Greater Sage-Grouse
(*Centrocercus urophasianus*)

Photo: U.S. Fish and Wildlife Service

The sustainability of the greater sage-grouse (*Centrocercus urophasianus*) is entirely dependent on intact expanses of sagebrush. The sage-grouse is one of over 350 plant and animal species that are sagebrush obligates; a high proportion of these are endemic, threatened, or endangered, because the sagebrush community is one of the most-altered vegetation classes in the western states (Connelly et al. 2004). Over the last century, the sage-grouse has been reduced to 56% of its former range westwide. The U.S. Fish and Wildlife Service (USFWS) recently gave the greater sage-grouse candidate status rather than listing it as threatened or endangered—stating that it warrants protection, but that other species, facing greater and more immediate threats, take precedence (USFWS 2010). A court ruling in 2011 followed a number of law suits filed against the USFWS for delaying full Endangered Species Act protection for the grouse; it gave the USFWS until 2015 to decide the bird's status. In the interim, the BLM will review Resource Management Plans throughout the range of the greater sage-grouse and revise or amend them if necessary to incorporate sage-grouse conservation measures (BLM 2011a).

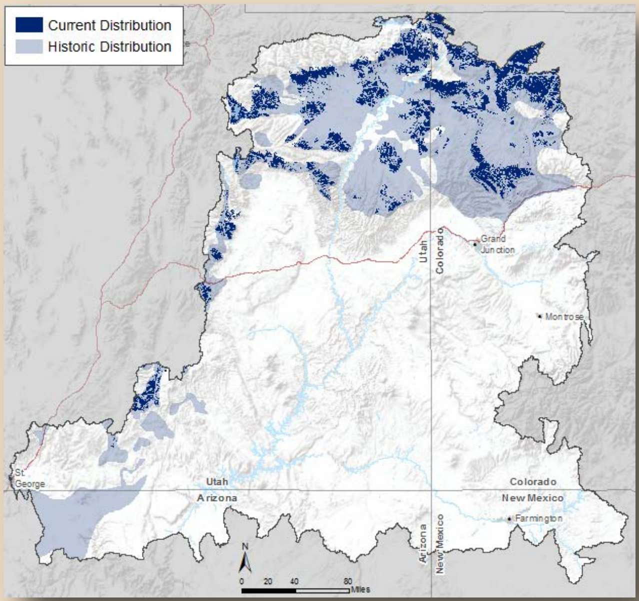

Figure 1. Map shows historic (light blue) and current (dark blue) distribution of greater sage-grouse in the Colorado Plateau.

Across the species' range, trend results from research and monitoring of sage-grouse populations indicate general declines, but results vary depending on the region and the scale of the investigation. Breeding Bird Survey trend estimate data for the Southern Rockies-Colorado Plateau ecoregion showed a 7.1% per year decline for the period 1966–2009 and a 5.2% per year decline for the period 1999–2009 (Sauer et al. 2011). However, these trend results carry a caveat, since they reflect detection difficulties on existing Breeding Bird Survey routes and a small sample size (<14). Local trends differ when examined at a regional level. Utah and northwestern Colorado represent the southeastern-most extent of the species' current distribution, which has contracted to the north (Figure 1), based on evidence of historic distributions. Greater sage-grouse populations in northwestern Colorado still maintain some connectivity with sage-grouse strongholds in Wyoming and Montana. Colorado populations are relatively stable and have been increasing (about 1% per year) over the last 17 years (Connelly et al. 2004). Sage-grouse habitat in Utah connects to these northern populations through the Uinta Basin where sage habitats are heavily fragmented. Sage-grouse populations are small and scattered along the western border of the Colorado Plateau ecoregion, and several small populations have been recently extirpated from former leks in southern Utah (Connelly et al. 2004). Annual rates of change in Utah populations indicate a long-term decline from levels of the late 1960s and early 1970s, when populations were approximately 2-3 times higher than current numbers (Connelly et al. 2004). The number of males per lek has decreased significantly and lek size has also decreased since the late 1960s, although there was a gradual increase in number of males per lek between 1997 and 2005 (UDWR 2009). In an examination of available data, Connelly at al. (2004) determined that sage-grouse populations declined at an overall rate of 0.35% per year in Utah from 1965 to 2003.

Thousands of pages have been written about sage-grouse functional requirements and threats to their future productivity; for a detailed review of greater sage-grouse related population ecology, data, study results, and literature, see Connelly et al. (2004) and Knick and Connelly (2011). Sage-grouse need large contiguous patches of sagebrush habitat because their functional habitat requirements differ by season and are quite specific, based on percent sagebrush cover and height, percent herbaceous cover and height, distance to other seasonal habitat types, and topographic position (Connelly et al. 2000). Access to several types of seasonal habitats for lekking, nesting, brood-rearing, and wintering is important for reproductive success, chick survival, and recruitment. Sagebrush patches used for nesting and brooding may be under 100 ha and located within a few kilometers of leks, but distances traveled by male grouse from lek to summer habitat and for all grouse between summer and winter ranges may be as much as 35–50 km (Connelly et al. 2004).

The species is sensitive and easily disturbed by land use activities that subdivide the landscape, disrupt the birds' site fidelity to traditional lekking and nesting areas, and ultimately isolate remnants of the population. Widespread degradation and conversion of sagebrush communities has occurred over the last century with broad scale agricultural conversion in irrigable areas, sagebrush treatments to increase forage for livestock on rangelands, the introduction of invasive annual species, and subsequent changes in fire regimes. In somewhat higher and more mesic areas, a cycle of grazing, leading to a decrease in fire frequency, has resulted in pinyon and juniper encroachment into sage grouse habitat and a reduction in ground cover perennials and forbs. Elsewhere, the invasion of cheatgrass (*Bromus tectorum*) and an associated increase in fire frequency has resulted in extensive loss of sagebrush stands that may take several decades to recover (Connelly *et al.* 2004, Crawford et al. 2004). Agricultural fields and irrigation canals affect 32% of sagebrush habitat in 9 western states (Connelly et al. 2004). In recent decades, exurban growth, expressed as rural small parcel development, has increased the fragmentation of sage habitat in former rangelands. The subsequent expansion of road networks, even low-volume secondary roads, negatively affects sage grouse. Recent studies have indicated that minimal road traffic (1–12 vehicles/day) reduces female grouse nest initiation (Lyon and Anderson 2003) and the number of breeding males displaying at leks (Holloran 2005). Powerlines and communications towers increase the pressure from predators and provide perches for raptors as do fences, which also cause direct mortality of sage grouse through collision and entanglement. Fences within 1.25 miles of active leks and fence densities > 1.6 miles/mile^2 of fence have been shown to increase risks for sage-grouse (thresholds listed in BLM [2011b], adopted from a study by Stevens [2011]).

Oil and gas drilling is the most pressing current and future threat to the sustainability of the sage-grouse in the Colorado Plateau. Increasing demand, a desire for energy security, favorable pricing, and recent extraction methods (e.g., fracking, see Section 4.1.4, Aquatic Resources of Concern) that retrieve oil and gas once thought too difficult and expensive to extract have created intense pressure to drill on public land

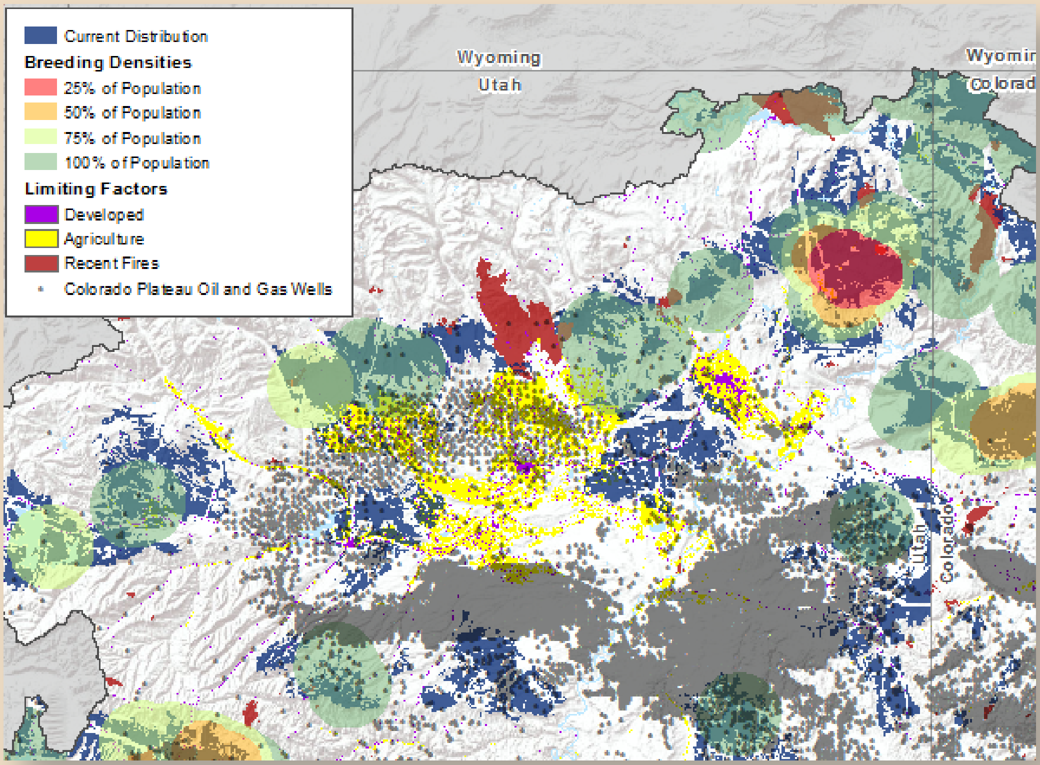

Figure 2. Map indicates sage-grouse activity areas and major stressors in the Uinta Basin: sage-grouse current distribution (blue areas), active leks (red, orange and green circles), oil wells (gray areas), agricultural areas (yellow), recent fires (irregular red polygons), and urban areas (purple).

in sagebrush habitats. Westwide, seven million hectares (~17,300,000 acres) of public lands—or 44% of the lands that the federal government controls for oil and gas development—have been authorized for drilling within distribution of the greater sage-grouse (Naugle et al. 2011). The sage-grouse has already been marginalized to the edges of the Uinta basin by oil and gas fields (gray areas in Figure 2) and other change agents (wildfire, urban and agricultural areas, Figure 2). Several long-term studies of sage-grouse response to oil and gas development in Wyoming have shown that the birds are sensitive to road density, traffic volume, noise, distance to wells, and well density (Holloran 2005, Walker et al. 2007, Doherty 2008, Harju et al. 2010). Walker et al. (2007) found that current management practices do not prevent impacts to the number of males attending sage grouse leks. In a 12-year study of 702 leks in Wyoming, Harju et al. (2010) found that impacts began occurring at well-pad densities as low as 0.396 well pads/km^2 (1 well pad/mile^2) and 0.772 well pads/km^2 (2 well pads/mile^2). Harju et al. (2010) also recorded that common well pad densities of 1.54 and 3.09 well pads/km^2 (4 and 8 well pads/mile^2) were associated with lek attendance declines ranging from 13.0% to 74.0% and 76.6% to 79.4%, respectively. Other seasonal habitats, such as winter habitat, are very important to sustain sage-grouse populations, but winter habitats are not regulated in terms of well pad densities. Doherty (2008) found in a winter habitat study that sage-grouse were 1.3 times more likely to occupy sagebrush habitats that lacked wells within a 4-km^2 area, compared to sage habitats that had a maximum density of 12.3 wells/4 km^2 (8 wells/mile^2).

Any attempt to strike a balance between conservation and energy development must have science-based tools to apply the information to a range of alternative solutions. The map of range-wide breeding densities is one such tool (Figure 3)—it can assist in cross-jurisdictional planning among federal and state agencies and local working groups (Doherty et al. 2010). Similar maps exist for sage-grouse management zones and individual states. The four colors of mapped dots represent the smallest area necessary to contain 25%, 50%, 75%, and 100% of nesting sage-grouse populations range-wide. The red and orange dots represent the highest densities of breeding males and the highest priority leks for protection where development may be restricted. Blue and green dots may be leks supporting smaller populations that are candidates for restoration or to maintain as nodes of connectivity with more productive sites (Doherty 2008). Some proportion of these lower productivity sites may be sacrificed to development. A map such as this provides a focus for regional planning and coordination among various agencies; local areas identified for possible development will require additional scrutiny for other important aspects of sage-grouse ecology such as chick rearing and winter habitat, seasonal migration corridors, and connectivity with other populations. The BLM and state agencies have collaborated on developing priority habitat areas that include breeding, brood-rearing, and winter concentration areas. Planning proposals may limit human disturbance in priority habitat. One proposal suggests that human-caused disturbance in priority habitats would be limited to less than 2.5% of the species' total habitat within that priority area (BLM 2011c); however, this is not a final determination—many proposals will be discussed over the next three years before the 2015 sage-grouse listing decision.

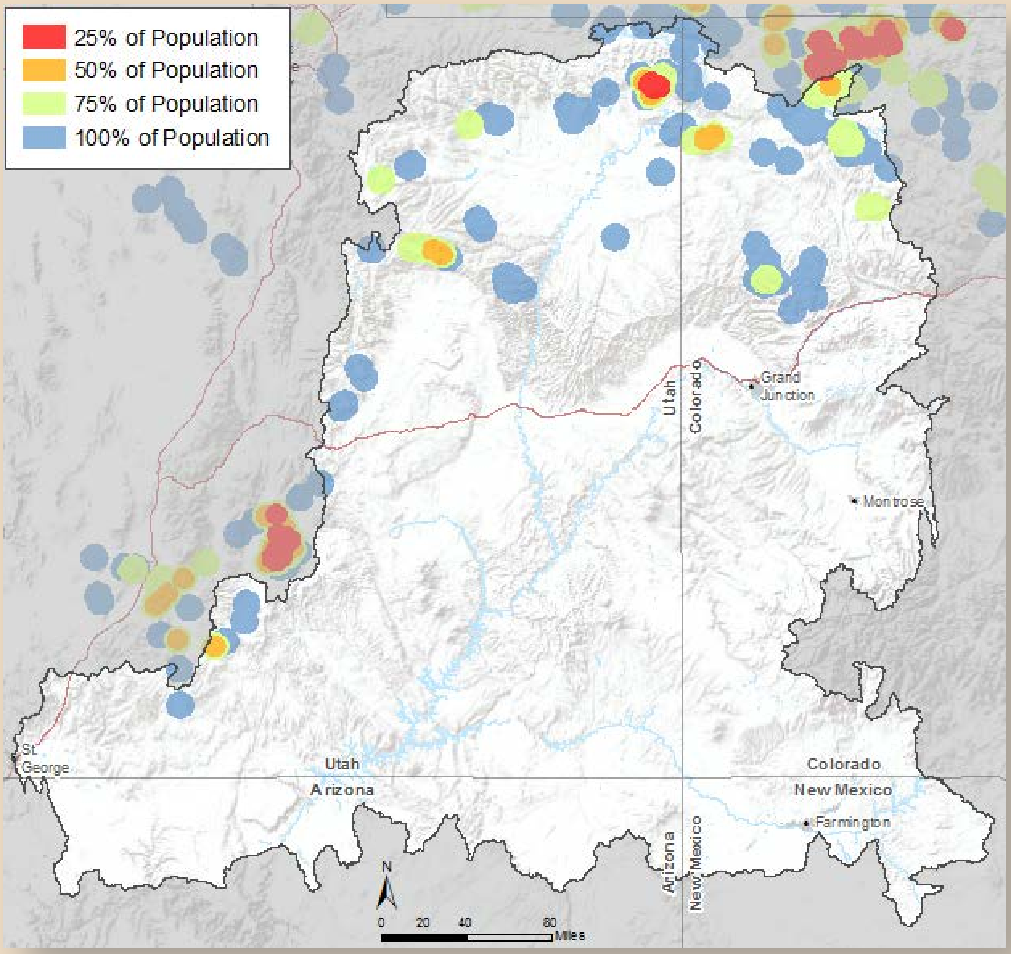

Figure 3. Sage-grouse breeding bird density map identifying buffered lek areas with red and orange symbols supporting the highest density of breeding males (from Doherty et al. 2010).

Status

Current distribution was evaluated for each wildlife species conservation element against the overall intactness model, which provides a regional perspective of vegetation condition, habitat quality, development profile, and natural habitat fragmentation patterns. It is relatively easy to test specific thresholds for individual species by altering the intactness model. As an example, for sage grouse winter habitat, the logic model was constrained with a threshold of >12 wells per 4 km^2 grid cell (>12 wells being false or unacceptable), a well density and activity level known to be limiting to sage grouse on their wintering grounds as discussed above (Doherty 2008); this minor adjustment to the model put 2% more sage grouse habitat into the very low intactness category (Figure 4). This is not a prescription, but an example to demonstrate how the model can be modified to test various management scenarios.

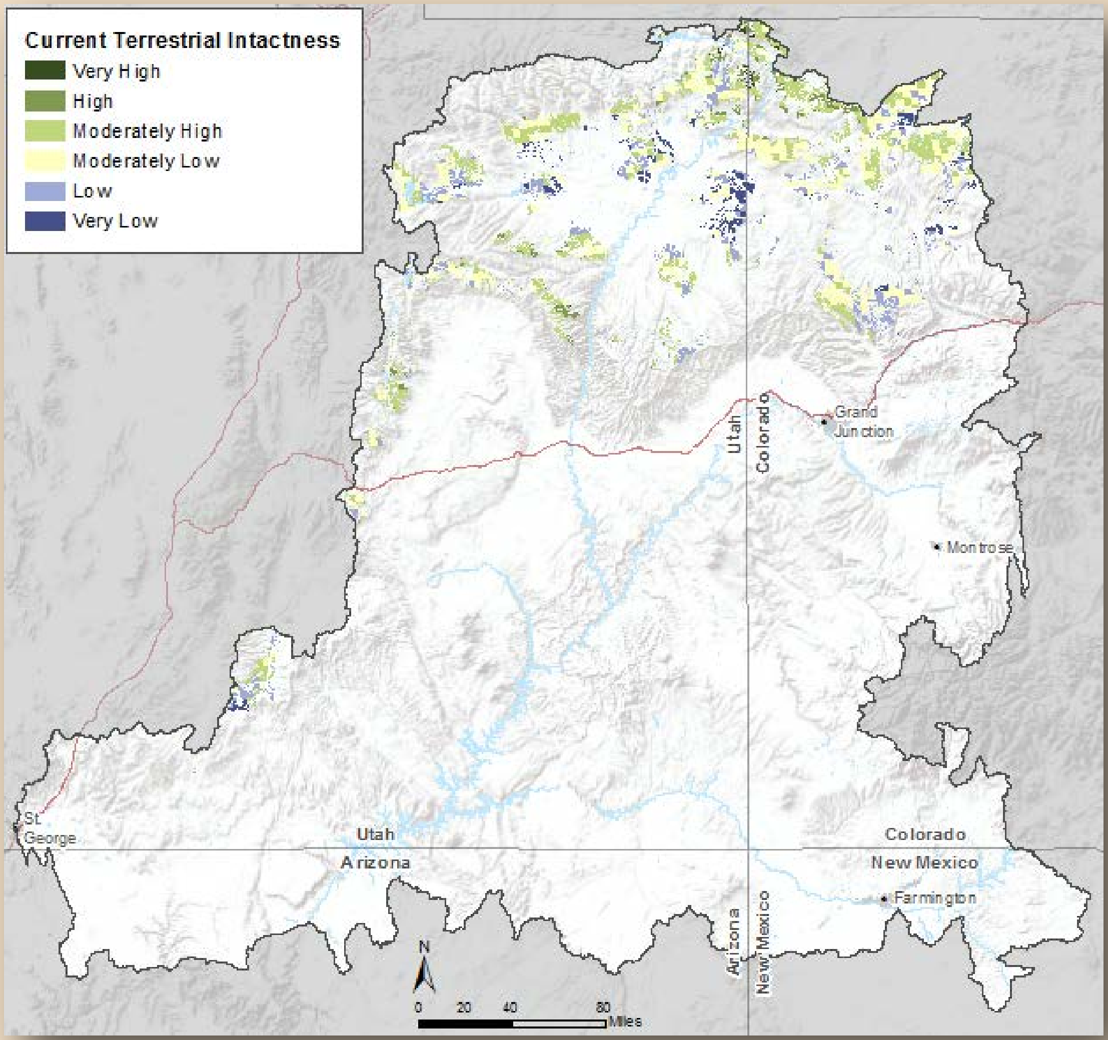

Figure 4. Current status for sage-grouse obtained from overlaying current distribution and the current landscape intactness model. A threshold of >12 wells/4 km^2 (8 wells/mi^2) was applied to the model to represent a known disturbance affecting sage-grouse populations.

Development Scenario (2025)

> MQ D6 What terrestrial species are vulnerable to change agents in the near term horizon, 2025? Where are these species and sites located?

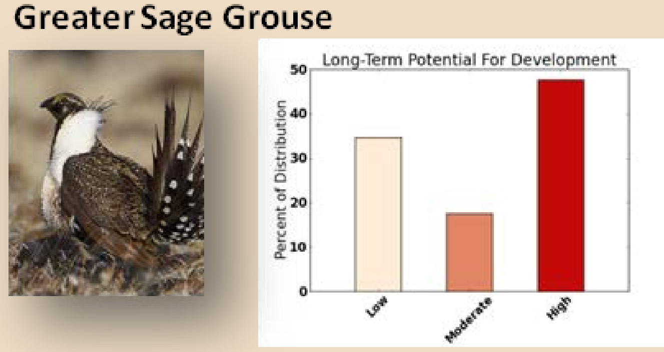

Figure 5. Histogram shows risk to sage-grouse from potential energy development with nearly 50% of its distribution in the High category.

As discussed above, oil and gas drilling is the most pressing current and future threat to the sustainability of the sage-grouse in the Colorado Plateau. Figure 2 showed the current situation for sage grouse in relation to human disturbances, and oil and gas in particular, in the Uinta Basin. The pressures on sage-grouse and its sagebrush habitat from oil and gas are increasing. When sage-grouse distribution was compared to the 4 km results for potential energy development, sage-grouse showed the highest risk of any conservation element from potential energy development with nearly 50% of its existing distribution in the high category with about another 18% in the Moderate category (Figure 5).

Copeland et al. (2009) created a model of oil and gas potential using geological and geophysical predictor variables, and they developed two build-out scenarios—anticipated and unrestrained—based on leasing history, recent increases in leasing based on increased demand, and agency (BLM) projections (Figure 6 below for the Uinta/Piceance Basin). Based on 2007 lek counts, Copeland et al. (2009) predicted a 7% sage-grouse population decline in the anticipated scenario and a 19% decline in the unrestricted scenario rangewide (added to declines that have already occurred).

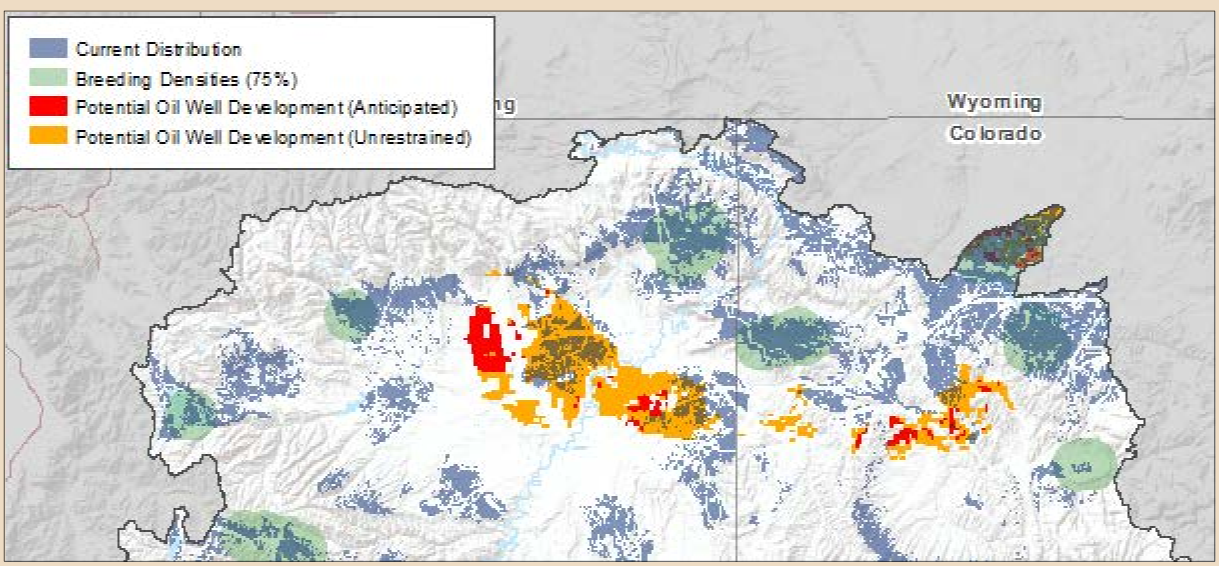

Figure 6. Map adapted from Copeland et al. (2009) for the Uinta/Piceance Basin showing coincidence of greater sage-grouse distribution and productive leks with two near-term future energy development scenarios. Map symbols represent current sage-grouse distribution (blue areas), productive sage-grouse leks (green symbols), and anticipated and unrestrained oil well development (red and orange areas).

In addition to sage-grouse, other sagebrush-dependent species are affected by the proliferation of drill pads; two of these species, pronghorn (*Antilopcapra americana*) and mule deer (*Odocoileus hemionus*) are REA core conservation elements. A model such as this offers an important tool for sage grouse conservation to be used with information on other major stressors and seasonal habitats. Note when comparing the map in Figure 6 to the previous map of lek densities (Figure 3) that the 75% breeding density symbols in the future development scenario (green circles) subsume the red, orange, and green symbols in the previous map, indicating the most productive sage-grouse leks. A number of blue symbols, representing less-productive leks that appeared in the previous map have been omitted from this future development scenario (Figure 6).

Climate Change Scenario (2060)

MQ D6. What terrestrial species are vulnerable to climate change in the long-term change horizon (2060)?

Key elements from the complex collection of climate change MAPSS results, such as potential for seasonal temperature and precipitation change and potential for vegetation change, were combined to create an overall relative climate change map (Section 5.4). The distribution of sage grouse was then overlaid on the climate change potential map to represent sage-grouse exposure to climate change (Figure 7).

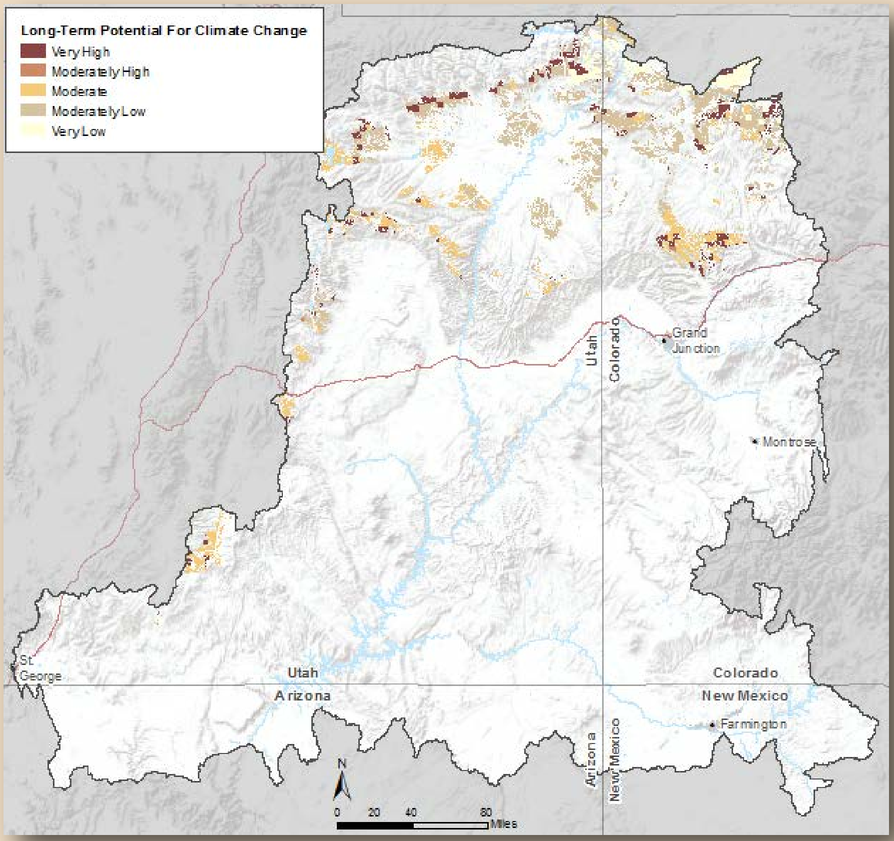

Figure 7. Map shows long term potential (2060) for climate change overlaid with the distribution of greater sage-grouse to produce a map representing sage-grouse exposure to climate change.

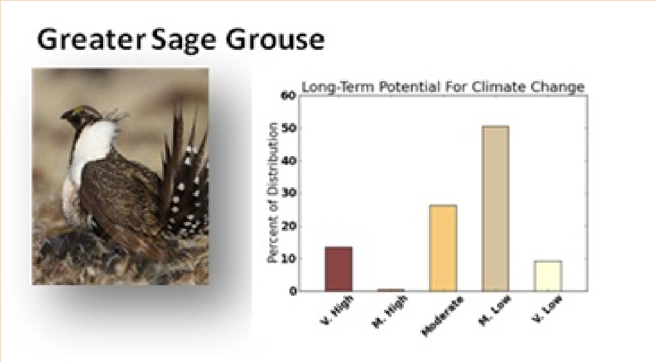

Figure 8. Histogram shows potential vulnerability to climate change for sage grouse with about 85% of its distribution in the moderate to very low range.

The amount of area in each class in the climate change map, when summarized in a histogram, indicates that about 85% of sage grouse distribution is in the moderate to very low categories (Figure 8). However, being a sagebrush obligate species, sage-grouse is very much tied to the condition of its sagebrush habitat. Of the vegetation communities, those showing the highest exposure to climate change in this analysis include the shrublands, particularly the Intermountain Basins Big Sagebrush and Montane Sagebrush Steppe (Figure 9).

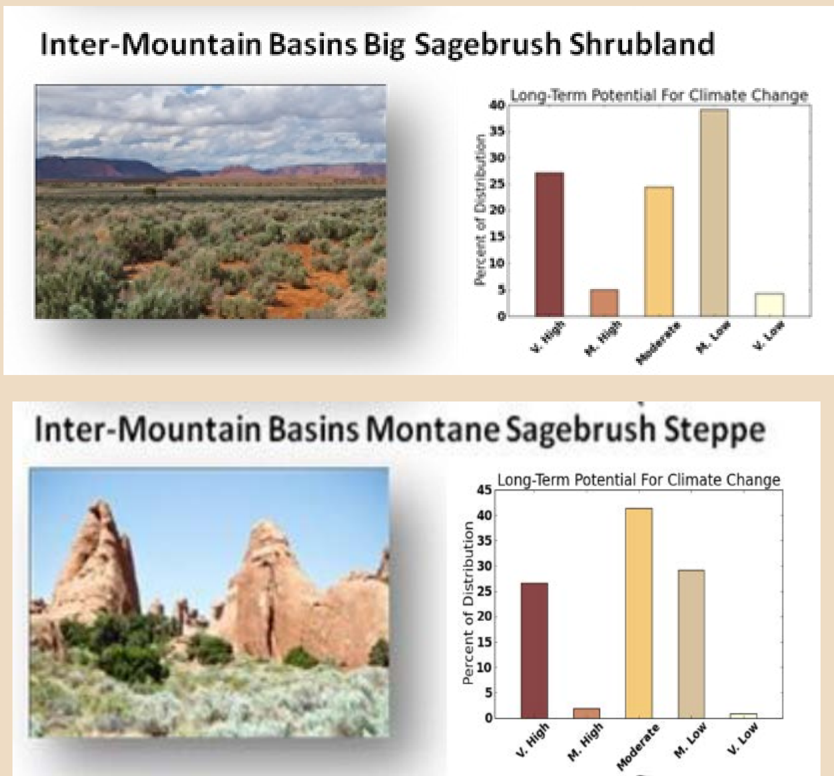

Figure 9. (Top): Histogram showing exposure to climate change for vegetation community big sagebrush shrubland and (Bottom): montane sagebrush steppe community exposure to climate change.

Almost 30% of the distribution of these two sage communities is in the High to Moderately High potential for climate change. Other estimates project that about 12% (or 87,000 km^2) of the current distribution of sagebrush will be lost with each 1° C increase in temperature (Neilson et al. 2005). However, any prediction is subject to innumerable conflicting variables and possible outcomes. For example, the largest areas of sagebrush in the Colorado Plateau occur in the northernmost portions, in the Uinta and Piceance Basins. This portion of the ecoregion is north of the influence of the summer monsoon; it may also be considered transitional to the mid- and northern latitudes, where climate change predictions may differ from those for the southwestern region. For example, some models predict that winters in mid-latitudes will be wetter as well as warmer (Miller et al. 2011). Increasing temperatures and increased atmospheric carbon dioxide favor invasive annual grasses like cheatgrass and also create an increasing incidence of fire that will favor the continued expansion of invasive annuals (Miller et al. 2011). Sagebrush communities may be further squeezed between saltbush incursion at lower elevations (that become climatically inhospitable to sagebrush) and woody vegetation infilling montane sagebrush habitats at higher elevations. Every encroachment into and fragmentation of sagebrush habitat reduces sage-grouse distribution and abundance. Thus, although climate change was not a major factor in determining candidate status for listing the greater sage-grouse (USFWS 2010), climate change will interact with other change agents (e.g., oil and gas development, invasive species, and fire) that have already degraded and reduced sage-grouse habitat to further threaten the sustainability of the species. Agencies that adopt a management strategy that withdraws core sage grouse areas from development must face the prospect that climate change may make these areas unsuitable for sage grouse. A core area strategy that works for today may have fewer options for future sage grouse conservation if the distribution of sagebrush habitats changes significantly (Smith et al. 2011).

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