

Shrubland Habitat Group

Mountain-foothills Shrub

1) Describe the habitat (Arno and Wilson 1986; Beidleman 2000; Bennet 1999; Brotherson et al. 1994; Cook et al. 1994; Hammond 1990; Howard 1997; Johnson 2000; Kay 1995; Knight 1994; Marshall 1995a, 1995b; Olson 1989; Zlatnik 1999b):

a) Historic conditions: Formed a patchy mosaic that included but was not limited to mountain mahogany, serviceberry, Gambel oak, antelope bitterbrush, skunkbush sumac, snowberry, hawthorn, wild plum, chokecherry, and boxelder. Frequent wildfires favored the expansion of many shrub communities, such as Gambel oak and serviceberry. Wildfires may have limited the expansion of other communities, such as mountain mahogany, which was largely confined to extremely rocky sites where fuel was sparse. Most communities probably exhibited an open canopy, young age classes, and low density, although multiple age classes existed. Fires in presettlement times were usually of low severity because of fuel discontinuity.

b) Present conditions: Mountain-foothills shrublands form pure or mixed stands that often include, but are not limited to mountain mahogany, serviceberry, Gambel oak, antelope bitterbrush, skunkbush sumac, snowberry, hawthorn, wild plum, chokecherry, and boxelder. Big and silver sagebrush stands often form mosaics with these shrubs, and numerous grass and forb species are associated with the shrub habitat. The mountain-foothills shrub community, which amounts to about 560,000 acres (226,000 ha) in Wyoming, usually exhibits a patchy mosaic of several codominant shrub species distributed across a heterogeneous landscape. Shrubland communities have demonstrated a variety of responses to human settlement, depending on which of the diverse shrub species are dominant. Fire suppression has allowed a gradual succession of many formerly open stands to dense shrublands or woodlands dominated by conifers. Serviceberry, Gambel oak, and skunkbush sumac communities have declined under the shade of developing canopies. Other communities, such as chokecherry and hawthorn, have increased in density and expanded into former grasslands due to fire exclusion and livestock grazing. The absence of fire has allowed mountain mahogany to increase in abundance, but it is becoming decadent on many sites and is unable to compete with associated conifers on some sites. Antelope bitterbrush communities have spread into ponderosa pine stands, but are becoming decadent as older plants are not replaced. Many formerly open shrub stands provide much greater fuel loads today, so when fires do occur they are likely to be more severe. Most shrub communities are stimulated by moderate browsing, but some may have deteriorated from overbrowsing by native ungulates and/or livestock.

2) Identify the issues:

a) Use: Foothills are linear features that add diversity to the plains and basins, usually providing more cover and a more mesic (moist) environment for plants and animals. Shrub communities provide important seasonal food and cover for many wildlife species at critical times of the year. In spring, many shrubs provide early forage and nesting opportunities both in cavities and on branches. In summer, many species use the shade that shrubs provide for feeding and resting. In late summer and fall, many shrubs produce edible seeds and fruits that are important to birds, bears, and other wildlife. In winter, they provide important cover and a large selection of forage types for wildlife species that have spent the summer at higher elevations. Shrublands also provide hunting opportunities and watershed protection.

b) Access: May be limited due to private ownership; however, privately owned areas are popular for housing and resort developments. In areas of public ownership, use and access have increased; there is now more recreation occurring in this habitat on public lands.

c) Problems: Lack of fire has changed the habitat, but ranches, summer homes, and resorts located in the foothills environment often prevent the use of prescribed burns. Housing and associated developments consume and fragment the habitat. Incompatible wildlife and livestock grazing place pressure on decadent shrub stands, and resprouting is often unsuccessful. Shrublands are occasionally cleared to increase forage for livestock or big game. Cheatgrass and other invasive species often invade shrub habitats after disturbances. The proximity of shrublands to environments that support cowbirds makes nest parasitism a problem. Conflicts over proper land use occur, primarily because of differing management priorities for private and public lands and because foothills landscapes provide an exceptional diversity of plants and animals, as well as desirable habitats for people.

d) What has been the cause of change to the habitat: Throughout Wyoming, the health, vigor, and reproduction of many mountain-foothills shrub communities are in decline. The two primary factors driving this trend are fire suppression and overbrowsing by wild and domestic ungulates. Shrub species differ in their responses to fire. In some cases, shrub communities have expanded into the surrounding grassland and conifer communities. In other cases, shrub communities have diminished under the shade of encroaching conifers. In general, however, fire suppression has caused most shrub communities to become dominated by old, decadent shrubs with considerable standing dead organic matter. Consequently, when fires do occur, their intensity is high and shrub recovery is slow. Recovery is made even slower in areas where browsing pressure is high. In some areas, particularly the Greater Yellowstone Ecosystem, large populations of native ungulates are having

dramatic impacts on shrub growth and seed/berry production. Other shrub communities are impacted by heavy concentrations of domestic livestock, especially where it is compounded by winter use by native ungulates.

3) Priority bird species in Mountain-foothills Shrub habitat in Wyoming:

Level I:

Columbian Sharp-tailed Grouse
Brewer's Sparrow
Sage Sparrow

Level II:

Gray Flycatcher
Dusky Flycatcher

Level III:

Common Poorwill
Virginia's Warbler
Black-throated Gray Warbler
Lazuli Bunting

Best Management Practices

Wyoming Partners In Flight Best Management Practices for Mountain-foothills Shrublands to Benefit Birds in Wyoming.

Introduction

It is challenging to establish clear guidelines for managing mountain-foothills shrublands for birds because of the variety of shrub species in the community and the diversity of their responses to management strategies. In addition, most research has been concentrated on those shrubs that are desirable for livestock and big game forage, and the management strategies that increase the forage productivity of those species. These guidelines must be implemented on a case-by-case basis, as they will not always work for all shrubs in the community, and will not always be in the best interest of all birds that use the habitat.

General

- 1) Maintain plant species diversity and manage for a patchwork or mosaic of native plant communities and age classes across the landscape.
- 2) Strive for no net loss of mountain-foothills shrublands on a landscape scale. Limit activities that reduce or remove shrub habitats (e.g. shrub eradication, some grazing, campgrounds, off-road vehicle travel, urbanization, roads, and wellpads). Avoid operating vehicles when soil is wet; driving in the same tracks repeatedly, causing ruts; and driving over sensitive areas, such as steep slopes.
- 3) Conserve unique representatives and/or large, ecologically functioning examples of mountain-foothills shrubland habitat.
- 4) Retain some blocks of tall, older, dense stands of shrubs for those species that require them (e.g. Virginia's Warbler and Black-throated Gray Warbler).
- 5) Provide small-scale openings of habitat for those species that require them (e.g. Common Poorwill and Black-throated Gray Warbler).
- 6) To help maintain shrublands, eliminate conifers that grow higher than the native shrubs.
- 7) Maintain existing larger stands of shrublands and continuity between stands wherever possible. Avoid designs and practices that create or increase the amount of edge between shrubland habitat and converted or highly altered land. These edges

support cowbirds, nest predators, and invasive grasses and forbs, and they expose wildlife to pesticides, shooting, collisions with vehicles, and other hazards.

8) Prevent the invasion of exotic plants (e.g. cheatgrass). To reduce the likelihood of weed invasion in stands that contain a community of native grasses and forbs, maintain the vigor of native species, control livestock stocking levels, avoid large-scale soil disturbances, and minimize habitat fragmentation. Weed control with herbicides, biological agents, and mechanical techniques should be followed by reseeded and restoring native plant species to prevent reinvasion of weeds.

9) Discourage road construction where it would reduce shrubland patch size. Limit the number of roads in shrubland habitat and consider rehabilitating old roads. This will reduce weed invasion, roadkills, and fragmentation. Reduce the number of roads to the minimum needed to cross the habitat, and cross at the narrowest point of the stand where feasible.

10) Minimize or eliminate insect control. If pest control is necessary, follow the principles of Integrated Pest Management (IPM) to determine the best course of action. The use of pesticides for insect control can greatly reduce the food base of many bird species by killing far more than just the target species.

11) Use selective basal spraying of herbicides to remove trees along roads and utility rights-of-way and to create stable shrubland or shrub-grass communities. Avoid maintaining road and utility rights-of-way with mowing or broadcast spraying of herbicide. Selective removal of trees can result in a diverse shrubland community that will support many species of birds that are typical of early successional habitats, including species that are shrubland specialists.

12) Consolidate open corridors along roads and utility rights-of way through forests to provide better habitat for shrubland bird species than narrow corridors can provide and to reduce fragmentation of forests.

13) While it is better for birds (and cats) if cats are kept indoors, have domestic “barn” cats spayed or neutered, keep pet food and food bowls indoors so predators like raccoons and feral cats do not have an additional food source, and never intentionally feed feral cats. Cats (even well fed domestic cats) can be devastating to local songbird populations. Natural predators, like owls and hawks, are very efficient at controlling rodent pests, even around human dwellings.

14) Be aware of the impacts that cowbird nest parasitism has on nesting birds. Increased nest parasitism results when forests and shrublands are fragmented or livestock grazing occurs near woody habitats during the nesting season. The cowbird is an open-habitat species that commonly associates with livestock because of the foraging

opportunities livestock provide. Due to their nomadic behavior, cowbirds build no nest of their own. Instead, females lay their eggs in the nests of host species, often removing the host's eggs in the process. Cowbird eggs hatch sooner than the hosts' eggs, and cowbird young are larger and more aggressive; therefore, they crowd the hosts' young and receive the majority of food brought to the nest, at the expense and often demise of the hosts' young. In the West, expansion of livestock into woody habitats has allowed cowbird populations to increase and expand their range. Cowbirds are highly mobile, commuting up to 4 miles (7 km) daily between breeding and feeding sites. Therefore, it is necessary to take a landscape-scale approach to planning grazing regimes to benefit birds.

15) Manage predator issues on a case-by-case basis where negative impacts to birds occur, as predators like raccoons, skunks, and crows often increase in number around human developments.

16) Regularly monitor birds to see how the management plan is working, and redirect efforts if necessary (with special emphasis for species that seem to be declining). Implement shrubland habitat monitoring programs to establish baseline data and identify changes in habitat quality (both positive and negative) through time. Use standardized methods to monitor the habitats and sensitive species in an area, before and at several-year intervals after treatments are applied, to aid in making proper land management decisions in the future.

Grazing

Concerns about the impacts of intensive use of mountain-foothills shrubs have been voiced for many years. Overbrowsing may result in significant habitat deterioration, increased water runoff and soil erosion, and greatly reduced community herbage production. In some areas, large populations of native ungulates are having dramatic impacts on shrub growth and seed/berry production. However, it is well documented that some level of browsing does prevent stagnation and increases the productivity of the shrub community. Proper stocking levels and grazing regimes can be effective habitat management tools and compatible with shrubland maintenance and improvement. Sustained high shrub vigor is best obtained by moderate use of the vegetation. These Best Management Practices for grazing focus on protecting shrubland areas during crucial growing periods.

1) On a landscape level, use livestock grazing practices that allow large acreages of shrublands to go to a climax successional stage for those species that require it (e.g. Virginia's Warbler and Black-throated Gray Warbler).

2) On a landscape level, use livestock grazing and fire together to produce a mosaic of habitat patches to benefit a variety of shrubland species.

- 3) Where possible, consider rotating livestock use during the songbird breeding season (April through July for most songbirds) in order to rest units from cowbird concentration in alternate years and to give local songbird populations [within a radius of 4 miles (6.5 km)] breeding opportunity without high parasitism pressure.
- 4) Limit grazing in areas where ground-nesting species (e.g. Virginia's Warbler and Common Poorwill) are nesting to avoid trampling nests.
- 5) Fruiting shrubs are often stunted and produce little fruit due to heavy browsing by wild and domestic ungulates. Minimize livestock grazing in areas where productive stands of berry-producing shrubs are desired.
- 6) Remove some mountain-foothills shrubland habitat from livestock grazing or reduce livestock grazing to improve the habitat and to recreate a heterogeneous landscape mosaic. Set aside pastures for permanent or long-term rest (at least 25 to 50 years).

Fire

Prior to human settlement and agricultural development, shrublands evolved with periodic burning. Although fires can be detrimental to birds during the summer when eggs and nestlings might be destroyed, the absence of fire for a long period of time can also create problems as unburned shrubland is slowly replaced by conifers, and old, decadent shrubs begin to die out without regenerating. Many shrub species require fire to top-kill the older plants so they may resprout from the root crown, regenerating the community. Other species regenerate from seed and require bare mineral soil cleared by fire for seedlings to thrive. Most shrub species are intolerant of shade and as the absence of fire allows tall conifer species to establish themselves, the shrubs begin to die out. Many species of shrubs sprout prolifically after a fire; in such communities, the vegetation density increases immediately after a fire and remains so for several years. Consequently, fires typically result in an increase in the density of herbivores, which leads to a better food supply for predators, such as insectivorous birds. From the viewpoint of many species, a shrubland fire is a necessity, not a disaster. Temporary shifts in species composition may occur following a fire because some species lack the ability to reproduce vegetatively, but most other shrubs are capable of sprouting. Preburn composition, fire damage to perenniating parts, use by ungulates, and post-fire competition could all influence shrub recovery.

- 1) Reestablish fire to recreate a heterogeneous landscape mosaic. Fire must be carefully implemented so that it will not establish large areas of the same age and structure, but will leave healthy mosaic patterns of various aged stands. Fires should not remove all shrubs but leave pockets of unburned vegetation. Prevent large-scale fires that will

eradicate large, continuous areas of shrubland or result in cheatgrass invasion. Use small, patchy, cool burns.

2) Burn at intervals within the natural fire frequency of about 10 to 25 years, depending on the dominant species in the community.

3) Burns should be timed to consider the development and vulnerability of desired plants. Mid-summer burns can devastate native plants, as they destroy foliage before it reaches maturity. Mid-summer fires also favor cheatgrass, and can increase erosion when the soil is exposed to severe rainstorms. Early spring and late fall burns when the soil is moist and plants are dormant (before growth begins or after maturity) usually have a less negative impact.

4) On a landscape level, use fire as a tool to maintain open areas and clearings for those species that require them (e.g. Common Poorwill).

5) On areas known to support nesting birds, conduct prescribed burns in early spring before birds arrive or in fall after nesting is completed. Leave adequate amounts of unburned shrubs to provide breeding habitat. Burn size should be scaled appropriately to the landscape so that a portion of the area contains nesting cover at all times.

6) Following a prescribed burn or wildfire (especially a hot fire), the area may require reseeding or replanting with container plants in order to stem the invasion of nonnative annuals. Avoid reseeding with crested wheatgrass or other nonnative species that create a continuous herbaceous cover and out-compete native species. Avoid revegetating with only grasses and forbs, which leaves out the landscape structure (i.e. shrubs) important to nesting birds. Use seeds and container plants that include appropriate native shrubs.

7) Keep cattle off recovering sites for one to two growing seasons; grazing after a burn can seriously damage soil and native perennials, delaying recovery.

Wildlife Management

1) Maintain big game populations at a level that the shrub community can support and continue to regenerate.

2) Fruiting shrubs are often stunted and produce little fruit due to heavy browsing by wild and domestic ungulates. Monitor browsing by wild ungulates in areas where productive stands of berry-producing shrubs are desired.

Shrub Species Accounts

Because the mountain-foothills shrub habitat is so diverse, blanket management recommendations may not be suitable for all communities. The efficacy of shrubland management depends upon knowledge of the ecological requirements of the dominant species in the community. Refer to the species accounts below for specific recommendations for selected shrub species.

True Mountain Mahogany

Occurs in the Black Hills and across the southern half of Wyoming. Is most common on semiarid foothills ranges where it often grows in almost pure stands. Generally occurs on drier sites and is limited to shallow, rocky soils on steep slopes. Although there is little overlap with the range of curlleaf mountain mahogany, true mountain mahogany usually grows at lower elevations where overlap does occur. Provides valuable forage, especially in winter, because of its high mineral content in winter and spring. Provides cover for a wide variety of wildlife. Is somewhat shade tolerant, but occurs more often and is more vigorous on sites without a forest canopy. Is capable of nitrogen fixation, which enables it to become established on relatively infertile soils. Exhibits relatively low seedling vigor and initial growth rates; requires abundant sheltering and shading, and presence of litter for successful seedling establishment. Is usually top-killed by fire, but usually sprouts vigorously from the root crown afterward. In open, dry habitats where it is likely to occur, fires in presettlement times were of low severity because of fuel discontinuity. Today, many formerly open stands are dominated by conifers and decadent shrubs that provide greater fuel loads. When fires occur, they are likely to be more severe. Disturbance and moderate browsing may promote health and vigor, but overuse has greatly restricted distribution. Many remaining stands have become decadent with little living browse matter and require active management.

- 1) Reduce losses from fire by conducting prescribed burns in the spring.
- 2) Do not allow livestock to browse true mountain mahogany stands too early in the growing season. If this precaution is not taken and yearly growth is retarded, permanent injury to the browse may result. Leaves should be $\frac{1}{4}$ to $\frac{1}{2}$ developed before allowing stock to graze on the area in the spring. If livestock browses the accessible twig growth year after year, plants will be reduced in vigor, but if part of the current year's growth remains, each with 1 or 2 lateral buds, then new growth is assured the following year.
- 3) May use seeds or container plants for revegetation. Use regional seed sources and transplant in the fall. May need to protect shrubs from overbrowsing. Keep competing vegetation to a minimum. Avoid using nitrogen fertilizers.

Curleaf Mountain Mahogany

Found primarily in western and northern Wyoming and on the foothills of the Bighorn Mountains. Grows on xeric (drier) sites, usually in isolated, pure patches that are often very dense. Inhabits rocky areas with shallow soils. Capable of nitrogen fixation, which enables it to establish on relatively infertile soils. Somewhat shade tolerant, but most vigorous on sites without forest canopy. Provides important browse for wildlife and livestock. Sustained protein levels through the winter provide considerable value as forage. In mature stands, much of the foliage is out of reach of browsing animals but provides excellent winter cover. Reproduces by seed, but natural germination is very difficult, and seedlings usually exhibit low vigor and slow initial growth rates. Its ability to sprout after top-kill is weak; sprouting appears limited to plants that are 20 to 30 years old. Although individual plants are severely damaged by fire, communities may depend on fire to reduce conifer competition and produce favorable soil conditions for seedling establishment. Seeds are not fire resistant, so reestablishment from seedlings after fire depends on some mature plants surviving the fire and providing seeds. Frequent wildfires prior to 1900 kept it largely confined to extremely rocky sites where fuel was sparse, but fire suppression has allowed it to expand into some adjacent communities. However, it is currently becoming decadent on many sites and seems unable to compete with associated conifers. Because mature plants are shade intolerant, their competitive ability is lost and they become senescent. Plants are often severely hedged from years of concentrated use by wintering ungulates. Young plants, particularly if abundant, appear to be able to overcome the stress of herbivory, but not the additive effects of herbivory and intraspecific competition. Attempts to grow the plant from seed have been generally unsuccessful, and the potential for the use of fire in management is limited because of the weak sprouting response. However, under proper conditions, prescribed fire and/or removal of conifers might induce regeneration through seeding or improve the vigor and productivity of existing stands. Closure of the species canopy can restrict regeneration, so a patchy fire can cause openings in the canopy and allow regeneration. In large stands where it does not kill all seed-producing plants, fire can reduce competition and stimulate seed production. Reduction of litter, by means of fire, will provide more favorable sites for seedling establishment.

1) Use small, cool, patchy burns conducted in the fall to create openings in the canopy and allow regeneration. However, burning is not recommended for all communities, and decisions about fire should be made on a case-by-case basis. Young, vigorous stands, such as those that have regenerated since 1920; stands surrounded by volatile fuels such as sagebrush; and stands where distribution is scattered (≤ 0.5 plant/acre) are not candidates for prescribed burning. Fire is not recommended for small stands, especially where there is a large amount of woody fuel. A hot fire can destroy all plants, removing seed sources.

2) Pruning decadent plants to improve winter range should be considered only for areas with favorable moisture regimes and soil conditions to maximize regeneration and production of current annual leader growth. Pruning can increase available browse by over 200% for 5 years, sustain increased forage production for up to 20 years, encourage the establishment of new seedlings, and increase understory vegetation. Since curlleaf mountain mahogany only sprouts from live branches, removal of the complete canopy kills the plant. Therefore, 80-98% of the canopy should be removed. Pruning should be carried out in small stands on crucial winter range and only young trees should be pruned in spring or early fall to decrease mortality. Pruning trees less than 12 feet (3.6 m) tall, with stem diameters of 2 to 4 inches (5 to 10 cm) yields best results. Large, mature trees are difficult to prune, have fewer branches suitable for pruning, and often die as a result of pruning.

3) It may be beneficial to eliminate conifers or other trees that are out-competing curlleaf mountain mahogany stands.

Serviceberry

Is a conspicuous but widely scattered shrub in mixed foothill shrublands and often forms very dense thickets, mats, or grows in clumps. Two species are common in Wyoming: Saskatoon, which occurs throughout the state, and Utah, which is found in drier foothill habitats to the west and south. The two generally share most characteristics. Serviceberry is an important component of the ungulate winter diet, and leafs out earlier in the spring than associated species. Its berries are important food for bears, and important winter food for birds since the berries stay on the shrub through the winter. Regeneration by sprouting from the root crown or rhizomes is most common; reproduction by seed is rare. Is top-killed by fire, but the plant is fire tolerant. Intolerant of deep shade and declines with canopy closure. Fire stimulates production by killing understory conifers, removing old top growth, and promoting sprouting. Recovery following fire is approximately 25 years. Heavy litter accumulations may increase the likelihood of fire-caused mortality. Vigor declines under combined domestic stock and wildlife browsing use.

1) Livestock grazing should be minimized where berry-productive stands of serviceberry are desired. Leaves should be $\frac{1}{4}$ to $\frac{1}{2}$ developed before allowing stock to graze on the area in the spring.

2) Even decadent plants may be successfully treated with fire, and season is not critical to post-fire response. Limit browsing pressure after fire to prevent slow recovery. Sites where prescribed burning may cause harm in the long term include harsh (especially very dry) sites with low plant density, and very cold sites where post-fire growth would be limited by temperature.

3) Stands should occasionally be thinned and protected from encroaching timber species.

Gambel Oak

Occurs in extreme southcentral Wyoming, on the west side of the Sierra Madre range. Spring frosts and summer drought have limited its spread northward into Wyoming by preventing seedling establishment. Occurs on mesic (moist) sites with deeper soils, usually as clones of shrubs in dense patches. A healthy stand contains shrubs of varying heights, has robust native bunchgrasses and forbs growing between them, and has very little bare ground. Provides winter forage for big game, and its energy-rich acorns are consumed by deer, elk, wild turkeys, and squirrels. Young pole stands provide sites for foliage-nesting birds. Old stands containing large amounts of dead crown and hollow boles or limbs provide nesting sites for small mammals and birds. Is a good source of fuelwood. Reproduces by suckering, and very large areas can be populated by clones. Resprouts vigorously from roots, rhizomes, and basal stems after fire, sometimes within 10 days. Fire usually increases density of previously open stands and merges scattered stands into continuous thickets. Can recover to original heights from a fire in 30 to 40 years. With fire exclusion, stands are invaded and canopy is suppressed by less fire-adapted species. In some areas of its range, Gambel oak is eradicated to improve forage for livestock and big game. However, in Wyoming, it can be considered a unique representative of its species, and because many species of wildlife are dependent upon oak associations, management strategies for Gambel oak rangelands that contain prescriptions for maintaining or improving these valuable habitats are necessary.

1) Gambel oak should not be removed at all. If it is absolutely necessary for forage improvement, thinning of younger stands (6-10 years of age) should maintain 35 to 45% average oak cover; this will promote growth of the remaining stems and result in some forage increases. A partial wood harvest is an alternative for older mature stands. A partial harvest designed to maintain or improve the mature stand may be preferable to a complete harvest that would most likely return the area to a sprout-dominated community.

Antelope Bitterbrush

Occurs throughout Wyoming, often intermixed with sagebrush. Often occurs in ravines and on sites where snow accumulates. Is capable of nitrogen fixation, which enables it to establish on relatively infertile soils. Is a very important browse plant for mule deer, pronghorn, and cattle because of its widespread abundance and forage value. Ungulates, birds, and rodents also use it for cover. Most plants in bitterbrush stands become established from rodent seed caches, but seedling survival can be very

low. Is shade intolerant and is an early colonizer on disturbed sites. Is vulnerable to being displaced by competitive noxious weeds (e.g. cheatgrass and leafy spurge). Is moderately browse tolerant, but serious deterioration can occur when it is utilized in the winter by big game and again during the summer by livestock. Sheep, deer, and elk generally browse only current annual growth, but cattle can be detrimental because they consume woody branches up to ¼ inch (6 mm) in diameter, as well as current annual growth. Moderate browsing may stimulate twig production, but continued heavy use will cause a decline in shrub vigor and an eventual loss of the stand. There are many methods that can be used to improve the vigor of stands, such as seeding, prescribed burning, pruning, rotomowing, proper grazing, and the introduction of new varieties. The most controversial improvement technique is prescribed fire, as bitterbrush does not sprout abundantly. However, fire creates litter-free sites that are necessary for seed germination. Also, bitterbrush communities are now widespread in ponderosa pine ecosystems due to decades of fire exclusion, but many existing stands have no seedling recruitment and are decadent with little browse production. Regular but not too frequent fires are necessary to clear out older, decadent plants; establish new seedlings; and/or to encourage sprouting. Sprouting ability after fire depends on fire intensity, genetic capability, soil moisture and type, and season of burn. When soils are moist at the time of the burn, the root crown incurs less damage, and plants are more likely to sprout. Is often killed by summer or fall fires, but may sprout after a light-severity spring fire. Very young and very old plants (<5 or >40-60 years) are least likely to sprout. Low-growing plants sprout better than upright forms.

1) Prescribed burns should be conducted in the spring and should not be repeated frequently. Soil moisture should be greater than 60% of field capacity at the time of burning. Enhance reestablishment on burned areas by leaving intact an ample seed source and/or by planting.

2) Late summer and/or fall grazing is preferable. Grazing during spring and early summer is the most detrimental to bitterbrush vigor, as its carbohydrate reserves are at a low from May through mid-July.

3) Seedling establishment should be protected from overgrazing and should include good weed control.

Skunkbush Sumac

At lower elevations, where the frost-free period is longer, skunkbush sumac is common, especially on the east side of the Bighorn and Laramie mountains. Is capable of nitrogen fixation, which enables it to establish on relatively infertile soils. Fruit persists through the fall and winter, and can provide a ready food source for birds and small mammals when other foods are scarce or unavailable. Is low in palatability for livestock but may receive considerable use by deer in winter, especially if other browse

is limited. Forms dense thickets that provide good hiding cover for many small birds and mammals. Has spreading woody rhizomes and sprouts readily from both root and crown after disturbances. Sprouts vigorously following fire. Crown width and overall coverage often increase in response to fire. Seedlings are intolerant of crowding, even under optimal conditions, and competition with other species can be detrimental to the growth of young seedlings. Is tolerant of heavy grazing; heavy summer use by livestock will possibly cause an increase in skunkbush sumac.

Snowberry

The two common species in the mountain-foothills shrublands of Wyoming are common snowberry and mountain snowberry. Is important browse for wildlife and livestock. While not highly nutritious or palatable, it is one of the first plants to leaf out in spring. Provides important hiding cover and food for small mammals and birds. Rhizomes are the primary method of reproduction. Is top-killed by fire, but root crowns usually survive even severe fire and sprout. May show decreases the first few years after severe fire, but coverages are usually regained by 15 years. Communities on dry sites will not sprout as well after fire as will taller shrub communities on more mesic sites. Annual or very frequent fires may be detrimental. Post-fire browsing may slow recovery time. Trampling and heavy browsing can cause the loss of snowberry stands. Increases in cover and forms low thickets after logging.

1) Leaves should be $\frac{1}{4}$ to $\frac{1}{2}$ developed before allowing livestock to graze on the area in the spring. Hbage production can best be increased by light grazing on alternate years in the middle of the growing season, or by use of a rest-rotation grazing system.

Hawthorn

Provides extremely valuable wildlife food and cover. Succulent shoots and young leaves are a palatable browse for deer, cattle, and rabbits. Dense, thorny stands and thick, intricate branching deter predators and provide excellent nesting sites or brood rearing areas. The fruit is eaten by many game and songbird species. Stands may be so dense as to preclude most livestock use. A shallow, diffuse root structure allows for sprouting and suckering. Is highly flammable; usually the entire thicket is consumed by fire. Removal of the plant may require years of growth for full reestablishment. Its range is limited by fire; frequent fires may confine plants to dense thickets.

Wild Plum

Often occurs in hardwood draws as part of a mosaic comprising grassland and ponderosa pine woodland in eastern Wyoming. Typically forms thickets and colonies. Is valuable as wildlife habitat. Is presumed to be somewhat resistant to fire mortality

due to its ability to spread from underground rootstocks, but post-fire response has not been widely documented.

Chokecherry

Grows throughout Wyoming at low to mid elevations where moisture accumulation is greater than average. Rarely dominates large areas, but often forms mixed stands with other tall shrubs. Important wildlife food and cover plant. Produces dependable berry crops, which are important to birds, bears, and other mammals. Browsed by deer and other big game. Foliage is toxic in large amounts but livestock normally do not eat fatal quantities except when other forage is scarce. Spreads by underground stems, forming clumps and thickets; also reproduces by seed. Is well adapted to disturbance by fire. Is susceptible to top-kill by fire, but resprouts rapidly and prolifically from root crowns and rhizomes. Seed germination improves with heat treatment. Is shade-tolerant, but reaches its greatest density near forest edges. Moderately tolerant of browsing, but heavy browsing has impacted populations in many areas. Has developed in former grasslands due to fire exclusion and grazing.

- 1) Thin stands occasionally and protect them from encroaching timber species.
- 2) Minimize livestock grazing where berry-producing stands of chokecherry are desired.

Boxelder

Often occurs in hardwood draws as part of a mosaic comprising grassland and ponderosa pine woodland in eastern Wyoming. Provides cover for wildlife and livestock, and the seeds are eaten by birds. Is susceptible to mechanical damage by livestock. Is injured by fire, but how it regenerates after fire is not known. Produces a large yearly crop of wind-dispersed seeds which germinate on a wide variety of soils; this is most likely its primary fire survival strategy. It may also sprout from the roots, the root collar, or stump if girdled or top-killed by fire.

Information and Education

- 1) Establish public education goals and implement programs to inform users of public lands and owners of private lands of the value, sensitivity, and importance of mountain-foothills shrublands to resident and Neotropical migratory birds and other species. This could range anywhere from interpretive signs on public lands, to distribution of Best Management Practices to landowners, to presentations at local grade schools, etc.

References and Additional Reading

- Aleksoff, K. C. 1999. *Symphoricarpos oreophilus*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.
- Arno, S. F., and A. E. Wilson. 1986. Dating past fires in curleaf mountain-mahogany communities. *Journal of Range Management* 39(3):241-243.
- Askins, R. A. 1994. Open corridors in a heavily forested landscape: impact on shrubland and forest-interior birds. *Wildlife Society Bulletin* 22(2):339-347.
- Austin, D. D., P. J. Urness, and R. A. Riggs. 1986. Vegetal change in the absence of livestock grazing, mountain brush zone, Utah. *Journal of Range Management* 39(6):514-517.
- Bartos, D. L., J. K. Brown, and G. D. Booth. 1994. Twelve years biomass response in aspen communities following fire. *Journal of Range Management* 47:79-83.
- Baumgartner, R. E. 1983. The home of true mountain mahogany. Pages 15-19 in H. G. Fisser and K. L. Johnson, editors. *Wyoming Shrublands: Proceedings of the Tenth Wyoming Shrub Ecology Workshop; Sybille Canyon, WY; 28-29 May 1981*. Division of Range Management, Laramie, WY. 39pp.
- Beidleman, C. A. 2000. *Colorado Partners In Flight Land Bird Conservation Plan*. 319pp.
- Bennet, L. E. 1999. *Current Shrub Management Issues in Wyoming*. Wyoming Game and Fish Department, Cheyenne. 54pp.
- Boss, A. S. 1990. Wildlife and shrub ecosystem management in the Yellowstone area. Pages 11-13 in H. G. Fisser, editor. *Wyoming Shrublands: Aspen, Sagebrush, and Wildlife Management: Proceedings of the Seventeenth Wyoming Shrub Ecology Workshop; Jackson, WY; 21-22 June 1988*. Department of Range Management, Laramie, WY. 76pp.
- Brotherson, J. D., D. L. Anderson, and L. A. Szyska. 1984. Habitat relations of *Cercocarpus montanus* (true mountain mahogany) in central Utah. *Journal of Range Management* 37(4):321-324.
- California Interagency Wildlife Task Group. *California Wildlife Habitat Relationships System*. California Department of Fish and Game. Online <http://www.dfg.ca.gov/whdab/cwhr/B277.html>.

Clark, R. G., C. M. Britton, and F. A. Sneva. 1982. Mortality of bitterbrush after burning and clipping in eastern Oregon. *Journal of Range Management* 35(6):711-714.

Clary, W. P. 1987. Overview of ponderosa pine bunchgrass ecology and wildlife habitat enhancement with emphasis on southwestern United States. Pages 11-21 in H. G. Fisser, editor. *Wyoming Shrublands: Proceedings of the Sixteenth Wyoming Shrub Ecology Workshop*; Sundance, WY; 26-27 May 1987. Department of Range Management, Laramie, WY. 71pp.

Clements, C. D., and J. A. Young. 1996. Influence of rodent predation on antelope bitterbrush seedlings. *Journal of Range Management* 49(1):31-34.

Cook, J. G., T. J. Hershey, and L. L. Irwin. 1994. Vegetative response to burning on Wyoming mountain-shrub big game ranges. *Journal of Range Management* 47(4):296-302.

Elliot, A. G., and S. H. Anderson. 1997. Management and Wildlife Use of Mountain Mahogany (*Cercocarpus montanus* and *C. ledifolius*): A Literature Review and Annotated Bibliography. Wyoming Cooperative Fish and Wildlife Research Unit, University of Wyoming, Laramie. 52pp.

Engle, D. M., C. D. Bonnam, and L. E. Bartel. 1983. Ecological characteristics and control of Gambel oak. *Journal of Range Management* 36(3):363-365.

Esser, L. L. 1995. *Symphoricarpos occidentalis*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.

Fisser, H. G. 1983. Some recent research findings in the true mountain mahogany type. Pages 7-10 in H. G. Fisser and K. L. Johnson, editors. *Wyoming Shrublands: Proceedings of the Tenth Wyoming Shrub Ecology Workshop*; Sybille Canyon, WY; 28-29 May 1981. Division of Range Management, Laramie, WY. 39pp.

Gruell, G. E. 1980. Fire's Influence on Wildlife Habitat on the Bridger-Teton National Forest, Wyoming. Vol. II—Changes and Causes, Management Implications. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT. Research Paper INT-252. 35pp.

Guenther, G. E. 1989. Ecological Relationships of Bitterbrush Communities on the Mount Haggin Wildlife Management Area. M. S. thesis. Montana State University, Bozeman. 73pp.

Habeck, R. J. 1991. *Crataegus douglasii*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.

Hammond, F. M. 1990. Bear use of berry producing shrubs in western Wyoming: implications for habitat management. Pages 65-66 in H. G. Fisser, editor. Wyoming Shrublands: Aspen, Sagebrush, and Wildlife Management: Proceedings of the Seventeenth Wyoming Shrub Ecology Workshop; Jackson, WY; 21-22 June 1988. Department of Range Management, Laramie, WY. 76pp.

Hoover, R. L., and D. L. Wills, editors. 1984. Managing Forested Lands for Wildlife. Colorado Division of Wildlife, Denver. 459pp.

Howard, J. L. 1997. *Amelanchier alnifolia*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.

Johnson, K. A. 2000. *Prunus virginiana*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.

Kay, C. E. 1995. Browsing by native ungulates: effects on shrub and seed production in the Greater Yellowstone Ecosystem. Pages 310-320 in B. A. Roundy, E. D. McArthur, J. S. Haley, and D. K. Mann, compilers. Proceedings: Wildland Shrub and Arid Land Restoration Symposium; 19-21 October 1993; Las Vegas, NV. USDA Forest Service, Intermountain Research Station, Ogden, UT. General Technical Report INT-GTR-315. 384pp.

Kituku, V. M., J. Powell, and R. A. Olson. 1994. Sites, mowing, 2,4-D, and seasons affect bitterbrush twig morphology. *Journal of Range Management* 47(3):200-205.

Knight, D. H. 1994. Mountains and Plains: The Ecology of Wyoming Landscapes. Yale University Press, New Haven, CT. 338pp.

Knudson, M. J., R. J. Haas, D. A. Tober, D. C. Darris, and E. T. Jacobson. 1990. Improvement of chokecherry, silver buffaloberry, and hawthorn for conservation use in the Northern Plains. Pages 291-299 in E. D. McArthur, E. M. Romney, S. D. Smith and P. T. Tueller, compilers. Proceedings: Symposium on Cheatgrass Invasion, Shrub Die-off, and Other Aspects of Shrub Biology and Management; 5-7 April 1987; Las Vegas, NV. USDA Forest Service, Intermountain Research Station, Ogden, UT. General Technical Report INT-276. 351pp.

- Lauver, C. L., D. A. Jameson, and L. R. Rittenhouse. 1989. Management strategies for Gambel oak communities. *Rangelands* 11(5):213-216.
- Marshall, K. A. 1995a. *Cercocarpus ledifolius*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.
- Marshall, K. A. 1995b. *Cercocarpus montanus*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.
- McMurray, N. 1987. *Prunus americana*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.
- McWilliams, J. 2000. *Symphoricarpos albus*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.
- Merrell, E. H., and J. M. Peek. 1982. Shrub responses after fire in an Idaho ponderosa pine community. *Journal of Wildlife Management* 46(2):496-502.
- Montana Bird Conservation Plan. 2000. Version 1.0. Online <http://biology.umt.edu/landbird/mbcp/mtpif>.
- Mozingo, H. N. 1987. *Shrubs of the Great Basin: A Natural History*. University of Nevada Press, Reno. 342pp.
- Neilson, R. P., and L. H. Wullstein. 1985. Comparative drought physiology and biogeography of *Quercus gambelii* and *Quercus turbinella*. *American Midland Naturalist* 114(2):259-271.
- Olson, R. 1989. A Study to Determine the Potential for Increasing Curlleaf Mountain Mahogany Production on Crucial Deer Winter Range Through Mechanical Top-Pruning. Wyoming Game and Fish Department, Lander. 16pp.
- Patton, D. R. 1987. Habitat and wildlife relations of Rocky Mountain shrubs in ponderosa pine. Pages 28-31 in H. G. Fisser, editor. *Wyoming Shrublands: Proceedings of the Sixteenth Wyoming Shrub Ecology Workshop*; Sundance, WY; 26-27 May 1987. Department of Range Management, Laramie, WY. 71pp.

Rosario, L. C. 1988. *Acer negundo*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.

Schultz, B. W., P. T. Tueller, and R. J. Tausch. 1990. Ecology of curleaf mahogany in western and central Nevada: community and population structure. *Journal of Range Management* 43(1):13-19.

Simonin, K. A. 2000. *Quercus gambelii*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.

Tirmenstein, D. A. 1987. *Rhus trilobata*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.

Tweit, S. J., and K. E. Houston. 1980. Grassland and Shrubland Habitat Types of the Shoshone National Forest. USDA Forest Service, Rocky Mountain Region, Shoshone National Forest, Cody, WY. 143pp.

Welch, A. J. 1983. Some comparisons and descriptions of mountain mahogany rangelands in southeastern Wyoming. Pages 25-34 in H. G. Fisser and K. L. Johnson, editors. Wyoming Shrublands: Proceedings of the Tenth Wyoming Shrub Ecology Workshop; Sybille Canyon, WY; 28-29 May 1981. Division of Range Management, Laramie, WY. 39pp.

Willard, E. E., and C. M. McKell. 1978. Response of shrubs to simulated browsing. *Journal of Wildlife Management* 42(3):514-519.

Yake, S., and J. D. Brotherson. 1979. Differentiation of serviceberry habitats in the Wasatch Mountains of Utah. *Journal of Range Management* 32(5):379-383.

Zlatnik, E. 1999a. *Amelanchier utahensis*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.

Zlatnik, E. 1999b. *Purshia tridentata*. In USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Online <http://www.fs.fed.us/database/feis/>.