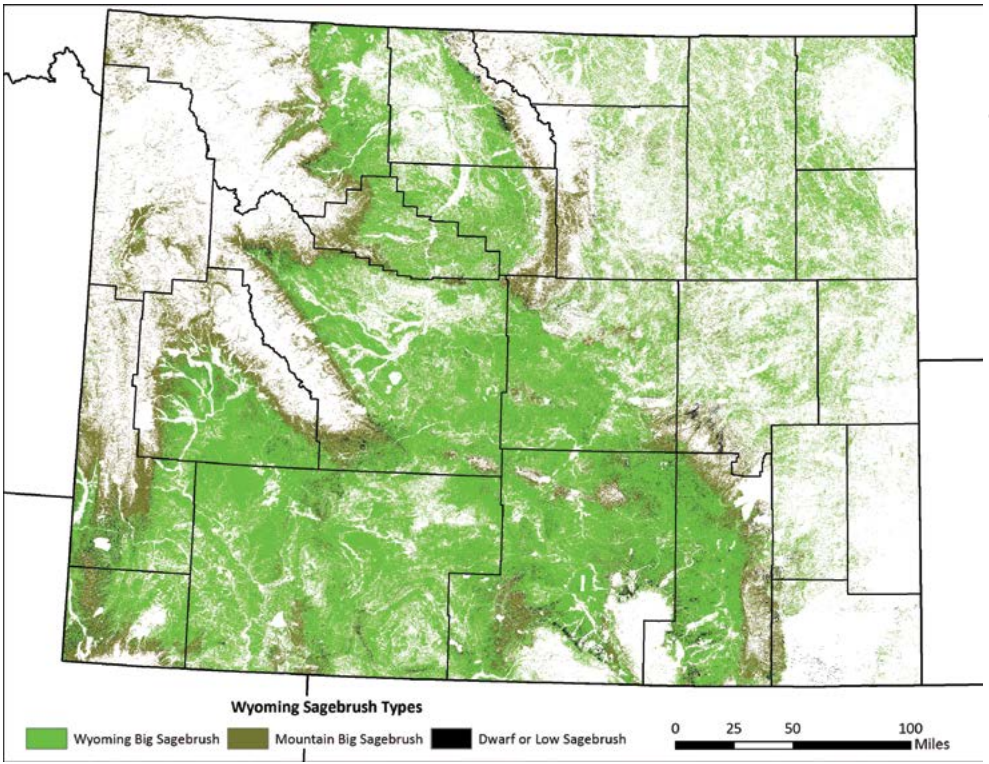

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Figure 7. Types of sagebrush habitats in Wyoming

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Columnar sagebrush

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Spreading sagebrush

throughout the year, depending solely on sagebrush leaves for food on winter range.

Studies have shown that sage-grouse select leaves from sagebrush species, subspecies, and even individual plants that have higher levels of protein and lower levels of secondary chemicals. Ideal winter range typically occurs where relief is moderate, and dense, tall sagebrush are accessible above the snow or on ridges where wind blows them free of snow.

The three major sagebrush community types in Wyoming are each characterized by a dominant sagebrush species: Wyoming big sagebrush (*Artemisia tridentata wyomingensis*), mountain big sagebrush (*Artemisia tridentata vaseyana*), and dwarf or low sagebrush (*Artemisia arbuscula)* (Figure 7). Elevation and precipitation influence where the presence of these three community types of sagebrush grow.

Sagebrush is not typically preferred by cattle; it contains secondary chemicals including phenolics, terpenoids, and coumarins that deter grazing.

Domestic sheep and goats are better equipped to eat sagebrush leaves, particularly in winter. Anatomical and physiological adaptations equip elk, mule deer, pronghorn, pygmy rabbits, and the sagebrush vole with an enhanced ability to digest sagebrush, which forms an important food source for these species in many areas of Wyoming during winter.

Sage-grouse are particularly well-adapted for obtaining nutrients from sagebrush; they isolate terpenes, which inhibit protein digestion, in their paired digestion chambers (termed ceca) and excrete them separately. The physical structure of sagebrush shrubs is critical for sage-grouse in winter, providing nesting cover and brood-rearing concealment. Moderately

tall, spreading-shaped sagebrush provides more screening cover than columnar-shaped (tree-shaped) sagebrush. When nesting, females typically scrape out a nest under tall big sagebrush plants with large canopies, where they lay a clutch of eggs and incubate them. These sagebrush plants provide escape cover and physical protection from predators. In summary, if there are no sagebrush, there are no sage-grouse.

GRASSES AND GRASS-LIKES

Bunchgrasses, especially perennial grasses, offer important cover for nesting and brood rearing. When combined with adequate sagebrush cover and structure, they help sage-grouse avoid ground predators, such as coyotes, and escape from aerial predators such as hawks. In some areas that are co-dominated by grass and sagebrush, such as northeastern Wyoming, grass height can be very important for the success of a sage-grouse nest. For sage-grouse, grass is important primarily for the physical structure it provides and is typically a very minor (<1%) component of diets. Annual grasses, especially exotic species like cheatgrass, threaten sage-grouse habitat

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Indian ricegrass *(Achnatherum hymenoides)*

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Needle and thread *(Hesperostipa comata)*

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Forb and ant – sage-grouse food sources

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Escape ramp in water tank

by suppressing the growth of native grasses and forbs and increasing extent and frequency of fires. If cheatgrass invades, it can burn frequently and most sagebrush species do not sprout following fire. It can take many decades for sagebrush to recover after fire.

FORBS AND INSECTS

Flowering plants, or forbs, serve as both a critical food source and as habitat for insects – an even more important food for sage-grouse chicks. When a female sage-grouse leaves the nest with her new brood of chicks, her primary focus is raising those chicks – a life stage called brood rearing. During this life stage, female grouse seek habitat that is more open and includes a mix of sagebrush, grass, and forbs. Sage-grouse chicks find forbs highly desirable but also seek out and require insects high in protein (primarily ants, beetles, and grasshoppers) in spring and summer. It is important for chicks to have both forbs and insects, because without both, the chicks' growth and development is stunted. Because sage-grouse chicks, especially very young chicks, rely on diets composed mainly of forbs and insects, the importance of these habitat components cannot be overstated. Adult sage-grouse also actively feed on ants, beetles, grasshoppers, and other invertebrates.

WATER

Sage-grouse, like many upland birds, acquire most of their hydration from the physiological breakdown of foods they eat. They also use standing water and can drown in water tanks not equipped with escape ramps; thus, it is suggested that tanks be equipped with escape ramps. Female sage-grouse with broods often

are found near wet areas in late summer, as these sites support forbs and insects longer in the summer than do upland sites.

SAGEBRUSH STEPPE SUCCESSION

Succession is the change in a plant community and vegetation structure over time. The timescale for detectable changes can vary for different plant communities, soil types, and precipitation regimes. Drivers of plant succession include fire, grazing, and climate or a variable combination of all three. In some plant communities, succession can be disturbance-driven and very rapid. For example, areas of the tallgrass prairie require frequent and regular fire to mitigate the transition from grassland to juniper woodland.

In other plant communities, such as the sagebrush steppe, succession can be much slower and may be driven more by climate than disturbances such as fire. Fires, however, can and do occur in sagebrush and can still cause rapid changes to plant communities. This impact is drastic because most sagebrush shrubs do not resprout after fire. They rely on new seedlings establishing (aka, recruitment rather than resprouting) and recovery after fire can take many decades. A notable exception is silver sagebrush (*Artemisia cana*), which can readily resprout after fire, but is not the dominant sagebrush throughout most sage-grouse range.

In sagebrush plant communities, several successional trajectories are possible.

First, a typical succession in existing sagebrush stands over multiple decades is the increase in sagebrush density and cover and subsequent decrease in perennial grass and forb density and cover.

Second, in some areas conifers also encroach into sagebrush stands. These include two-needle piñon pine (*Pinus edulis*) and juniper (*Juniperus*) species that slowly establish and alter sagebrush steppe. When this occurs, it can be detrimental to sage-grouse because they prefer the relatively open landscape of sagebrush-dominated sites and may seek out areas without conifers.

Third, some areas have experienced invasion by annual grasses such as cheatgrass that can lead to an altered fire cycle. In these cases, as cheatgrass invades, it also readily burns and can lead to more frequent fires. Because most sagebrush species are sensitive to fire, the plant community can transition from being dominated by sagebrush and native perennial grasses to a cheatgrass monoculture.

Rangeland managers have the difficult task of understanding and managing plant succession in the sagebrush steppe, which is not as simple as other plant communities that are more resilient and dependent on disturbances. Rangeland managers have to consider all tools in the toolbox to manage succession and prevent rapid state changes while optimizing sagebrush cover, perennial grass cover, and forb richness and diversity. Tools that are strategically used include herbicides, fire, mechanical treatments, and biological treatments.

It is important to realize that natural disturbances, such as fire and grazing, occurred before European settlement in North America and played an integral part in structuring plant communities. The challenge is understanding how these disturbances functioned and how humans have changed their intensity, duration, and frequency. What's more, using these

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Early succession after fire

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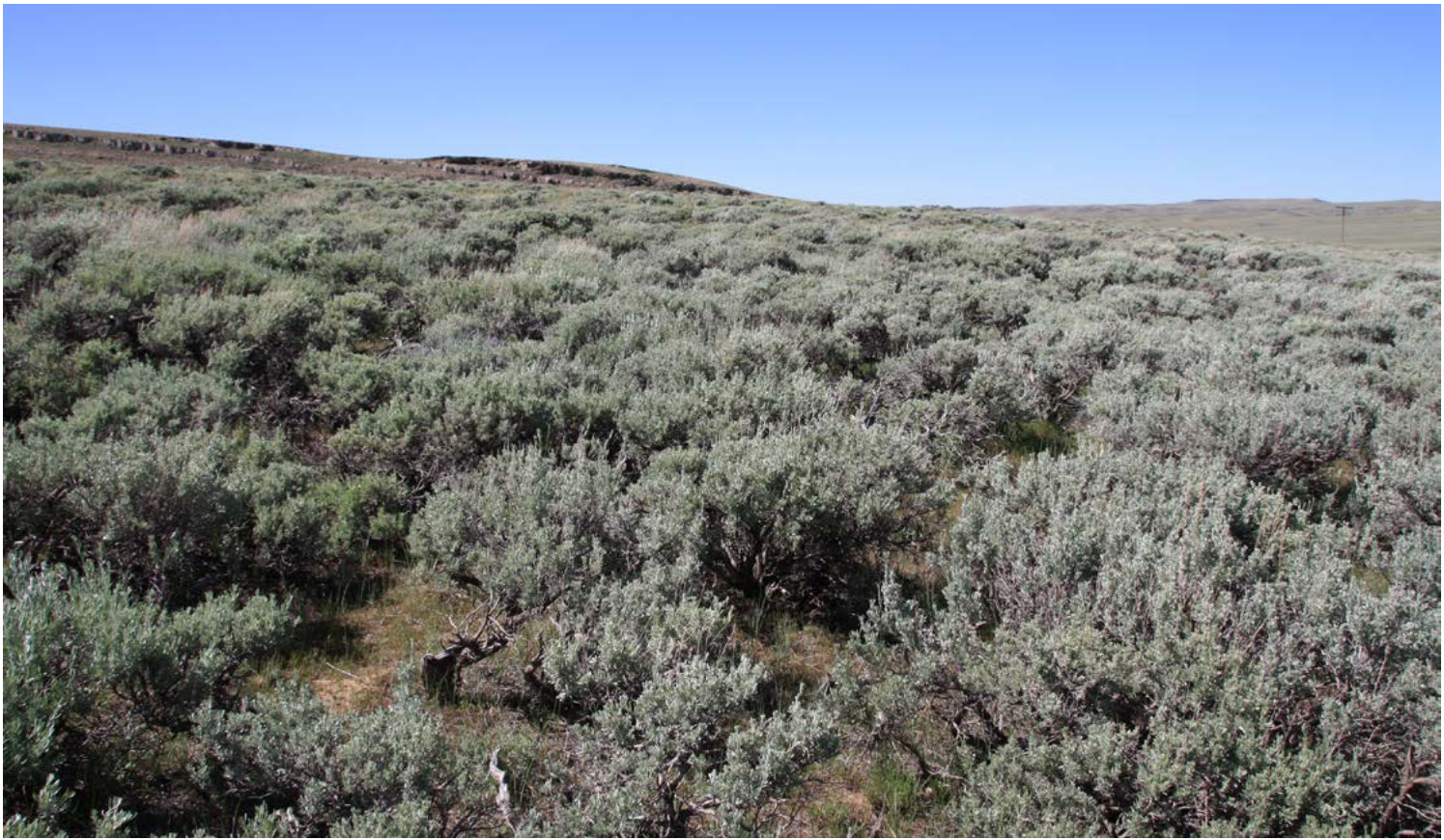
Mid-succession

tools can be problematic because reducing sagebrush cover can encourage expansion and increase of annual grasses, including cheatgrass. Thus, we encourage recognition of site resistance to invasion of annual plants and resilience to disturbance in planning whether treatments are warranted or will be effective. For more information on Wyoming sagebrush habitat research, see Chambers et al. 2016 and Smith 2006.



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Late-succession

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Life Stages and Habitat Needs

Seasonal habitats (Table 1) are important to meeting the requirements of greater sage-grouse during these life stages: (1) breeding which includes lekking, prenesting, nesting, and early brood rearing, (2) summer/late brood-rearing, and (3) fall and winter (Connelly et al. 2000).

Federal and state agencies may break down the seasonal habitats even further for purposes of management and monitoring habitats. Specific features are important for lekking, nesting, brood-rearing, and winter habitat. It is important to identify these biologically meaningful areas on a ranch-level scale to implement successful sage-grouse conservation (Figure 8).

Numerous studies have been conducted on habitat characteristics important for greater sage-grouse persistence. General seasonal habitat information is included in the following sections. Additionally, Tables 2-5 contain the specific habitat characteristics used as the foundation for implementing greater sage-grouse conservation efforts in Wyoming. Local conditions will vary and the herbaceous height requirement may not be met in habitats dominated by grasses that are relatively short when mature. Height and cover requirements should be developed that are reasonable and ecologically defensible (Connelly et al. 2000).

Sage-grouse also occur in areas where these conditions do not exist and that do not have the site potential to support this type of vegetation.

Table 1. *General seasonal habitat descriptions modified from Connelly et al. (2000) as presented in Stiver et al. 2015*

Habitats	General Use Period[1]	General Description[2]
Breeding Habitat	March 1 - June 30	A variety of sagebrush plant communities in close proximity to leks and big sagebrush communities
Summer/Late Brood-Rearing Habitat	July 1-September 30	Variety of mesic or moist habitats in close proximity to sagebrush communities
Winter Habitat	December 1 - February 28 or 29	Variety of sagebrush communities that have sagebrush above the snow

1 Use periods may vary based on elevation and annual weather conditions

2 General descriptions for some areas; primary vegetation communities may vary based on local conditions and availability

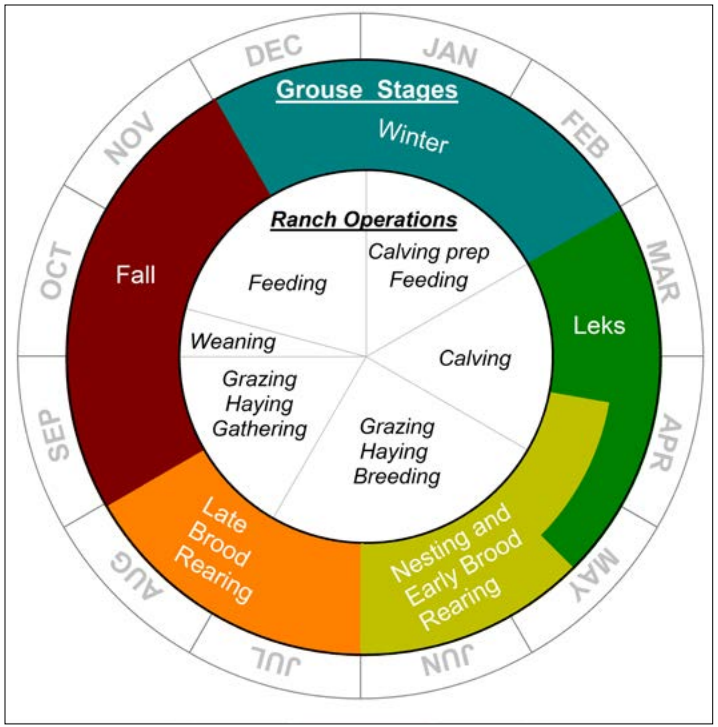

Figure 8. *Comparison of ranch operations to sage-grouse life stages. Individual operations can adjust the inner "ranch operations" to minimize impacts and support optimal sage-grouse conservation. Adjustments are especially important during particularly sensitive life stages (such as nesting and lekking) and on areas of the ranch where these occur.*

BREEDING AND LEKKING

Male sage-grouse display on communal breeding grounds, known as strutting grounds or leks, from mid-March through mid-May. In addition to vocalizations to attract mates, the intricate displays that male sage-grouse exhibit include wing swishing and fanning their pointed tail feathers while skin sacks (gular sacks) around their necks are inflated with air. For visibility, leks are typically open areas with close proximity to sagebrush cover (Table 2).

Although male and female sage-grouse build fat stores by subsisting on sagebrush leaves in the winter (Remington and Braun 1988), these stores in males are largely depleted by the end of the two-month strutting period. Male survival tends to be lowest during the lekking period when they are more visible to aerial predators. Leks are a focus of the breeding ecology of sage-grouse, with most nests in Wyoming occurring within 3 to 5 miles from leks.

NESTING

Female sage-grouse typically attend leks in April, where most are bred by one or two dominant males. Soon afterward, they select a nesting site, most within 3 to 5 miles of the lek, where they lay a clutch of six to nine, greenish-colored eggs. Female sage-grouse build their nests on the ground, primarily under tall, broad big sagebrush plants to conceal them from nest predators. Some research points to the need for females to obtain adequate nutrition prior to laying, including from forbs, which provide crude protein, phosphorous, and calcium (Barnett and Crawford 1994). Nests hatch within

Table 2. *Breeding/lek habitat characteristics identified as suitable and being used to implement greater sage-grouse conservation (Connelly et al. 2000, Stiver et al. 2015).*

Habitat Indicators	Description	Habitat Suitability Characteristics
Availability of Sagebrush Cover	Lek has adjacent sagebrush cover in close proximity.	Adjacent sagebrush cover within 100 m (328 feet).
Proximity of Detrimental Land Uses	The distance to land uses that have detrimental effects on lek use i.e. highways, railroads, industrial parks.	Detrimental land uses are not within line of sight of lek and absent to uncommon within 3 km (1.86 mile) of lek.
Proximity of Trees or Other Tall Structures	Presence of trees or other tall structures within line of sight of leks.	Trees or other tall structures are not within line of sight of lek and absent or uncommon within 3 km (1.86 mile) of the lek.

Table 3. *Nesting and early brood-rearing habitat characteristics identified as suitable and being used to implement greater sage-grouse conservation (Connelly et al. 2000, Stiver et al. 2015)*

Habitat Indicators	Description	Habitat Suitability Characteristics	
		Arid Sites[1]	Mesic Sites[2]
Sagebrush Height	Average sagebrush height for land cover type	30-80 cm (12-30 inches)	40-80 cm (15-30 inches)
Predominant Sagebrush Shape[2]	Number of sagebrush plants by shape and most common sagebrush shape for land cover type	Spreading	Spreading
Perennial Grass and Forb Heights	Average maximum heights in land cover type	≥ 18 cm (≥ 7 inches)	≥ 18 cm (≥ 7 inches)
Perennial Grass Cover	Average percent cover for land cover type	≥ 10%	≥ 15%
Perennial Forb Cover	Average percent cover for land cover type	≥ 5%	≥ 10%
Preferred Forb Availability	Number of preferred forbs in land cover type	Good abundance and availability relative to ecological site potential	

[1] Mesic and arid sites should be defined on a local basis; annual precipitation, herbaceous understory, and soils should be considered (Connelly et al. 2000).

[2] Sagebrush plants that are more tree- or columnar-shaped, with no or few lower branches, provide less protective cover near the ground than sagebrush plants with a spreading shape.

26 to 28 days of the initiation of incubation, which is solely done by individual females.

In many years no more than half the nests laid by females in a sage-grouse population hatch. Many nests are lost to egg predators, and some may be abandoned following storms. Also, sage-grouse often abandon their nests if flushed from them by humans. Female sage-grouse may renest, but the rate of renesting is notably less than that of many other upland game birds, such as quail and pheasants. Also, clutch size after renesting is smaller than for first nests. Nests that are successful tend to be screened by high canopy cover and obstructed by shrubs and grasses (Table 3). Recent research (Gibson et al. 2016) showed grass height measurements were biased when taken after grouse nest fate was determined. This is because the measurements were taken earlier in the growing season at unsuccessful nests versus later in the growing season at successful nests. Therefore, grass height prescriptions need to be revisited. Nevertheless, repeated heavy grazing removes bunchgrasses and leads to less desirable grass species dominance (Cagney et al. 2010) and in areas where sagebrush cover is low (Management Zone 1 in Northeast Wyoming), grass still provides important screening cover.

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Local habitat conditions will vary. Sagebrush height, percentage of cover, and understory are dependent on elevation, precipitation, and soils. The following pictures represent breeding and nesting habitat for areas within Wyoming in Management Zones 1 and 2.

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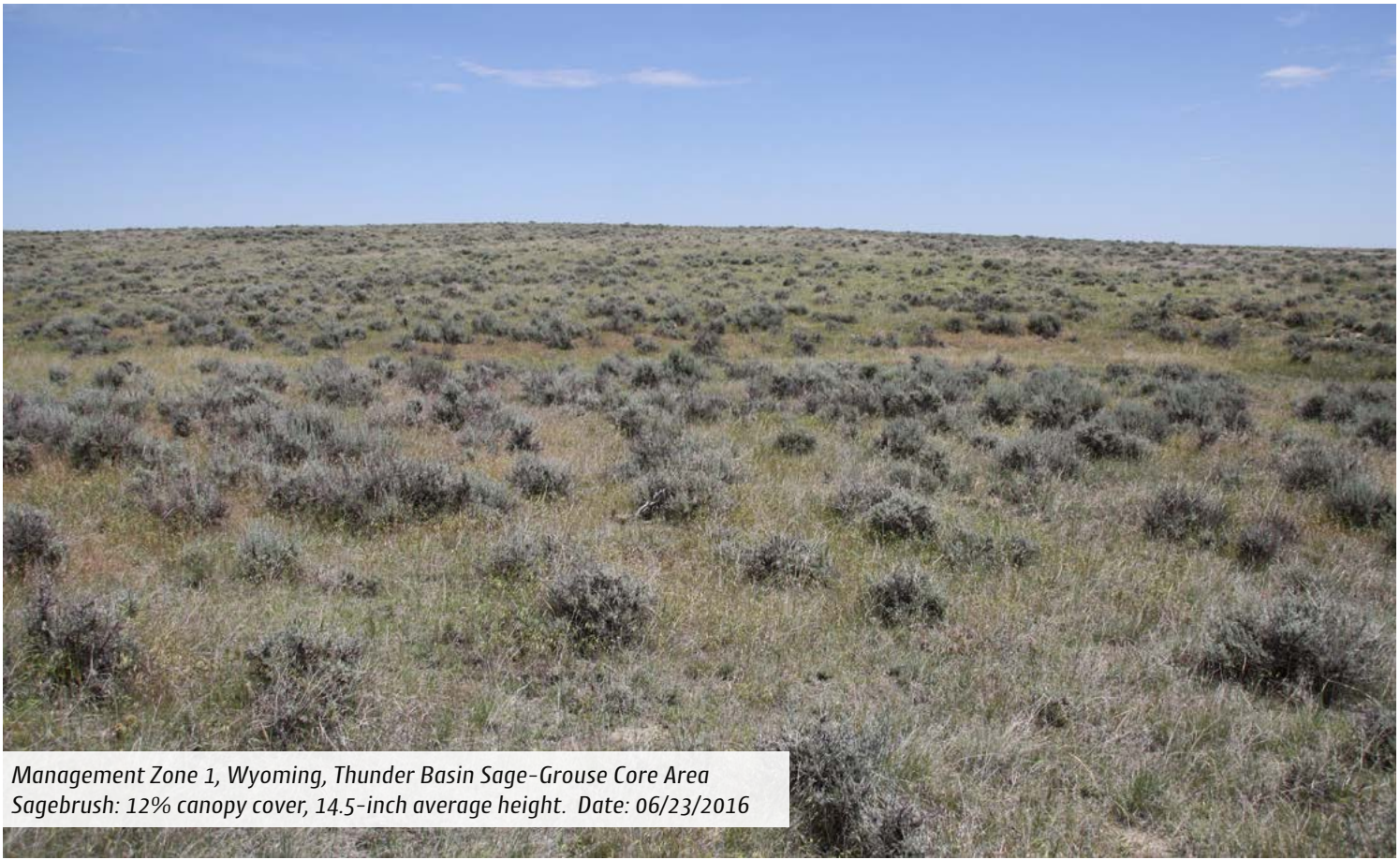
Management Zone 1, Wyoming, Thunder Basin Sage-Grouse Core Area
Sagebrush: 5% canopy cover, 9-inch average height Date: 06/23/2016



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Management Zone 1, Wyoming, Thunder Basin Sage-Grouse Core Area
Sagebrush: 12% canopy cover, 14.5-inch average height. Date: 06/23/2016

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Management Zone 1, Wyoming, Thunder Basin Sage-Grouse Core Area
Sagebrush: 20% canopy cover, 16-inch average height. Date: 06/23/2016

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Management Zone 1, Wyoming, Buffalo Sage-Grouse Core Area
Sagebrush: 7% canopy cover, 14-inch average height. Date: 06/07/2016

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Management Zone 1, Wyoming, Buffalo Sage-Grouse Core Area
Sagebrush: 21% canopy cover, 24-inch average height. Date: 06/07/2016

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Management Zone 1, Wyoming, Buffalo Sage-Grouse Core Area
Sagebrush: 55% canopy cover, 42-inch average height. Date: 06/07/2016

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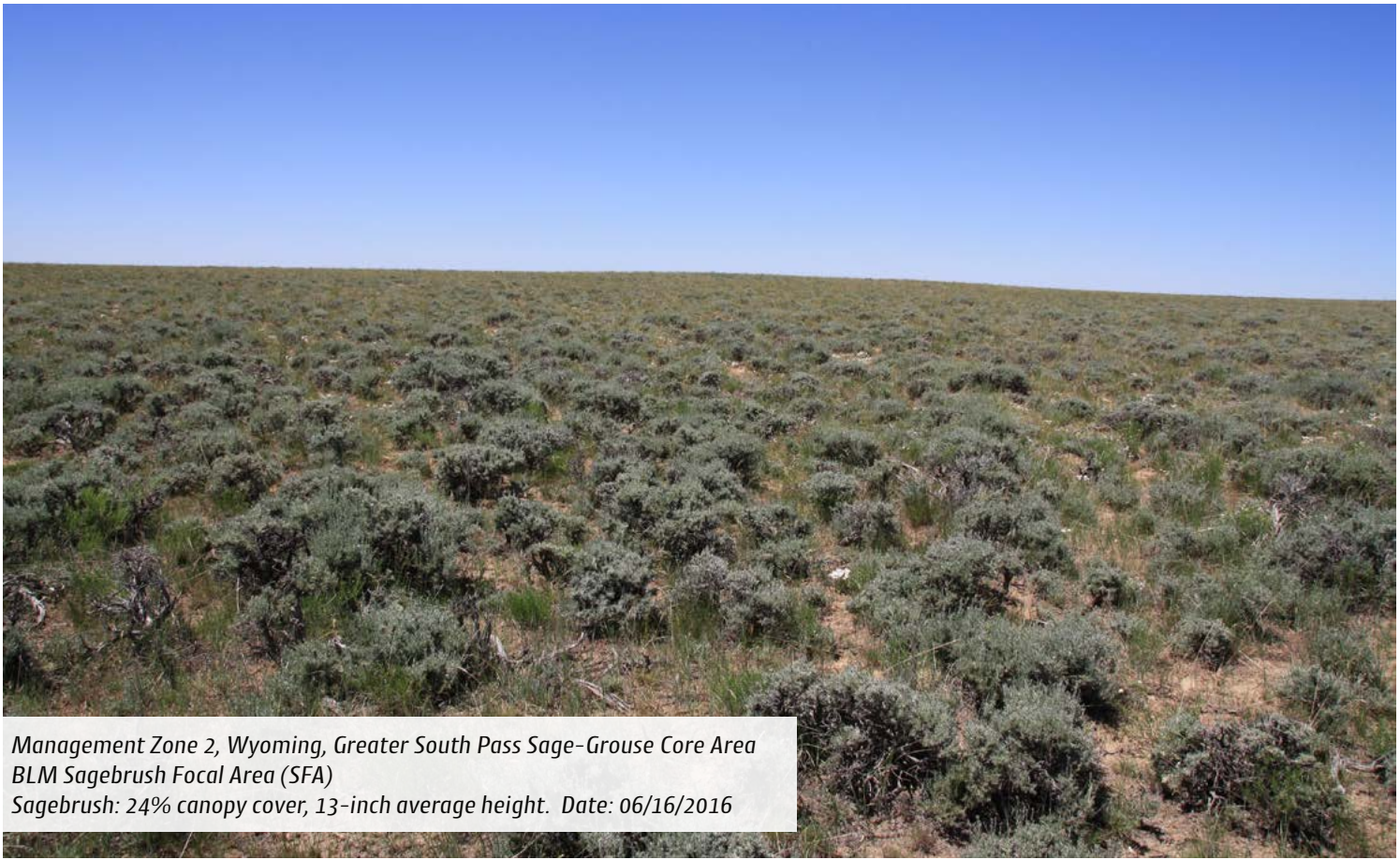
Management Zone 2, Wyoming, South Rawlins Sage-Grouse Core Area
Sagebrush: 13% canopy cover, 12-inch average height. Date: 06/15/2016



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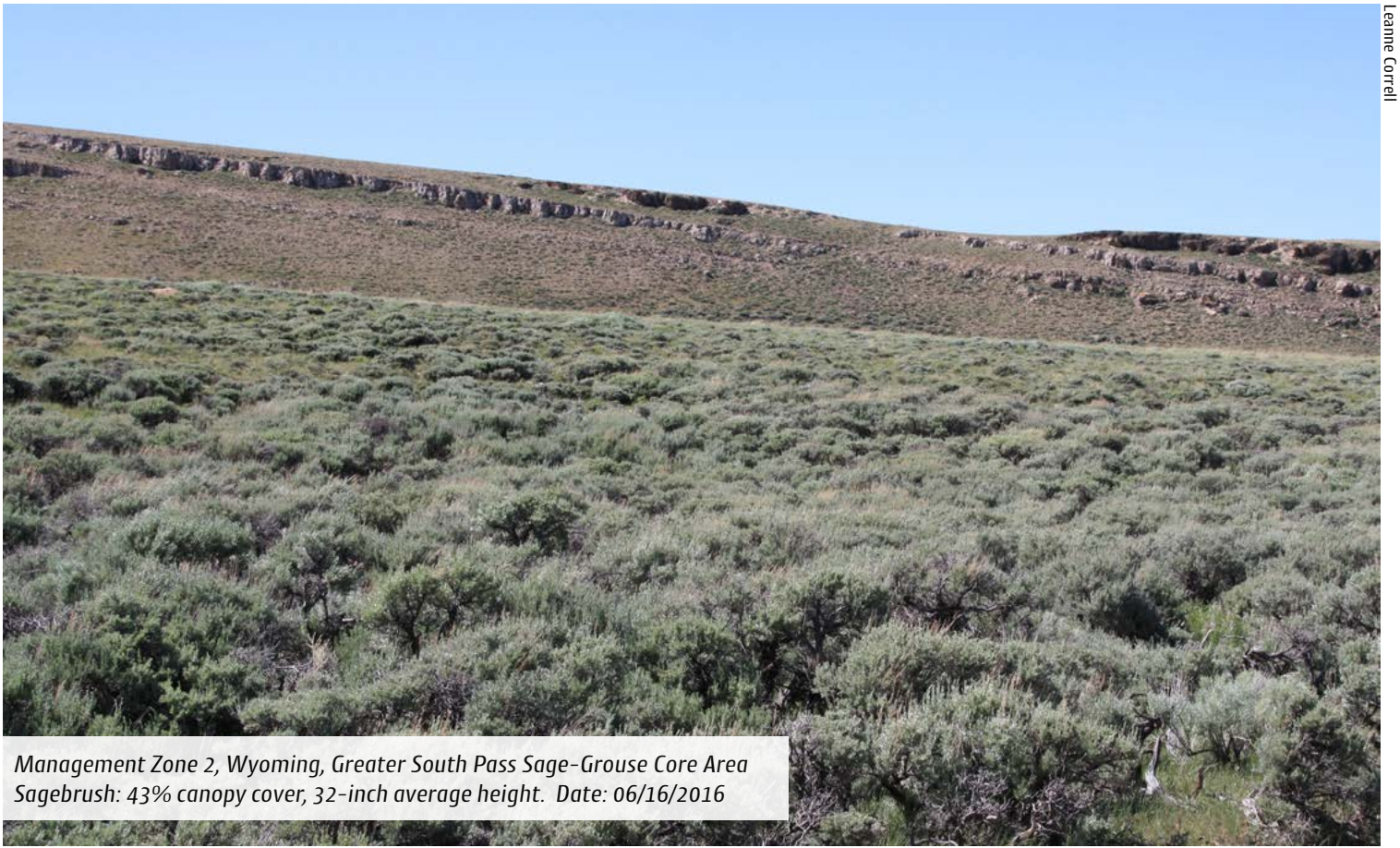
Management Zone 2, Wyoming, Greater South Pass Sage-Grouse Core Area
BLM Sagebrush Focal Area (SFA)
Sagebrush: 24% canopy cover, 13-inch average height. Date: 06/16/2016



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Management Zone 2, Wyoming, Greater South Pass Sage-Grouse Core Area
Sagebrush: 43% canopy cover, 32-inch average height. Date: 06/16/2016

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Management Zone 2, Wyoming, Daniel Sage-Grouse Core Area
Sagebrush: 10% canopy cover, 10-inch average height. Date: 07/06/2016

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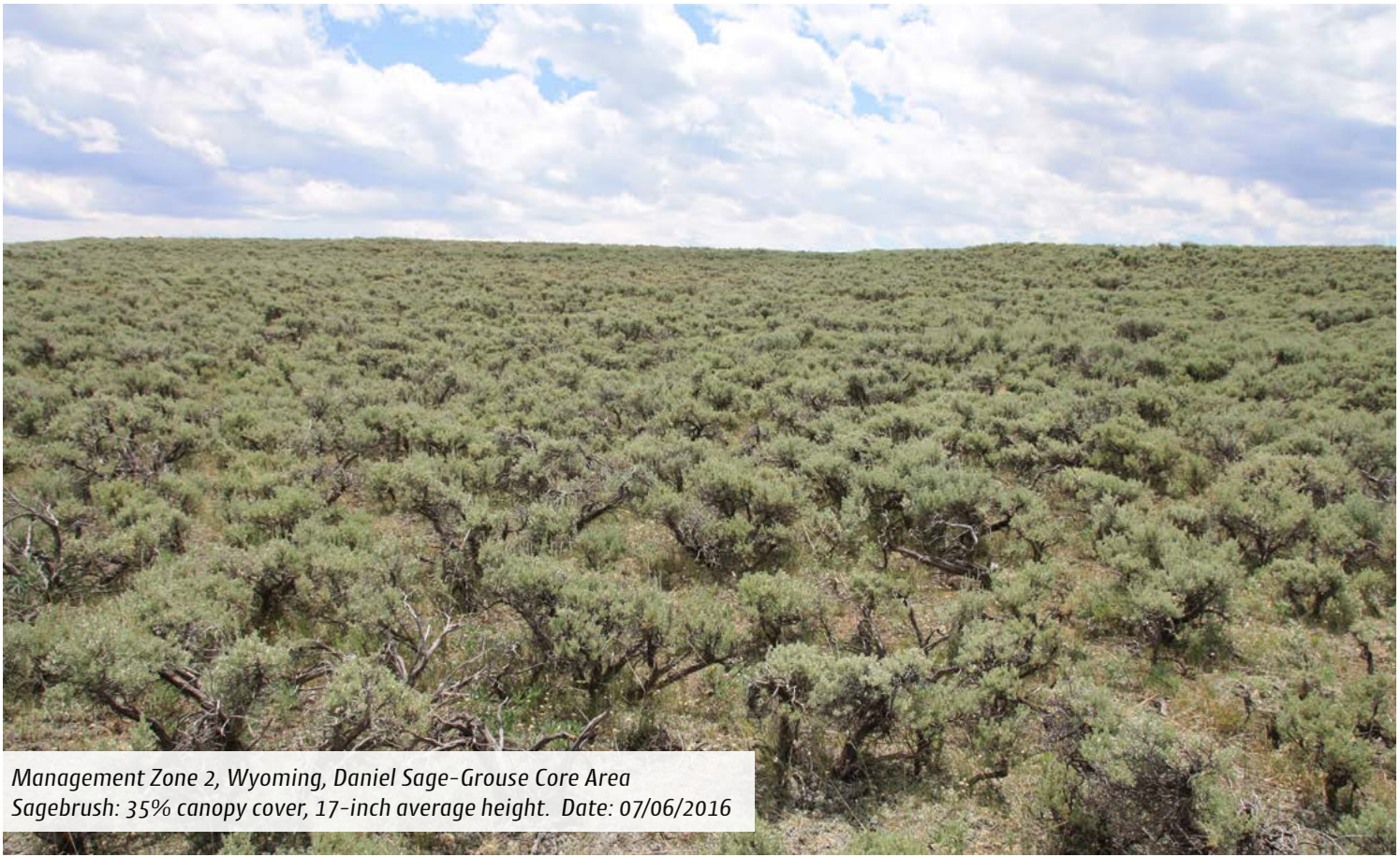
Management Zone 2, Wyoming, Daniel Sage-Grouse Core Area
Sagebrush: 24% canopy cover, 20-inch average height. Date: 07/06/2016



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Management Zone 2, Wyoming, Daniel Sage-Grouse Core Area
Sagebrush: 35% canopy cover, 17-inch average height. Date: 07/06/2016

BROOD-REARING

Early brood-rearing occurs within several hundred yards of nests during the first two to three weeks after hatch, when chicks are still unable to fly. The diet of chick sage-grouse is composed of forbs and insects (ants, beetles, and then grasshoppers as chicks grow and are able to catch them), which are digestible and highly nutritious. The protein and minerals insects provide to chick sage-grouse is crucial for adequate growth and development.

Chicks are vulnerable to predation until they are 10 weeks of age, after which survival rate is higher, similar to that of adult sage-grouse (Beck et al. 2006). As chicks become more mobile and succulent vegetation near nesting areas senesces (browns and withers), females tend to move their broods to wet meadows at higher elevations or, in some cases, irrigated agricultural fields (Fischer et al. 1996). Here, they find forbs and insects to forage on and sagebrush for protective cover (Table 4). Broods tend to aggregate as summer progresses, with groupings of a few to several females and their chicks forming mixed flocks through at least early October.

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Riparian brood-rearing habitat within close proximity to sagebrush

Table 4. *Summer and late brood rearing habitat characteristics identified as suitable and being used to implement greater sage-grouse conservation (Connelly et al. 2000, Stiver et al. 2015).*

Habitat Indicators	Description	Habitat Suitability Characteristics	
		Upland Sagebrush Communities[1]	Riparian and Wet Meadow Communities
Sagebrush Cover	Average percentage of cover for land type	15-25%	
Sagebrush Height	Average sagebrush height for land cover type	30-80 cm (12-30 inches)	
Availability of Sagebrush Cover	Foraging site has sagebrush cover in close proximity		Sagebrush cover is within 100 m of riparian or wet meadow foraging area
Perennial Grass and Forb Cover	Average percentage of cover for land cover type	≥ 15%	
Riparian Stability	Functioning condition		The majority of riparian areas are in proper functioning condition
Preferred Forb Availability	Number of preferred forbs in land cover type	Good abundance and availability relative to ecological site potential	

[1] In areas where agricultural fields provide the food resources, the habitat indicators for protective cover apply.

WINTER

Sage-grouse move to winter habitats in response to changes in food plants and fall weather in October or November. Sage-grouse are also known to aggregate in large concentration areas during winter. Habitat used by sage-grouse during winter is characterized by large, continuous expanses of sagebrush with flatter topography. Sagebrush in these areas tends to be tall, permitting sage-grouse to access sagebrush leaves above snow levels (Table 5). Sage-grouse are well adapted to cold conditions and will snow burrow in some cases to escape harsh weather. The diet of sage-grouse during winter is dominated by leaves from big sagebrush plants, with other species of sagebrush, such as black sagebrush (*Artemisia nova*), forming an important dietary component on many winter ranges. Research has demonstrated that wintering sage-grouse are very efficient in foraging on species of sagebrush, within patches of sagebrush, and

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on individual sagebrush plants that are higher in crude protein and lower in plant secondary chemicals (Frye et al. 2013). Overwinter survival is typically high, except during severe winters, when birds are more vulnerable. Sage-grouse gain weight and build fat stores during winter (Remington and Braun 1988), which are depleted during breeding.

Table 5. *Winter habitat characteristics identified as suitable and being used to implement greater sage-grouse conservation (Connelly et al. 2000, Stiver et al. 2015).*

Habitat Indicators	*Description*	*Habitat Suitability Characteristics*
Sagebrush Canopy Cover	*Average percentage of cover exposed above snow in wintering area*	*≥ 10 - 30% exposed above snow*
Sagebrush Height	*Average height above snow in wintering area*	*≥ 25 - 35 cm (10-14 inches) exposed above snow*

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Management Zone 2, Winter Concentration Area
Sagebrush: 29% canopy cover. Date: 07/06/2016

Monitoring Sagebrush Habitats

Rangeland monitoring of sagebrush habitat makes it easier to assess whether rangeland goals are being achieved and documenting conditions on the ground helps inform grazing management decisions. Data collected can be used to monitor changes in habitat over time, often revealing trends, and documenting successful sage-grouse conservation efforts is critical to landscape conservation.

HABITAT MONITORING BASED ON LIFE STAGES

Different governmental agencies classify sage-grouse life stages differently. These differences stem from how each agency views sage-grouse habitat requirements and how they monitor rangeland to document habitat conditions. For this publication, rangeland monitoring is based on the Greater Sage-Grouse Umbrella Candidate Conservation Agreement with Assurances (Umbrella CCAA) for Wyoming Ranch Management (USFWS 2013). Four distinct habitat seasons are defined. Personal knowledge of the land and other resources can also be used to determine if a property includes leks, nesting, brood-rearing, or winter habitat. Ranches may have one or all of these habitats. Adjust individual ranch monitoring as appropriate for the goal of greater sage-grouse conservation.

WHAT TO MONITOR

Lek habitat monitoring includes documenting the potential threat of conifer or sagebrush encroachment and changes over time.

Nesting habitat monitoring includes measuring and documenting sagebrush and grass canopy cover and height.

Brood-rearing habitat monitoring includes measuring and documenting perennial forb and grass canopy cover and compiling a list of the dominant riparian and wet meadow plant community species.

Winter habitat monitoring includes measuring and documenting sagebrush canopy cover and sagebrush height.

HOW TO MONITOR

Several monitoring methods that can be used to achieve these monitoring requirements are described in the Wyoming Rangeland Monitoring Guide (http://wyagric.state.wy.us/divisions/nrp/range-guide).

Governmental agencies often use a suite of rangeland monitoring methods at each monitoring site to accomplish a wide range of monitoring goals. Increasingly, federal agencies are moving toward the Habitat Assessment Framework (HAF; Stiver et al. 2015) and Assessment Inventory and Monitoring (AIM; Herrick et al. 2016) rangeland monitoring protocols. Range conservationists, range consultants, and UW Extension educators can assist in determining appropriate approaches for the goals and objectives of an individual ranch.

WHEN TO MONITOR

Timing of monitoring is critical to detecting habitat features such as forbs. Typically, monitoring is conducted in May and June to

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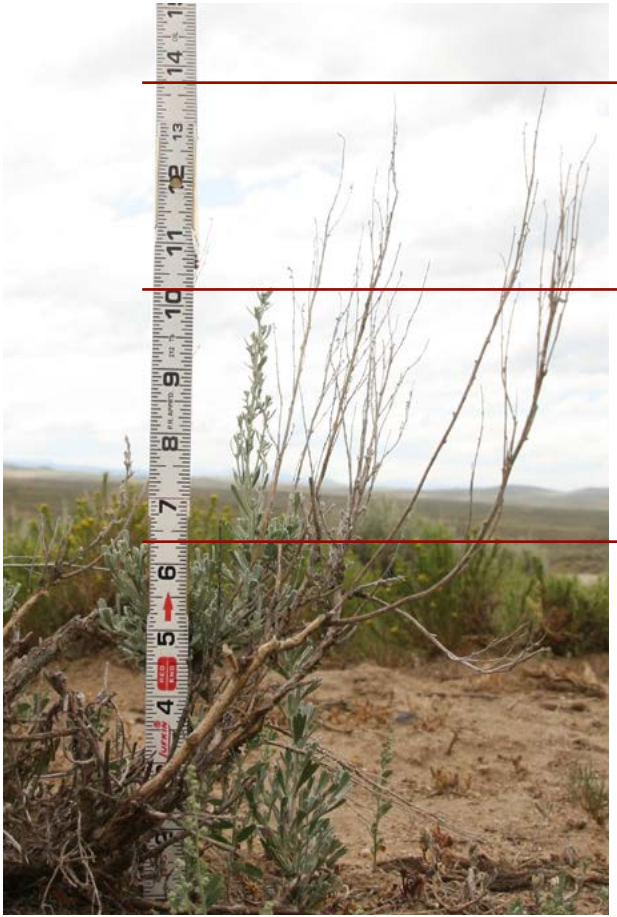

Figure 9. *Three different ways of measuring sagebrush height*

optimize forb detection. If, however, winter habitat is the monitoring goal, it should (obviously) be conducted during the winter.

MONITORING DIFFERENCES

Consistency is crucial when monitoring vegetation features or bird populations (such as in a lek count) to ensure methods are repeatable and data can be used reliably over time to evaluate trends. It is important to have written protocols for each monitoring location to ensure consistency from one year to the next. Information can be recorded differently among some of the common monitoring methods, and monitoring results can be biased if lack of consistency occurs. Three different measurements are identified in Figure 9 to show how inconsistencies can skew results.

Predator Impacts

Both the U.S. Fish and Wildlife Service 2010 listing decision (75 FR 13910; March 23, 2010) and the 2015 not warranted determination (80 FR 59857; October 2, 2015) identify predation as a potential threat for greater sage-grouse. Both documents acknowledge localized predation from a range of predators that target sage-grouse during different life stages, but neither lists predators as a primary threat.

Oral accounts of sage-grouse predation are known, but studies to quantify the impacts have been limited. Newer field studies, however, (e.g., Coates et al. 2008, Dinkins et al. 2012, 2014, Howe and Coates 2014, Hopken et al. 2016) and literature reviews on sage-grouse depredation, including Schroeder and Baydack (2001), Mezquida et al. (2006), and Hagen (2011), provide a better understanding of the effects of predators on sage-grouse.

Greater sage-grouse are a natural prey species for a variety of predators, including skunks, ravens, red foxes, coyotes, snakes, badgers, and avian predators such as golden eagles, ravens, and hawks (Schroeder and Baydack 2001, Hagen 2011). Several factors influence the highly variable level of predator impact. The number of predators – both number of species and cumulative number of predators – may vary during the year and from one locality to another.

The predatory species of primary concern in a given area also influences impact. Different predator species impact sage-grouse at different life stages. Nest and chick predation are much higher than for adults. Depredation of nests and chicks is influenced by cover, weather patterns, and other prey availability. Furthermore, a Wyoming study determined sage-grouse avoid avian predators as part of the selection process for nesting and brood-rearing sites (Dinkins et al. 2012), suggesting the presence of avian predators can reduce habitat used by sage-grouse during important life stages.

Studies have provided a broad-scale knowledge of predator impacts to sage-grouse; however, it is difficult to know which predators are the greatest threats to sage-grouse on a ranch-scale basis. On-the-ground landowners and managers are key to U.S. Fish and Wildlife Service having a better understanding of local predator threats. The observation form at the end of this guide can be used to document observations in the field. The key is to provide this information to the Wyoming Game and Fish Department and the U.S. Fish and Wildlife Service, so it can be included in future management decisions. Additional sage-grouse predator studies are needed to gain a better understanding of impacts to local sage-grouse populations.

Jason R. LeVan

Depredated greater sage-grouse eggs

Jason R. LeVan

Successfully hatched greater sage-grouse eggs

Final Thoughts

Greater sage-grouse conservation has and continues to be a focus for Wyoming landowners and managers. Private landowners have implemented practices that not only benefit their ranching operations, but also benefit sage-grouse and the many species of wildlife that inhabit the large, open landscapes required by greater sage-grouse. Unlike most other game birds that can spend their entire lives often on less than one square mile, some migratory sage-grouse move tens of miles between seasonal ranges. Even non-migratory birds will move several miles. Most greater sage-grouse populations have both migratory and non-migratory individuals.

State-led conservation plans and mechanisms are being implemented that address the complexities of the sagebrush ecosystems and acknowledge that disturbances to these ecosystems have far-reaching, long-term impacts. Federal land management agencies have developed regulatory mechanisms through their land and resource management plans to minimize impacts to sagebrush habitats and conserve greater sage-grouse in priority areas throughout the West.

Ecosystem management and conservation are vital for healthy ecosystems for a multitude of species. Because sage-grouse are considered an umbrella species in sagebrush habitats, conserving their populations and habitats benefits some 350 other species. Sage-grouse are an indicator of healthy, functioning sagebrush steppe ecosystems; thus, effective management of the bird is beneficial to grazers.

There is high variability within sagebrush habitats in Wyoming, including the amount of sagebrush cover, sagebrush height, perennial grasses, and forb species. Therefore, a "one size fits all" approach does not work for greater sage-grouse conservation. Local conditions determine the best practices for greater sage-grouse conservation and what works best in one area may be detrimental in another.

This guide, which includes the basic biology, life stages and habitat needs, habitat components, sagebrush monitoring, conservation planning in Wyoming, and predator impact, is intended to enhance understanding of sage-grouse conservation in Wyoming. Greater sage-grouse conservation, put simply, is understanding the needs of the sage-grouse for each life stage, knowing the life stage you provide habitat for, knowing what threats exist on the land, and implementing actions on the land to minimize or reduce the threats.

There are many resources available to assist landowners and managers in pursuing greater sage-grouse conservation in our sagebrush ecosystems. Assistance is just a phone call or email away.

Leanne Correll

Additional Information

The following can provide more information on sage-grouse conservation and management in Wyoming.

Bureau of Land Management (BLM), Wyoming
5353 Yellowstone Road, Cheyenne, WY 82009
Public Desk: 307.775.6256
www.blm.gov/wy

Natural Resources Conservation Service (NRCS), Wyoming
100 East B Street, 3rd Floor, Casper, WY 82601
Main Line: 307.233.6750
www.nrcs.usda.gov/wps/portal/nrcs/site/wy/home/

NRCS Plants Database
www.plants.usda.gov
Resource for descriptions and images of plants in the United States

Sage Grouse Initiative
www.sagegrouseinitiative.com/

U.S. Forest Service Rocky Mountain Region (R2)
740 Simms Street, Golden, CO 80401
Public Desk: 303.275.5350
www.fs.usda.gov/r2#sthash.eZv2v5wa.dpuf

U.S. Forest Service Intermountain Region (R4)
Federal Building, Ogden, UT 84401
Public Desk: 801.625.5605
www.fs.usda.gov/r4#sthash.eZv2v5wa.dpuf

U.S. Fish and Wildlife Service (USFWS)
Wyoming Ecological Services Field Office
5353 Yellowstone Rd, Suite 308A, Cheyenne, WY 82009
Main Line: 307.772.2374
www.fws.gov/wyominges/index.php

University of Wyoming Extension (UW Extension)
Department #3354
1000 E. University Ave, Laramie, WY 82071
Office: 307.766.5124
www.uwyo.edu/uwe/

Wyoming Department of Agriculture (WDA)
2219 Carey Ave, Cheyenne, WY 82002
Main Line: 307.777.7321
www.wyagric.state.wy.us

Wyoming Game & Fish Department (WGFD)
5400 Bishop Blvd, Cheyenne, WY 82006
Main Line: 307.777.4600
www.wgfd.wyo.gov

Wyoming Rangeland Monitoring Guide
http://wyagric.state.wy.us/divisions/nrp/range-guide
or request a hard copy from Wyoming Dept. of Agriculture or local UW Extension Office

Wyoming Sage-Grouse Implementation Team (SGIT)
5400 Bishop Blvd, Cheyenne, WY 82006
WGFD Habitat Protection Services: 307.777.4506
www.wgfd.wyo.gov/Habitat/Sage-Grouse-Management
This website contains comprehensive information on Wyoming Sage-Grouse Management, Governors' Freudenthal and Mead Sage-Grouse Executive Order, Sage-Grouse decision documents, Density Disturbance Calculation Tool (DDCT), SGIT, Sage-Grouse Core Area maps and shapefiles, local working groups, and other sage-grouse information

Wyoming Wildlife & Natural Resource Trust (WWNRT)
2300 Capitol Ave, Ste 161D, Cheyenne, WY 82006
Main Line: 307.777.8024
www.wwnrt.wyo.gov

Glossary of Terms

Active lek: Any lek attended by a male sage-grouse during the most recent strutting season.

Bunchgrass. A grass that grows in a clump and has roots that extend downward and outward from the base of the bunch but do not sprout laterally, forming sod.

Brood: A group of young animals, usually birds, hatched at the same time and raised together.

Brood-rearing: The act of raising young, a brood, to an age of self-sufficiency.

Canopy cover: The percentage of the ground covered by a vertical projection of the plant.

Clutch: Number of eggs laid in a nest.

Conservation Measure: Any action to protect, enhance, and/or restore sage-grouse habitat to minimize or eliminate identified threats on a given piece of land.

Core Area Strategy: A policy framework by which to apply a set of conservation actions to core population concentration areas of greater sage-grouse whereby concentrated efforts can effectively ensure long-term greater sage-grouse species survival.

Depredation: The act of preying on nests, chicks, or adults.

Ecosystem: All elements and relationships between the elements that make up an area, including all plants, animals, microorganisms, water, soil, and people.

Endangered Species Act: A U.S. law passed in 1973 designed to protect and recover imperiled species and the ecosystems upon which they depend. Under the ESA, a species may be listed as either endangered or threatened. "Endangered" means a species is in danger of extinction throughout all or a significant portion of its range. "Threatened" means a species is likely to become endangered within the foreseeable future. (USFWS 2013)

Forb: A broad-leafed flowering plant.

General Habitat Management Areas: Occupied (seasonal or year-round) habitat outside of priority habitat. These areas have been identified by the BLM in coordination with respective state wildlife agencies (USDOI 2015).

Improper grazing: Grazing at an intensity or in ways that impair ecosystem functions of the sagebrush ecosystem. (USFWS 2015)

Invasive annual grasses: Non-native grasses that live for one growing season, produce large amounts of seed, and threaten native plants through aggressive competition.

Lek: A traditional courtship display area attended by male sage-grouse in or adjacent to sagebrush-dominated habitat. A lek by the Wyoming Game and Fish Department is designated based on observations of two or more male sage-grouse engaged in courtship displays. Before adding the suspected lek to the database, it must be confirmed by an additional observation made during the appropriate time of day, during the strutting season. Signs of strutting activity (tracks, droppings, feathers) can also be used to confirm a suspected lek.

Sub-dominant males may display on itinerant (temporary or satellite lek) strutting areas during population peaks. Such areas usually fail to become established leks. Therefore, a site with less than five males are observed strutting is generally confirmed active for two years before adding it to the lek database. (USFWS 2013)

Lek complex: A lek or a group of leks within 2.5 km (1.5 mi) of each other between which male sage-grouse may interchange from one day to the next. Fidelity to leks has been well documented. Visits to multiple leks are most common among yearlings and less frequent for adult males, suggesting an age-related period of establishment (Connelly et al. 2004).

Priority habitat: Sage-grouse priority habitats are areas that have the highest conservation value for maintaining or increasing sage-grouse populations. These areas would include breeding, late brood-rearing, winter concentration areas, and where known, migration or connectivity corridors. Sage-grouse priority habitat includes core plus connectivity habitat (USDOI 2015).

Priority Habitat Management Area: Sage-grouse priority habitats are areas that have the highest conservation value for maintaining or increasing sage-grouse populations. These areas would include breeding, late brood-rearing, winter concentration areas, and where known, migration or connectivity corridors. Sage-grouse Priority Habitat Management Area includes core plus connectivity habitat (USDOI 2015).

Riparian area: An area of land between dry uplands and a river or stream that is influenced by water. Vegetation is in this area is usually subirrigated.

Sagebrush Focal Area: Areas recognized by U.S. Fish and Wildlife Service as "strongholds" for greater sage-grouse where the highest densities of greater sage-grouse are noted, and habitat characteristics are present for the persistence of sage-grouse.

Sagebrush steppe: An arid to semi-arid, lowland area containing an ecologically diverse sagebrush/bunchgrass plant community.

Succession: The changes in species in a plant community over time, sometimes years or decades, particularly after a major disturbance such as fire.

Umbrella species: A species having a large home range with habitat that overlaps with that of many other species. By protecting umbrella species, other species using the same range will also be protected.

Understory: The plants growing underneath the sagebrush canopy (i.e., in the shade and protection of the sagebrush plant) and in interspaces between shrubs in sagebrush communities.

Vector: An organism, usually a biting insect or tick, that transmits a disease to a human or animal.

Leanne Correll

Frequently Used Acronyms

AIM	Assessment Inventory and Monitoring
BLM	Department of Interior, Bureau of Land Management
BMP	Best Management Practices
CCA	Candidate Conservation Agreement
CCAA	Candidate Conservation Agreement with Assurances
COT	Conservation Objectives Team
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
GHMA	General Habitat Management Area
GIS	Geographic Information System
GPS	Global Positioning System
GRSG	Greater sage-grouse *Centrocercus urophasianus*
HAF	Habitat Assessment Framework
LWG	Local Working Group
MOU	Memorandum of Understanding
MZ	Management Zone
NEPA	National Environmental Policy Act
NRCS	USDA Natural Resources Conservation Service
PA	Participating Agency
PAC	Priority Area for Conservation
PHMA	Priority Habitat Management Areas
RMP	Resource Management Plan
ROD	Record of Decision
S&G	Standards and Guidelines
SFA	Sagebrush Focal Area
SGI	Sage Grouse Initiative
SGIT	Sage-Grouse Implementation Team
USFS	Department of Agriculture, United States Forest Service
USFWS	Department of Interior, United States Fish and Wildlife Service
WAFWA	Western Association of Fish and Wildlife Agencies
WGFD	Wyoming Game and Fish Department

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J. Derek Scasta

Observation Data Sheet

IMPORTANCE OF LOCAL OBSERVATIONS

Local observations of sage-grouse are important for many reasons. Documenting observations is beneficial for the landowner's own purpose of land management. Observations are also important for future status reviews of the greater sage-grouse. Some examples of observations are listed below:

- Number of birds observed on leks
- General locations of leks (GPS coordinates if possible, allotment, or nearest highway)
- Number of sage-grouse broods
- Activity of birds seen in the field (nesting, feeding, dead, etc.)
- Predators noticed in the area of known leks and nests (coyotes, foxes, ravens, etc.)
- Noticeable changes in habitat (sagebrush cover, increase in cheat-grass, etc.)

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DATA COLLECTION FORM

Date	Location	Observation

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