Desert Shrublands

Photo courtesy of WGFD

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Habitat Description

Desert shrublands typically occur in basins at elevations between 4,980 and 7,220 feet (Colorado Natural Heritage Programs website) where less than 10 inches of precipitation falls annually (Knight 1994). Soils are often poorly developed and are characterized by being fine-textured, moderately deep, with lower infiltration rates, and a tendency to alkalinity or salinity. With the exception of soil salinity, desert shrublands share many features with sagebrush habitats including a predominance of shrubs, moisture and nutrient limitations to plant growth, and sensitivity to various forms of herbivory (Knight 1994).

Desert shrub communities vary from almost pure stands of single species to fairly complex mixtures. Common Wyoming desert shrubs include greasewood, shadscale, fourwing saltbush, Gardner's saltbush, winter-fat, spiny hop-sage, and kochia which are all characteristic of the Great Basin Deserts to the west (Knight 1994). Cushion-plant vegetation is a community of forbs that commonly provide ground cover under similar location and climate conditions as desert shrubs, but are a distinct form of habitat on windblown rims and rock outcrops in south-central Wyoming (Jones 2005). The composition and distribution of plant species is most heavily influenced by complex relations among physical, chemical, moisture, and topographic gradients (Blaisdell and Holmgren 1984). Greasewood desert shrubland and saltgrass meadows are characteristic of playas (small basins that periodically fill with water) and other comparatively wet depressions (Knight 1994). Bud sagebrush, early sagebrush, and bird's-foot sagebrush are also common short-statured shrubs found in these habitats (Winward 2004). Basin big sagebrush is often found along intermittent drainages (NatureServe 2010). Uplands are composed of mixed desert shrublands, salt desert shrublands, and desert grasslands. Wyoming big sagebrush-dominated shrublands are often found intermingled with desert shrublands, where soils are less saline and better drained, and on the lee side of slopes where snowdrifts form. Expanses of sagebrush steppe often border desert shrublands at slightly higher elevations or where annual precipitation is greater (Knight 1994). Cool-season grasses associated with desert shrublands include Indian ricegrass, squirrel-tail, wild ryes, western wheatgrass and Sandberg bluegrass. Important warm-season grasses are galleta, alkali sacaton, sand dropseed, and blue grama (Blaisdell and Holmgren 1984). A number of annual species may also grow in association with this habitat type, although they are usually rare and confined to areas of recent disturbances (Blaisdell and Holmgren 1984). Perennial forb cover is generally sparse, although in some areas woody aster, Hooker's sandwort, Hood's phlox, and globemallow are common (NatureServe 2010).

Desert shrublands have low primary productivity due to dry conditions, cold temperatures, high soil salinity, and a short growing season. Bare ground is common. Sparse plant cover, along with fine-grained saline soils, makes this habitat type vulnerable to water and wind erosion. Many areas within this habitat resemble badlands. Desert pavement and coppice dunes often form in mixed-desert shrublands. Wind can erode silt and sand, leaving a surface of pebbles adjacent to small dunes, where finer particles accumulate around shrubs (Knight 1994). Some desert shrubland soils and plants have high levels of selenium, a naturally occurring chemical element that can be toxic at high levels. High erosion rates in desert shrublands raise concern about both salt and selenium water contamination.

The space between plants is frequently covered by a biotic soil crust (West 1982). This crust is important to long-term soil formation and stability, and its blue-green algal component is a major fixer of nitrogen.

Drought and herbivory are the most common disturbances in desert shrubland communities (Knight 1994). Fires occur infrequently, but can occur in stands of greasewood or mixed-desert shrublands where adequate fuel levels accumulate as a result of light grazing or the invasion of cheatgrass (Knight 1994). Unlike most species of sagebrush, many desert shrubs have the ability to sprout following disturbance.

Land uses that occur in desert shrublands habitats include livestock production, energy production and mining, wildlife habitat, and a variety of outdoor recreational activities.

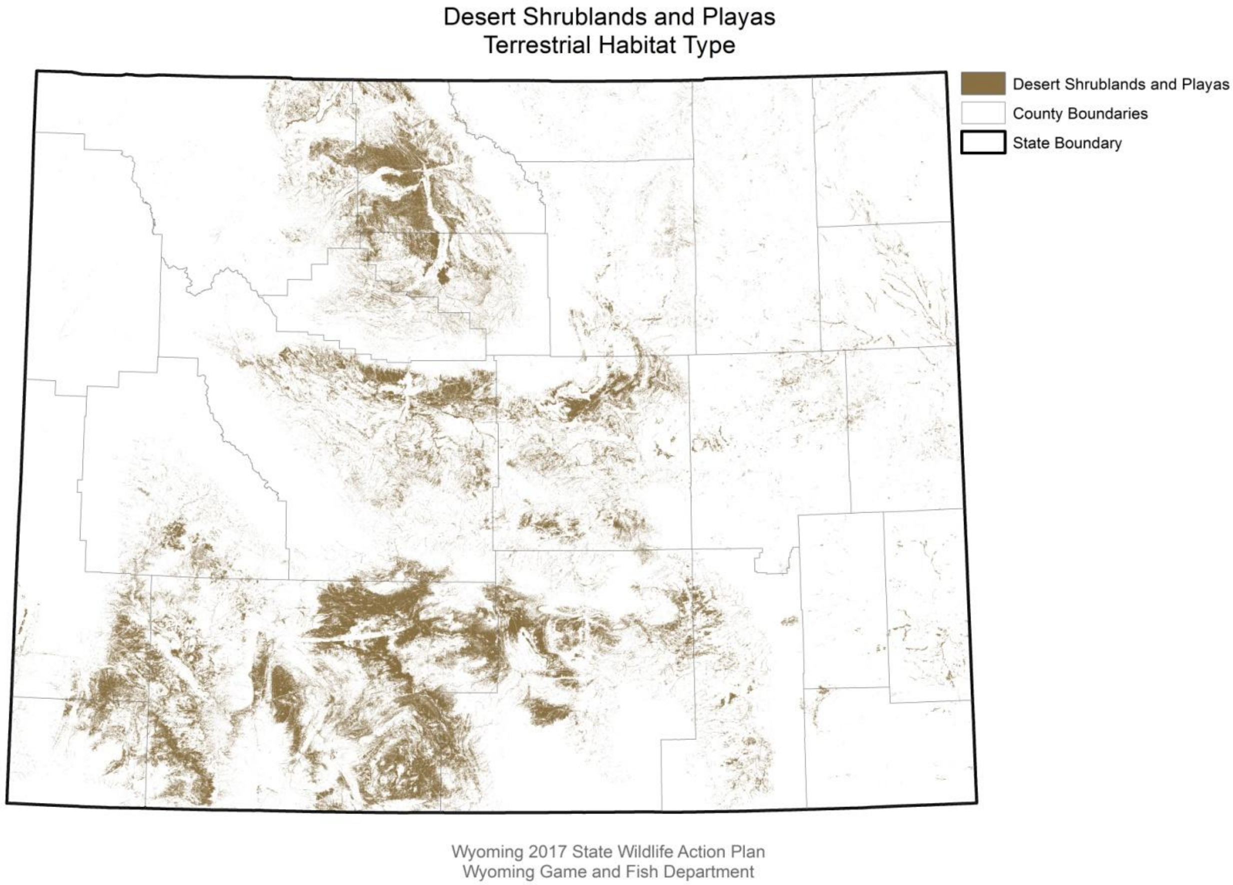


FIGURE 5. Wyoming Desert Shrublands

TABLE 5. Wyoming Desert Shrublands NatureServe Ecological Systems[1]

1. Western Great Plains Badland
2. Inter-Mountain Basins Shale Badland
3. Northwestern Great Plains Shrubland
4. Inter-Mountain Basins Semi-Desert Shrub-Steppe
5. Introduced Upland Vegetation – Shrub
6. Inter-Mountain Basins Mat Saltbush Shrubland
7. Inter-Mountain Basins Mixed Salt Desert Scrub
8. Inter-Mountain Basins Greasewood Flat

[1] Descriptions of NatureServe Ecological Systems which make up this habitat type can be found at: NatureServe Explorer: an online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, VA. http://www.natureserve.org/explorer.

TABLE 6. Wyoming Desert Shrublands Species of Greatest Conservation Need

Mammals
Great Basin Pocket Mouse
Olive-backed Pocket Mouse
Wyoming Pocket Gopher
Yuma Myotis

Birds
Burrowing Owl
Brewer's Sparrow
Ferruginous Hawk
Greater Sage-Grouse
Loggerhead Shrike
Mountain Plover
Sagebrush Sparrow
Sage Thrasher

Reptiles
Great Basin Gophersnake
Greater Short-horned Lizard
Midget Faded Rattlesnake
Northern Tree Lizard
Plains Hog-nosed Snake
Plateau Fence Lizard
Prairie Rattlesnake

Amphibians
Great Basin Spadefoot
Great Plains Spadefoot
Western Tiger Salamander

Desert Shrublands Wildlife

Desert shrub communities serve as habitat for wildlife that range in size from insects and small mammals to birds and large herbivores. Animals, as well as plants, exhibit wide fluctuations in productivity from year to year, largely as a result of varying weather conditions.

The Wyoming pocket gopher, Wyoming's only endemic mammal, is associated with dry, salty, low-productivity sites. Although there is some overlap, Wyoming pocket gopher habitat is distinct from northern pocket gopher habitat in terms of soils and vegetation. Specifically, Wyoming pocket gophers tend to occur on flatter slopes with ample bare ground where Gardner's saltbush and winter-fat are present and Wyoming big sagebrush is subdominant. Wyoming pocket gopher soils have higher clay content and fewer coarse fragments when compared to northern pocket gopher soils (Keinath et al. 2014).

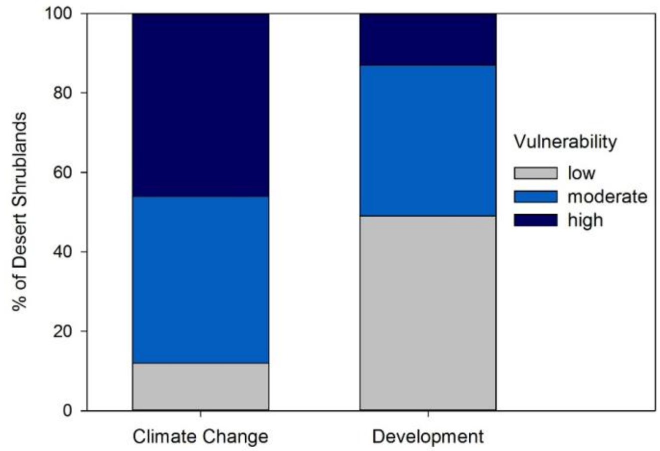
Game species found in desert shrublands habitat include mourning dove, sage-grouse, desert and mountain cottontails, pronghorn, and mule deer. Crucial winter range for pronghorn and mule deer has been designated in some desert shrublands areas. Pronghorn are more common than deer in salt-desert shrub vegetation; however, both are highly mobile and make much use of associated habitats, especially sagebrush and grasslands (Blaisdell and Holmgren 1984). Well known desert shrubland small mammals include the white-tailed jackrabbit and bushy-tailed woodrat. Common predators include coyote, bobcat, badger, great horned owl, golden eagle, Swainson's hawk, red-tailed hawks, and prairie falcon.

Mountain plover are one species of special concern due to their specific habitat needs in desert shrublands, particularly where they nest. On May 12, 2011, the U.S Fish and Wildlife Service announced the decision to withdraw the proposed listing of the mountain plover as a threatened species under the Endangered Species Act. Mountain plovers prefer flat terrain (less than 5% slope), with low-growing vegetation, and a minimum of 30% bare ground. Pesticide use to control grasshoppers and Mormon crickets can reduce prey availability for grassland birds, especially the mountain plover.

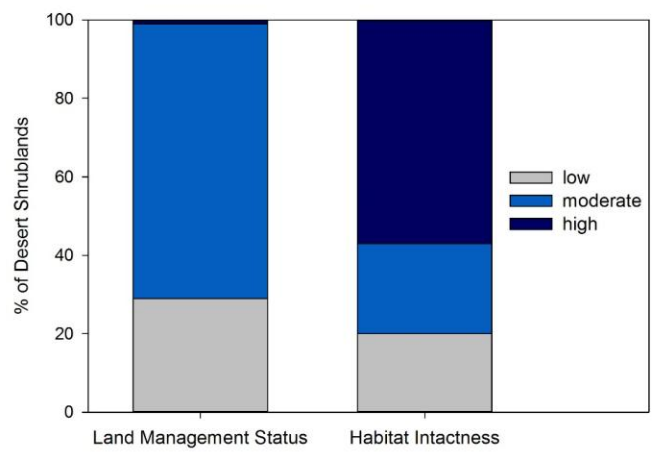
Invertebrates may be important to the overall wildlife value of desert shrub systems, similar to the way invertebrates operate in sagebrush systems where they may provide a crucial forage base, helping bridge seasonal shortages of protein (spring) and water (late summer, fall) for vertebrate wildlife.

Desert Shrublands Habitat Threats

Figure 6. Desert Shrublands Vulnerability Analysis



The colored bars show the proportion of the habitat type that was identified as having low, moderate, or high vulnerability to climate change or development, based on classification of scores ranging from 0 to 1 into the following categories: low (<0.34), moderate (0.34-0.66), and high (>0.66). Rankings for climate change or development vulnerability were based on the land area of the habitat type classified as having high vulnerability: low (<10%), moderate (10-33%), or high (>33%). Vulnerability was calculated as exposure minus resilience. Development vulnerability includes existing and projected residential, oil and gas, and wind energy development. Further details are provided in the Leading Challenges section of this report and in Pocewicz et al. (2014).



The colored bars show the proportion of the habitat type that was identified as having low, moderate, or high land management status or habitat intactness. For land management status, high corresponds to the percent of the habitat occurring in GAP status 1 or 2, moderate to the percent occurring in GAP status 2b or 3, and low to the percent occurring in GAP status 4. Rankings for land management status were based on the land area of the habitat type classified as having high status or legal protection: low (<10%), moderate (10-33%), or high (>33%). For habitat intactness, scores ranging from 0 to 1 were assigned to categories as follows: low (<0.34), moderate (0.34-0.66), and high (>0.66). Rankings for intactness were based on the land area of the habitat type classified as having high intactness: low (<25%), moderate (25-75%), or high (>75%).

Invasive plant species – High
Halogeton, Russian thistle, and cheatgrass are the three most significant invasive annual species in Wyoming desert shrublands. Alyssum, pepperweed, hound's-tongue, Russian knapweed, and whitetop are also common on bare ground.

Invasive species frequently become established in desert shrubland habitats adjacent to or within ephemeral drainages, near reservoirs, in areas of livestock overuse, or locations of high human traffic, such as roadways for recreation, energy development, or bentonite mining.

Halogeton and Russian thistle are primary invaders on clay soils in saline shrub plant communities where there is soil disturbance. Halogeton is extremely poisonous to sheep and is restricting winter grazing in some areas. The spread of halogeton could alter livestock distribution and encourage the conversion of sheep allotments to cattle allotments. These changes could further modify grazing dynamics and in turn influence plant diversity and seasonal use patterns by wildlife (A. Warren, personal communication, April 2010).

Increases in cheatgrass are considered to contribute to a shift from sagebrush dominance to greasewood dominance in some locations in Washington shrublands (Rickard 1964). Similar shifts could occur in Wyoming if cheatgrass becomes more abundant (Knight 1994). Increases in fire frequency in communities where cheatgrass is prevalent can decrease spring insect availability for birds and contribute to the spread of other invasive species.

Many invasive plant species decrease native plant diversity and reduce forage quality for wildlife and livestock that use these habitats (see Wyoming Wildlife Leading Conservation Challenges – Invasive Species). Additionally, the establishment of invasive species is correlated with increasing soil erosion and reductions in site productivity. Invasive plant species that become established in desert shrublands can serve as a seed source, facilitating their spread to nearby riparian and sagebrush habitats.

Incompatible energy development and mining practices – Moderate
Natural gas development is common in desert shrubland habitats and wind-power development is expanding. Energy development can result in direct and indirect impacts to wildlife species and their habitat (see Wyoming Wildlife Leading Wildlife Conservation Challenges – Energy Development). Direct impacts include the removal and fragmentation of desert shrubland habitats by activities such as mine excavation and the building of roads, drill pads, fences, power lines, and pipelines. Indirect impacts include increased human activity and noise. These impacts can displace animals and decrease reproductive success if animals are forced to use less productive habitats or expend more energy to avoid people. Soil disturbance from roads and other types of construction and increased vehicle traffic are significant contributors to the establishment and spread of invasive plant species.

Even more so than actual construction of energy production facilities, the establishment of roads can be problematic in desert shrubland habitats due to their length, drainage crossings, and overall change in hydrologic processes. Soil compaction due to road construction may be particularly important for burrowing mammals, including the Wyoming pocket gopher (Cudworth and Grenier 2015). Much of this habitat type is transected by roads and pipelines from past oil and gas explorations. Some older wells are being reworked, resulting in damage to previous reclamation efforts, which are slowly returning to pre-disturbance conditions. (E. Warren, personal communication, 12 November 2009). Reclamation can be difficult in desert shrubland habitats due to saline, fine-textured and unproductive soils, and low precipitation levels.

Off-road vehicle use – Moderate/Locally High
Off-road vehicle use, primarily by all-terrain vehicles (ATVs), is increasing in desert shrublands. Vehicle use off established roads

can enhance the spread of invasive species including halogeton, alyssum, pepperweed, and cheatgrass. Tires can damage biological soil crusts leading to decreased organism diversity, soil nutrients, stability, and organic matter. This can result in greater erosion and reduced water quality. Wildlife often avoid areas of increased noise and disturbance from outdoor recreational vehicles, and riding off-road can destroy the nests, eggs, and young of ground-nesting birds. These impacts can also lead to conflicts with hunting, wildlife viewing, and other forms of nature-based recreation. Managing off-road vehicle use can be difficult and controversial in desert shrubland habitats where new trails are relatively easy to create and where some off-road vehicle users have little value for what appears to be an unproductive and barren landscape.

Inappropriate grazing practices – Moderate

Desert shrublands are more sensitive to livestock grazing than the grasslands of the Great Plains, in part because their evolutionary history did not include large numbers of bison (Knight 1994). Cattle grazing can have profound effects on the composition of desert plant communities. Intensive, long-term grazing has been shown to decrease the abundance of perennial grasses and forbs and increase the amount of annual grasses and weeds in these areas (Rice and Westoby 1978, Brotherson and Brotherson 1981, Hanley and Page 1981, Medin and Clary 1990). Cattle grazing can also decrease the amount of litter (Milchunas et al. 1992), and moderate to intense grazing increases soil bulk density (Van Harren 1983) and decreases soil aggregate stability (Warren et al. 1986). Palatable species are most commonly damaged by growing season grazing, heavy use, or a combination of the two (Blaisdell and Holmgren 1984). Even under moderate stocking rates, the use of palatable species by livestock may be high, even if the plant is in low abundance. As a result, in overgrazed areas where a palatable species is poorly represented, its recovery can be especially difficult. When livestock graze in ephemeral riparian areas populated with rabbitbrush or greasewood, the biotic soil crusts can be damaged from trampling during wet periods, and soil compaction is common during dry periods.

Both stocking rates (Holechek 1988) and grazing season (Whisenant and Wagstaff 1991) have an influence on determining vegetation compositions and trends. In particular, these studies suggest that annual March-April grazing is an important cause of the deterioration of range conditions in some salt desert shrub ecosystem.

Wild horse numbers in the Adobe Town & Salt Wells herd management areas have been known to exceed the appropriate management level by two to three times (Bureau of Land Management 2010). Although wild horse diets typically are dominated by grasses, at high population levels and during drought, their diets shift more to shrubs, particularly winter-fat, saltbush, and sagebrush. During these periods, horse grazing may be particularly detrimental to the cover and vigor of these species.

Practices such as periodic rest, rotation of use, or adjustments in stocking rates have been demonstrated to improve range conditions in desert shrubland habitats (Blaisdell and Holmgren 1984). Desert shrubs such as shadscale and winter-fat have been known to decline following cessation of grazing, whereas perennial grasses and a few other species increase (Harper et al. 1990).

Rural subdivisions – Low

Rural subdivision and development can reduce, degrade, and fragment desert shrubland habitats (see Wyoming Leading Wildlife Conservation Challenges – Rural Subdivision and Development). Houses, outbuildings, and lawns directly replace native wildlife habitat. Soil disturbance from construction, year-round grazing of horses and other hobby livestock, and the use of nonnative plants as ornamentals can facilitate the establishment of invasive species (Maestas et al. 2002).

Wildlife commonly abandons or alters use of habitats with greater human and pet activity. Increased energy expenditures in avoiding people or greater use of lower quality habitats can decrease animal health and reproductive capacity. Greater road densities and traffic volume can increase wildlife–vehicle collisions. Predation on wildlife can intensify with greater numbers of domestic dogs and cats, as well as increases in generalist predatory species such as ravens and human-commensal species such as raccoons (U.S. Department of Agriculture 2007).

Current Desert Shrublands Conservation Initiatives

Controlling invasive species has received less attention in desert shrublands, compared to other habitats, because of low productivity and poor vegetative states that can require additional forms of treatment to restore sites to their natural conditions. Also, in desert shrubland habitats herbicide use can be restricted due to extended soil residence times as a result of low organic soil content. Most of the herbicides available for use by the Bureau of Land Management (BLM) have restrictions on spraying less than 200 feet from water sources. Weed Management Areas, organized by the County Weed and Pest Districts, and Coordinated Resource Management teams (CRM), which are generally landowner-driven and facilitated by the Wyoming Department of Agriculture, have been established in various locations to control invasive species in desert shrublands.

Several efforts focused on enhancing the wildlife compatibility of energy development in Wyoming encompass desert shrub habitats. The Wyoming Landscape Conservation Initiative (WLCI) is a multi-agency and stakeholder initiative focused on data collection, monitoring, research, and facilitating land management actions in southwest Wyoming. Its purpose is to protect or enhance wildlife habitat and other resource values in the face of intensive energy development. The Jonah Interagency Office (JIO) is an example of a mitigation fund that has been established to support projects to maintain important biological areas in the vicinity of the natural gas field near Pinedale, Wyoming. Similar mitigation activities are underway for other oil and gas fields, including the Continental Divide-Creston, Hiawatha, and Pinedale Anticline.

The BLM and other partners, including the Wyoming Game and Fish Department (WGFD), are developing transportation plans, many of which were established primarily for wildlife habitat. Enforcement of new state laws limiting the time when shed antlers can be collected west of the Continental Divide should help reduce disturbance to desert shrubland habitats in late winter and early spring when they are prone to erosion.

In general, adverse grazing impacts have been reduced in desert shrubland habitats with the adoption of grazing management practices that control grazing intensity, opportunity for recovery, and season of use. There are continuing efforts by the livestock industry, BLM, Natural Resources Conservation Service (NRCS), conservation districts, county extension, and sage-grouse working groups to promote best management practices to improve rangeland health. Some BLM grazing permittees are incorporating private monitoring efforts into their grazing operations in addition to the monitoring conducted by agencies.

Land use plans, such as the one developed by Carbon County promoting development close to existing infrastructure, help to maintain open space and wildlife habitats, as well as to provide more cost-efficient community services. Conservation easements have been acquired on desert shrubland habitats in a number of locations by land trusts operating in Wyoming.

Recommended Desert Shrublands Conservation Actions

Increase awareness about grazing best management practices in desert shrubland habitats.

Desert shrubland habitats are often used for wintering livestock. Early winter grazing has less impact on desert shrubland habitats than grazing in late winter or early spring. Sheepherders should also be encouraged to not keep their camps or flocks on areas known to support sage-grouse leks and nesting habitat.

Wild horse populations should be kept at herd objectives to avoid negatively affecting plant vigor and cover. Uses by wild horses, livestock, and wildlife should be evaluated simultaneously to address the needs of all large ungulates making use of this habitat type. Activities like grazing and events such as energy and water development, which may alter animal distribution patterns, and drought, should be taken into consideration when establishing herd objectives and grazing strategies

Increase invasive species mapping and treatment efforts in desert shrubland habitats.
Greater mapping of the locations of invasive species is needed, and new types of control technologies and treatments should be developed to advance reclamation efforts associated with energy and other forms of development. This would require additional soil testing and project trials. Greater attention should be placed on ensuring energy industry compliance with invasive species control permitting stipulations.

Enhance planning and mitigation efforts to minimize the negative impacts of energy development on desert shrubland habitats.
The development and implementation of energy development plans for oil, gas, and wind, is crucial to the success of accommodating growth in these industries while minimizing negative impacts to natural habitats and wildlife species. Bentonite mining should also be considered in these plans. Mitigation plans should stress avoiding biologically sensitive areas within project sites and directing off-site mitigation funds to nearby high-value wildlife locations. Energy-development planning and mitigation efforts could be specifically benefited by:

- Developing new mitigation and reclamation techniques and technologies for the harsh, unproductive environment found in desert shrubland habitats. Due to their low productivity, desert shrubland habitats can be slow to recover from disturbance. Even with good management or complete protection, direct revegetation is often necessary. However, the harsh environment usually makes the successful establishment of vegetation difficult (Bleak et al. 1965, Van Epps and McKell 1980). Special practices such as transplanting, watering, shading, soil additives, or extremely careful selection of plant materials may be necessary.
- Continuing research on the effects of energy development on desert shrubland wildlife species and ecosystems the Wyoming Chapter of the Nature Conservancy, Wyoming Natural Diversity Database, and Wyoming Game and Fish Department completed research evaluating the vulnerability of Wyoming terrestrial SGCN to oil, gas, and wind development. Vulnerability was investigated by evaluating each species' potential exposure and sensitivity to energy development. Exposure was evaluated through a GIS analysis that overlays distribution maps of SGCN with areas of known and projected energy development. Sensitivity was determined by examining habitat and behavioral attributes of SGCN as well as reviewing existing impact studies. Research results give an indication of which species and taxonomic groups are potentially vulnerable to development, as well as help direct future research to address information gaps. The project was jointly funded jointly by the U. S. Geological Survey, Wyoming Landscape Conservation Initiative (WLCI), and WGFD and can be found at:: http://www.nature.org/media/wyoming/wyoming-wildlife-vulnerability-assessment-June-2014.pdf.
- Encouraging, where appropriate, the implementation of mitigation measures and/or best management practices detailed within the Wyoming Game and Fish

Commission documents *Recommendations for Development of Oil and Gas Resources within Crucial and Important Wildlife Habitats* (Wyoming Game and Fish Department 2010a) and *Recommendations for Wind Energy Development in Crucial and Important Wildlife Habitat* (Wyoming Game and Fish Department 2010b). Sage-grouse habitat protection recommendations for uranium and bentonite mining as well as other significant surface disturbing activities are addressed in the Sage-grouse Core Population Area implementation recommendations available on the WGFD website.

- Reviewing management actions proposed by state and federal agencies involving desert shrubland ecosystems and associated wildlife habitats, and working closely with the Wyoming Governor's office, industry, private land owners, and agency staff during early stages of energy development project planning. The SWAP, SHP, and Sage-grouse Core Population Areas should be consulted during development and mitigation planning. Maintaining connectivity between core areas will be important for the long-term conservation of sage-grouse and other desert shrubland associated species.

The enforcement of reclamation and weed treatments in BLM Resource Management Plans conditions of approval (COAs) will help ensure the maintenance or restoration of the health of desert shrubland communities.

Manage off-road vehicle use in environmentally sensitive areas or during seasons where wildlife is particularly sensitive to disturbance.
More efforts should be made on public lands to identify areas that are appropriate and inappropriate for off-road vehicle use including using carsonite markers. Locations may vary seasonally to minimize disturbance to wildlife during critical periods such as when animals are on winter range or during nesting or fawning seasons. Public education should include increasing awareness of the ecological role of maintaining unbroken biological soil crust and the value of all types of vegetation.

Increase public awareness of wildlife values of desert shrublands.
Desert shrublands are often underappreciated and overlooked for wildlife conservation efforts due to their barren appearance and low productivity. Species such as Wyoming pocket gophers are desert shrub obligates while others species such as sage-grouse, loggerhead shrikes, pronghorn, and mule deer are seasonally dependent upon this habitat. Educational efforts should include increasing awareness about the importance of biotic soil crust to desert shrubland plants and ecology.

Desert Shrublands Monitoring Activities

Continue monitoring population trends or changes in distribution of desert shrubland SGCN and other obligates in order to infer changes in habitat quality or other threats.

More inventory and monitoring data for specific sites within Wyoming are needed to fully understand current plant communities, their health, and the effects of management practices upon desert shrubland habitats.
Basic long-term monitoring of desert shrublands condition can be accomplished by a combination of photo points (a series of photographs taken at specific points to identify vegetative changes) and monitoring residual plant cover. More long-term monitoring of the biotic integrity and the hydrologic function of desert shrubland sites can be determined through a combination of data collected by the belt transect method and either line-point intercept or gap intercept methods (Herrick et al. 2005). Long- and short-term monitoring efforts should occur at the same locations.

Monitor the size and landscape distribution of desert shrubland habitats through remote sensing.

Remote sensing is useful in tracking the size and distribution of desert shrublands in Wyoming. Information gathered would contribute to determining the cumulative impacts of activities and events such as energy development, rural subdivision, road construction, and the spread of invasive species. Monitoring should be conducted in relation to the possible effects of climate change.

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