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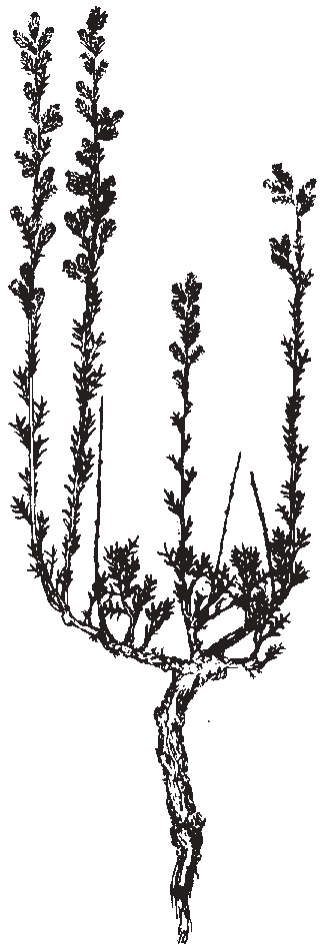
Chapter 13

Incorporating Wildlife Habitat Needs into Restoration and Rehabilitation Projects



Habitat Concepts

Wildlife species richness, densities, and distribution are directly related to the quality and quantity of habitat (Autenrieth 1983; Autenrieth and others 1982; Bodurtha and others 1989; Call and Maser 1985; Caughley 1979; Kindschy and others 1982; Leckenby and others 1982; Reynolds 1980; Russo 1964; Thomas and others 1979a,c; Yoakum 1980). Productive big game ranges, are generally productive livestock ranges. Productive livestock ranges can, with proper planning and management, be productive wildlife ranges (fig. 1); however, many livestock range improvement projects have been detrimental to wildlife, particularly to big game and sage-grouse.

Figure 1—Productive wildlife and livestock range rehabilitation project characterized by good diversity, high quality forage, and a good mixture of grasses, forbs, shrubs, cover, and edge.

Any decision a manager makes that changes or alters a vegetative community or landscape, alters wildlife habitats. Range and wildland restoration and rehabilitation projects that increase habitat diversity will most likely be beneficial to wildlife (MacArthur and MacArthur 1961; Roth 1976; Yahner 1988). Rehabilitation projects that result in monocultures of any plant species or group of species, large open spaces, minimal edge, limited cover, and scarcity of water are undesirable and should be reconsidered. A primary goal of any wildlife or wildlife-livestock rangeland improvement project should be to improve wildlife habitat.

Each wildlife species is a product of its environment. If an area has the right combination of habitat components, it will have the potential to produce the maximum amount of healthy wildlife. If an area lacks just one habitat factor, or it is limited in quantity and quality, then it is hindered in its ability to produce a good balance of wildlife populations (Caughley 1979; Dasmann 1971; Maser and Thomas 1983; Russo 1964; Thomas and Bell 1987; Yoakum 1983). Improving nonlimiting factors without improving the limiting factors will do little to enhance the overall habitat or positively affect the key habitat users.

No two wildlife species are affected by habitat changes in the same way or to the same degree. Enhancement of habitat for all species within a given area is not always practical or possible. Key wildlife species must be identified and projects designed and implemented to meet the needs of those species. Project planning and implementation requires information on the habitat needs of each selected wildlife species.

If an area provides optimum habitat for a key wildlife species, then wildlife habitat improvement cannot be used as a justification for a rehabilitation and restoration project. Wildlife habitat improvement can be used in assessing costs and benefits of a proposed improvement project only on those areas that provide inadequate habitats for the key wildlife species and where the project will enhance habitat needs.

A key to productive wildlife habitat is diversity in space, cover, food, and water (Thomas and others 1979a,c) (fig. 2). As diversity in a plant community increases, so does the diversity and health of the animal community (Dealy and others 1981; Reynolds 1980; Thomas and others 1979c). If diversity is not increased, the project most likely will not enhance wildlife habitat.

Each plant community has its own individual potential as wildlife habitat. What is maximum diversity and productivity in one community, most likely will not be in another. Type and amount of diversity and productivity in a black greasewood community for example, will be vastly different from that in a mountain brush community.

Habitat improvement projects may be undertaken for a number of reasons:

l. Reduction in erosion and sedimentation.

2. Revegetation of depleted or severely disturbed areas.

3. Improvement of wildlife habitat.

4. Replacement of undesirable plant species with more desirable species.

5. Improvement in livestock forage production and distribution of grazing animals.

Figure 2—Well planned and implemented 3-year-old deer and elk rehabilitation project.

Whatever the basic reason for the project, these wildlife considerations should be included in the planning and implementation of all projects:

1. Identify wildlife species that use the area and the time of year the use occurs.
2. Identify wildlife species that would make use of the area and the time of year the use would occur once the project is completed.
3. Identify the key wildlife species for which the project is being designed. Key species are not limited to big game. Upland game birds, waterfowl, or nongame species might be key species.
4. Identify the types of use that the key wildlife species make or have the potential to make of an area. Types of use may include: (a) feeding, (b) sleeping and resting, (c) security cover, (d) thermal cover, (e) travel and migration, (f) breeding, (g) nesting, (h) birthing, (i) rearing, (j) social activities, and (k) watering.
5. Determine the habitat factor(s) that currently limit the key wildlife species; then plan, design, and implement projects to ameliorate the limiting factor(s).

Food and Cover

Food and cover are usually interrelated. For some animal species food and cover are provided by the same plants. Sage-grouse eat sagebrush leaves, and use the sagebrush as nesting and hiding cover. Mule deer will use sagebrush, mountain mahogany, cliffrose, Gambel oak, and other shrubs only as cover during the spring and early summer while grazing understory herbs, yet these same shrubs furnish both forage and cover in the fall and winter. Forage may be available on an area but may not be used due to the lack of proper cover.

When planning a rehabilitation project, diversity in both the vertical and horizontal community, along with the composition, location, amount, and type of cover are major components of wildlife habitat that need to be considered. Manipulation of plant communities will create gradation in vegetation between treated, and untreated areas (fig. 3). On some areas more than one revegetation technique may be necessary, due to variation in site potential over the area. The use of more than one seed mixture on a site can result in ecotones between mixtures. Ecotones commonly produce high quality, heavily used security and thermal cover, as well as forage (Yahner 1988).

Figure 3—Two well designed, 1-year-old big game range rehabilitation projects, on juniper-pinyon areas. Allowances are made for security and thermal cover, travel lanes, maximum edge area, and quality forage.

Figure 4—Mixture of native and exotic grasses, forbs (alfalfa, small burnet, Utah sweetvetch), and shrubs (mountain big sagebrush, antelope bitterbrush, and Gambel oak) on a 12-year-old juniper-pinyon rehabilitation project.

The number of species used in seeding or planting mixtures will vary with site potential, key species requirements, and economics. For maximum wildlife value, no single species should make up more than 35 percent (seed per pound, number of transplants) of any mixture. Seedings that consist of only a few species or one plant type (grass, forb, or shrubs) generally provide less productive wildlife ranges than do more varied mixtures. In many cases, wildlife values are compromised when improvement projects consist of few plant species and only one plant type.

Multi-species revegetation projects can benefit wildlife habitat by providing: (a) vertical and horizontal plant diversity, (b) increased forage production, (c) improved variety and nutritional quality in the diet, (d) more and better cover, (e) increased edge effect, (f) increased diversity of the animal communities (Stevens 1986b; fig. 4), and (g) species that will be resistant to drought, and responsive to normal and above-normal precipitation. This allows the site to be productive regardless of climatic conditions. Multi-species mixtures also help to enhance ground cover and soil stabilization, make the seedings more aesthetically pleasing, and decrease the susceptibility of the plant community to plant disease and insect problems (Stevens 1986b).

Individual Species Needs

Mule Deer and Elk

Daily and seasonally, mule deer and elk use a variety of terrain and vegetation types for cover and foraging. Migrating animals use lower winter ranges through spring, then move to higher elevation summer ranges. Fawning and calving usually occur on upper spring and lower summer ranges. Fall migration is largely influenced by weather. Snow precedes migration from fall to winter ranges. In light or moderate winters, deer and elk may not move to winter ranges at all. Elk generally winter at slightly higher elevations than deer; however, during winters with heavy and continuous snow, deer and elk may winter for various periods of time in the same area. Spring and fall ranges, therefore, need to provide plant species that will fulfill fall, winter, and spring requirements. Both cover and forage in proper quantity and quality are essential for big game animals (Brown 1987; Leckenby 1984; Leckenby and others 1982; Leege 1979b; Lyon and others 1985).

All age classes of mule deer and elk require high quality succulent forage in the spring to recover from winter stress, replenish body reserves, and to grow and reproduce at optimal rates. Thus, rangeland improvement projects on fall, winter, and spring ranges require the establishment of succulent, high quality forbs, grasses, and browse. Small burnet, Lewis flax, and Palmer penstemon are semi-evergreen forbs that provide nearly year round forage. Alfalfa, cicer milkvetch, nineleaf and Nuttall lomatium, Rocky Mountain penstemon, and arrowleaf balsamroot provide early spring growth. Utah sweetvetch, sainfoin, yellow sweetclover, crownvetch, and showy goldeneye develop later in the season. All of these species are heavily used in some seasons by all big game. Alfalfa leaves and seed heads are sought out during all seasons. Sufficient plants of alfalfa or other highly sought after species must be initially established in high enough numbers to ensure their survival, as such highly desirable plants can be killed through over use (Rosenstock and Stevens 1989). On juniper-pinyon and sagebrush-grass areas, a minimum of 1.5 to 2 lbs (0.7 to 0.9 kg) of seed per acre must be applied to ensure the establishment of a viable stand.

Indian ricegrass, bluebunch wheatgrass, needle-and-thread, Russian wildrye, mountain rye, and bottlebrush squirreltail begin growth in early spring. Species that start growth later include crested wheatgrass, sheep fescue, and orchardgrass. Grasses that begin growth last include Great Basin wildrye, intermediate, slender, pubescent, and tall wheatgrass, and smooth brome.

Generally, evergreen shrubs provide more nutritious forage during the dormant season than do deciduous shrubs. Major evergreen shrubs include curlleaf mountain mahogany, cliffrose, big sagebrush (fig. 5), ephedra, rubber rabbitbrush, winterfat, and forage kochia. Serviceberry, true mountain mahogany, Gambel oak, bitterbrush, and fourwing saltbush lose their leaves in the fall and early winter and supply only twigs for winter forage.

Figure 5—Mule deer using low elevation mountain big sagebrush.

Seed mixes should include species that fulfill seasonal forage quality requirements. Seed of a large number of species are now available; care must be used in selecting species and sources that are adapted to each site and that satisfy animals needs (Asay and Knowles 1985a,b; Ferguson 1983; McArthur 1983a; Monsen 1987; Stevens 1983a,b; Urness 1986).

Some winter and spring-fall deer and elk ranges may have sufficient browse, but lack forbs and grasses. Succulent herbaceous species can be introduced on these depleted ranges. A pipe-harrow, disk-chain, or chain can be used to thin mature depleted big sagebrush (fig. 6), fourwing saltbush, rubber rabbitbrush, serviceberry, and Gambel oak stands, and to cover broadcast seed. Spot or strip spraying with effective herbicides, and selected prescribed burns are effective methods of reducing and thinning Gambel oak, aspen, pinyon-juniper, and big sagebrush stands (Neuenschwander 1980; Wright and others 1979). Seeding of desirable species should follow. Where a single species of grass has been seeded on big game winter or spring-fall ranges, other desirable species can be established by transplanting or interseeding into scalps, pits, spots, or strips created by mechanical or chemical tillage (fig. 7) (Crofts and Carlson 1982; Monsen and McArthur 1985; Otsyina 1980; Provenza and Richards 1984; Rumbaugh and others 1981; Stevens 1981).

Livestock management can be used to increase shrub density in grass and shrub seedings. Early spring

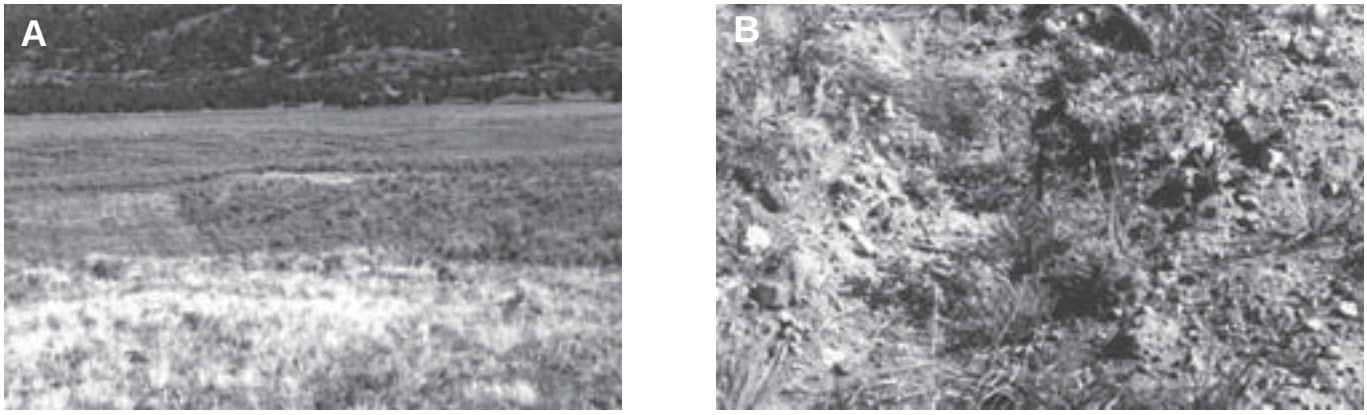


Figure 6—(A) A mature basin big sagebrush site with a depleted understory 1 year following disk-chaining in strips and seeding. This area serves as habitat for sage-grouse, as well as winter range for deer and elk. (B) Species seeded (bluebunch wheatgrass, orchardgrass, basin wildrye, alfalfa, cicer milkvetch, sainfoin, small burnet, yellow sweetclover, and forage kochia) into a disk-chained area. Forage and cover value of adjacent big sagebrush is retained, and succulent, nutritious, forage, and edge areas are provided.

grazing with cattle can be used to reduce the vigor of grasses and provide shrubs the opportunity to increase (Stevens 1986 b).

Ideal summer ranges consist primarily of grasses and forbs (fig. 8). Rangeland improvement projects in aspen, coniferous forest, and other higher elevation summer ranges are appropriate in areas that are depleted of perennials, highly erodible, and support closed, unproductive vegetative communities (Debyle 1985a; Frischknecht 1983; Lyon and others 1985; Patton and Jones 1977).

Summer succulents are generally lacking on most desert ranges. Rehabilitation project should include adapted forbs, grasses, and shrubs. The tendency has been to convert desert shrublands to single or few-species grass communities. Many of these conversion projects have decreased wildlife values. Every effort should be made to ensure that adapted forbs are included in seedings and that a variety of grasses, forbs, and where needed, shrub species are used.

Elk generally summer in aspen, spruce-fir, ponderosa pine, lodgepole pine, and subalpine areas (fig. 9). They

Figure 7—A palatable variety of rubber rabbitbrush transplanted into a crested wheatgrass field 3 years after planting. Deer, elk, and pheasants moved into and used the area once the shrubs were established and desirable forage and cover were available.

Figure 8—Excellent high-elevation summer ranges offer good diversity in forage and cover.

Figure 9—Elk on excellent summer range with a good mixture of succulent forbs and grasses.

prefer grasses and forbs, wet and semi-wet meadows, forest openings, and open grass herblands next to cover (fig. 10). Elk seek out clearcuts and burns in aspen and conifer forests, especially those with small openings and irregular edges (Brown 1987).

Fire can be used as an effective tool for improving wildlife habitat in aspen and conifer stands (Brown 1985b; Canon and others 1987; DeByle 1985b; DeByle and others 1989). Openings in these stands can be created by prescribed burns (fig. 11), timber harvest, fuelwood harvests, and herbicides (Harniss and Bartos 1985). Optimum size of openings for maximum elk use varies considerably. Factors affecting optimum size include variation in topography, aspect, vegetative communities, makeup of adjacent tree communities, shape of opening, location of roads, and other disturbance sources (Brown 1987; Thomas and others 1979a,c). An opening can be larger if the edges are irregularly shaped, providing maximum edge effect and ensuring that maximum distance between edges at any one point in the opening is less than 500 ft (152.4 m). Patches or islands of cover within openings are sometimes desirable (Peek and Scott 1985; Winn 1985). Greatest benefits are realized when islands are connected to edge by stringers of trees. The Interagency Workgroup (1981a) recommends that patches or islands be 30 to 60 acres (12.1 to 24.3 ha). Allen (1971) and Brown (1987) suggested that pattern and juxtaposition of cutting units and openings may be more important than number of acres treated.

On many summer ranges, forage is not a major limiting factor. Lyon and others (1985) working on elk summer ranges, concluded that selection of habitat for forage alone was a less specific requirement than selection for shelter and security. Collins and Urness (1983) found that elk preferred aspen stands over adjacent clearcut areas, even though the clearcuts produced considerably more available and palatable forage. The proper ratio between cover and forage for elk differs from area to area and from forest type to forest type (Brown 1987; Interagency Workgroup 1981a,b; Peek and Scott 1985; Thomas and others 1979c; Winn 1985). Slash left following timber harvest can adversely affect elk use of clearcuts and adjacent areas (Lyon 1975). It is recommended that slash be removed, preferably by broadcast burning to a height of less than 1.5 ft (0.5 m) (Interagency Workgroup 1981a,b).

Spring and fall ranges for elk are generally in the mountain brush and lower aspen community. Elk seek out succulents in the form of green grasses and forbs. Dry and semi-evergreen grasses and forbs, and some shrubs, are consumed during fall and spring. Rehabilitation projects in these areas should emphasize species

Figure 10—Elk prefer openings and meadows in aspen and conifer forests. Succulent forbs and grasses are preferred on summer ranges.

Figure 11—Forbs and grasses have responded to removal and thinning of mountain big sagebrush in this burned forest opening.

that green early in the spring and stay green late into the fall. Escape and thermal cover are especially important on spring, fall, and winter ranges (Peek and Scott 1985; Winn 1985). Rehabilitation and restoration projects should leave undisturbed cover in sufficient quantity and quality, strategically placed to accommodate elk and deer requirements (fig. 3). Known calving and fawning areas should be left undisturbed.

In the Intermountain West (Idaho, Montana, Nevada, and Utah), hundreds of thousands of acres of pinyon and juniper have been chained or burned and seeded. In the late 1950s and 1960s, projects involved seeding primarily introduced grasses, a few forbs (alfalfa and yellow sweetclover), and a few slow-growing shrub species. Projects usually produced large openings with little edge and a lack of thermal or security cover. As these older projects developed with time, deer and elk use increased (Barney and Frischknecht 1974; Stager and Klebenow 1987; Stevens 1986a; Tueller and Monroe 1975). Trees that were not killed during chaining have grown and now provide much needed cover (fig. 12) (Stevens 1986a; Van Pelt and others 1990). Introduced and native shrubs have had a chance to grow, reproduce, and spread (Skousen and others 1986; Stevens 1987b). Many mature seedings are now providing forage and cover for elk and deer during fall, winter, and spring. Elk especially are staying on older, more mature juniper-pinyon improvement projects the entire year (fig. 13). The question is often asked, "What are we going to do about the juniper and pinyon trees that are growing on older chainings?" As far as big game is concerned, the answer should be, "Very little or nothing." Juniper and pinyon trees, especially those over 5 ft (1.5 m) tall, provide excellent thermal and security cover. As habitat requirements were better understood and techniques, equipment,

Figure 12—Young pinyon and juniper trees in an 18-year-old juniper-pinyon chaining. Deer make extensive use of forage where cover is available.

Figure 13—Eighteen-year-old juniper-pinyon project used extensively by elk year round, and by deer during winter and spring.

seed of additional grass, forb, and shrub species became available, projects improved. Almost immediate positive effects on mule deer and elk populations have occurred on more recent, well-planned juniper-pinyon chainings and burns. These have incorporated multi-species mixtures of succulent forbs, grasses, and rapidly growing shrubs, employed proper treatment design for maximum edge area (fig. 14), regulated size of openings, and left travel lanes and escape-and-thermal cover within the project area.

Thermal cover becomes very important, and many times it is the limiting factor for survival of wintering elk and deer (Fowler and Dealy 1987; Hobbs 1989). Maximum distance between edges should not exceed 325 ft (99.1 m). Best results have been obtained when groups or islands of trees have been connected with corridors and edges, rather than with isolated islands. No more that 50 percent of an area should be treated. Undisturbed areas should be no longer or no smaller than disturbed areas. Patches or islands of trees, and travel lanes (fig. 14) that are left for deer should be selected carefully. Leckenby and others (1982) recommend that either evergreen or deciduous trees and shrubs can be used for thermal cover, but they should be at least 5 ft (1.5 m) tall, and the crown closure within the island should be greater than 75 percent. Cherry (1984) recommends that security islands can be from one tree to 100 acres (40.5 ha). The size of areas left for thermal cover should be at least 2 to 5 acres (0.8 to 2.0 ha). Topographic features are used for security cover, but have limited value as thermal cover (Fowler and Dealy 1987; Wood 1988). Activities of mule deer are associated with vegetation density (Owen 1980). Security cover requirements are generally highest during fawning, calving, and hunting seasons. Optimum security cover for mule deer on shrublands has been defined as vegetation over 24 inches (61.0 cm) tall and capable of hiding 90 percent of a bedded deer from view at 150 ft (45.7 m) or less

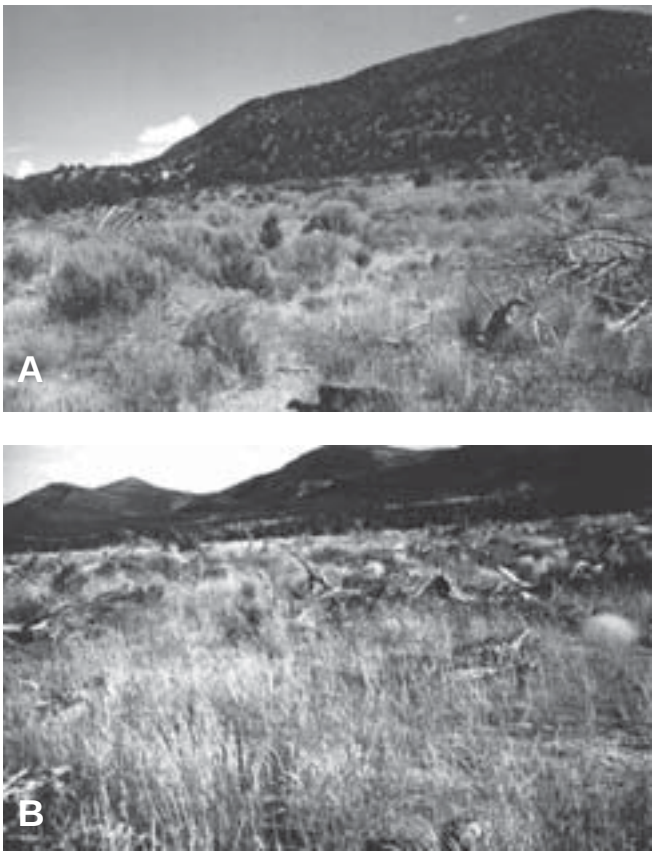


Figure 14—Five-year-old range rehabilitation projects with excellent and intermediate big game values. (A) A good mixture of succulent, early-greening grasses and forbs, and fast-growing (white rubber rabbitbrush, fourwing saltbush, and big sagebrush) and slower growing (bitterbrush and green ephedra) shrubs. Quality edge areas and security and thermal cover are available. (B) This seeding mixture was made up primarily of exotic aggressive grasses on this area. Thermal and security cover are lacking. Edges are too straight and openings too large, resulting in a project of only intermediate value.

(Leckenby and others 1982). Security cover requirements are less for bedded fawns, and more for standing fawns and mature animals. Phenological development of plants can influence the effectiveness of an area to provide cover. During the growing season, shrubs, trees, and grasses furnish maximum cover. Cover decreases as leaves drop. Size of thermal and security cover areas varies with density and height of vegetation. Areas with vegetation over 5 ft (1.5 m) tall and fairly dense can be smaller than areas with shorter, less dense vegetation or where mature conifers are highlined. Downed trees can be used as cover (Cherry 1984; Short and McCulloch 1977); however, as downed trees break up and decay their effectiveness as cover decreases.

Big sagebrush occupies a considerable area in the Intermountain West. In many places it is the dominant plant on winter and spring ranges for mule deer and elk. On many desert ranges it is browsed and used as cover year round. In the basin big sagebrush type, where the understory has been lost, the potential for range improvement is generally high. Big sagebrush can be killed with prescribed fire (Bunting and others 1987), herbicides, plows, rails, chains, and disks. Thinning and spot or strip treatments (fig. 6) are recommended on most big sagebrush ranges. A large number of grasses, forbs, and shrubs are adapted to the various big sagebrush types (Stevens 1983b, 1987a). Diversity of food and cover types over short distances is the key to enhancing mule deer populations in big sagebrush areas (Holecheck 1981). The distribution and pattern of a shrub stand is generally far more important than the quantity of brush. If sufficient sagebrush is available to meet an animal's cover and browse requirements, quantity and quality of succulent forbs and grasses become the second most limiting factor.

Ideal late fall and winter ranges for mule deer and elk are sites where shrubs extend above the snow (fig. 15). Elk and deer also make use of most herbs that are exposed by snowmelt or that extend above the snow. Austin and others (1983) report that ungrazed crested wheatgrass is more available and is used more by deer than are grazed plants. Snow around and on ungrazed plants melts faster and plants are available over larger periods of time. On some winter ranges, elk spend considerable time on open, windswept ridges where plants are exposed. Great basin wildrye (fig. 16)

Figure 15—Quality deer winter ranges require shrubs that extend above the snow. Mountain and basin big sagebrush, black sagebrush, fourwing saltbush, and rabbitbrush are available during the winter period.

Figure 16—Elk range rehabilitation project. Great Basin wildrye was seeded to provide forage that will extend above snow level.

and, to a lesser extent, tall wheatgrass and intermediate wheatgrass are three species that can extend above moderate snow levels. Evergreen shrubs such as cliffrose, big and black sagebrush, curlleaf mountain mahogany, ephedra, rubber rabbitbrush, forage kochia, and winterfat (fig. 17), generally provide more forage than do deciduous shrubs such as fourwing saltbush, bitterbrush, true mountain mahogany, and serviceberry. In the absence of snow, or when elk and deer are able to paw through the snow, they prefer and will seek out evergreen and semi-evergreen species such as forage kochia, Lewis flax, small burnet, and Palmer penstemon. Range improvement projects should include adapted species that provide nutritious forage during the dormant season.

Figure 17—Rubber rabbitbrush, mountain big sagebrush, and forage kochia established by seeding, provide evergreen forage year round to elk and deer on an 8-year-old-rehabilitation project.

Rapid seedling development of a shrub is an important consideration in selecting shrubs for wildlife plantings (fig. 17). Big sagebrush, fourwing saltbush, winterfat, rubber rabbitbrush, and forage kochia exceed most other shrubs in their growth rate, rate of recovery following browsing, and ability of young plants to survive browsing. Planting these shrubs with slower growing shrubs is a means of providing forage and cover very quickly and allowing slower developing species time to establish (Monsen 1987). Fall, winter, and spring range improvement projects should be designed to encourage and increase desirable onsite shrubs. Bitterbrush, cliffrose, mountain mahoganies, ephedras, serviceberry, blue elderberry, big sagebrush, Gambel oak, and rubber rabbitbrush can all be suppressed by pinyon and juniper. Once the trees are removed these shrubs will respond rapidly, put on considerable growth, and may reproduce. Smooth anchor chains or cables should be used for chaining pinyon and juniper with the intent of releasing shrubs. A smooth chain does less damage to shrubs than does any other type of chain. Less shrub damage results if the chain is held taut and the crawler tractors travel further apart. When sufficient shrubs exist, shrubs can be left out of the seeding plan. Forbs and a few grasses may be seeded to fill in the interspaces and tree root pits to prevent invasion of undesirable annuals and to stabilize soils and reduce erosion.

In most cases, areas heavily used by animals are sites that are the most difficult and costly to improve. South and west facing slopes and ridgetops are generally more open and heavily used. They are also most often depleted of desirable vegetation. Poor access, less favorable soil temperatures, high evaporation rates, winds, shallow soils, predominance of annual weeds, and concentrated use by animals can reduce the success of improvement projects. Rehabilitation projects on more favorable sites such as basins, valley bottoms, and north and east facing slopes will not compensate for lack of treatment on the more preferred south and west slopes, and ridgetops (fig. 2, 3, 10, 14). It is on these latter sites where big game naturally concentrate. Many times these areas are the only sites open and available when other areas are covered with snow. Rehabilitation projects should be planned for areas most used by big game. Sites should not be selected for treatment based on forage potential (Short and McCulloch 1977) ease of treatment, or anticipated future use by big game.

Big game depredation problems on agricultural lands can be reduced, and in some cases eliminated, by providing game animals cover and an alternate source of forage. Wildlands adjacent to farm lands can be used to intercept big game. On agricultural lands deer and elk generally seek succulent plants. Where sufficient succulent and highly preferred plants are

provided along with security and thermal cover, animal use can be diverted from agricultural fields. Range improvement projects with travel lanes and escape cover adjacent to agricultural fields encourage big game to use the fields. Establishment of travel lanes and escape cover that enhance access to agricultural fields should be avoided. However, at times, big game will cross large, open areas to use highly desirable forage.

Shiras Moose

Shiras moose (fig. 18) are generally found in mountain brush, aspen, mixed conifers, and subalpine communities. In central Utah they use juniper-pinyon and upper sagebrush-grass areas. As snow melts and succulent grasses and forbs appear, moose turn from their browse diet to succulent species. Grasses and forbs are used abundantly from snowmelt to mid June and early July. Willows and aspen (Babcock 1981; Wilson 1971) are major components of their diet in late summer and early fall. By September their diet is almost exclusively browse. Willow and aspen are important browse species all winter, along with Gambel oak, serviceberry, chokecherry, and true mountain, and curlleaf mountain mahogany. Depending on occurrence and availability, cottonwood, birch, elderberry, snowberry, maple, antelope bitterbrush, and cliffrose can be important fall and winter browse. It does not appear that moose use mountain big sagebrush to any great extent.

During summer months, moose require water and shade in close proximity to succulent forage. Aspen, aspen-spruce-fir, aspen-lodgepole pine, and willow bottoms are important summering areas. Movement from summer to fall and winter ranges can mean moving only from a north or east facing slope, around the hill to south- or west-facing slopes at the same elevation, or it can mean movement down a drainage, or from one drainage to another (Babcock 1981). Time of movement is triggered by the switch in diet from succulents to browse and not by snow depth. Fall, winter, and spring ranges are generally shrub communities with open side hills. Moose generally winter at a higher elevation than elk. Snow depths of 4 to 5 ft (1.2 to 1.5 m) are not detrimental to moose and do not cause them to move.

Beneficial range improvement projects on spring and summer moose ranges are those that increase herbaceous succulents. This can be accomplished by seeding adapted grasses and forbs into depleted openings in aspen, conifer, and subalpine communities that are adjacent to water and shade. Where summer, fall, and winter ranges overlap, special consideration should be given to enhancing the availability and quantity of browse. Projects should never decrease browse quantity.

Figure 18—Moose on a summer range with a variety of succulent forage.

Fall, winter, and spring range improvement projects in moose habitat should be designed to increase and improve browse. Prescribed burning or accidental fire in aspen, aspen-spruce-fir, and aspen-lodgepole pine communities can promote sprouting of aspen (DeByle 1985b). Burning closed, mature lodgepole pine stands does not generally benefit moose. Moose show particular preference for aspen reproduction. On fall, winter, and spring ranges commercial harvest, chaining, or any other type of disturbance that promotes aspen sprouting should be encouraged. Chaining and burning of thick, tall Gambel oak (Stevens and Davis 1985), willow, chokecherry, and maple stands can result in more nutritious and available browse. As on all moose range, no treatment should decrease the amount or availability of browse.

Antelope

Forage needs, plant size, and species density requirements for pronghorn antelope are specific, and critical to animal survival (fig. 19) (Yoakum 1983). Rehabilitation of antelope ranges must include consideration of proper forage and plant structure requirements (Autenrieth 1983; Kindschy and others 1982; Neff 1986; Yoakum 1980, 1983).

In most cases, rehabilitation of antelope ranges is best restricted to flats, bottoms, and valleys. Open ridges and slopes on some areas should not be treated, because plant community structure is generally adequate. Flat bottoms and valleys are the areas where forage and plant structure requirements are generally lacking. These areas frequently have the highest site potential and provide the best opportunity for rehabilitation efforts that will benefit antelope.

Shrubs are a most important component of antelope habitat. Availability of shrubs as winter forage has been directly linked to antelope survival (Barrett

Figure 19—Antelope on black sage and Wyoming big sagebrush range. This community has a good mixture of grasses, forbs, and low-growing shrubs. Clear, unrestricted vision is provided.

1982; Bayless 1969; Kindschy and others 1982; Neff 1986; Smith and Beale 1980; Yoakum 1980). Shrubs are used as cover for young fawns as well as for adults. Big and black sagebrush, low and rubber rabbitbrush, winterfat, budsage, and bitterbrush are all important forage and cover species for antelope. These shrubs should be protected and managed as a part of the natural plant community. If necessary, they should be included in improvement projects on sites where they are adapted.

Excessively high shrub density can suppress much needed forbs and grasses (Yoakum 1980, 1983). Shrubs over 2 ft (0.6 m) tall can impede animal mobility and provide cover for predators (Yoakum 1983). Yoakum (1983) suggested that a plant community containing five to 10 shrub species that comprise 30 to 50 percent of the ground cover provides optimum vegetation for antelope. Shrub communities that are too dense or too tall can be thinned using a pipe harrow, disk-chain (fig. 6), anchor chain, or rail. Grasses and forbs can be seeded prior to or in conjunction with the treatment.

Forbs are essential to antelope. Fawns as well as mature animals use forbs when available. Rehabilitation projects should be designed to encourage and increase forbs on all antelope ranges. Alfalfa is highly preferred by antelope. Other forbs that antelope use, and for which seed is available are small burnet, Lewis flax, sainfoin, Utah sweetvetch, yellow sweetclover, cicer milkvetch, globemallow, alfileria, western yarrow, balsamroot, goldeneye, lupine, and Palmer penstemon.

Monotypic shrublands and grasslands are generally poor antelope habitat. Antelope make only slight use of pure fairway crested wheatgrass stands. Considerable use is made of areas where alfalfa and other forbs are found along with fairway crested wheatgrass (Hall 1985; Kindschy and others 1982; Urness 1986; Yoakum 1979). Diversity in plant community makeup enhances antelope ranges. Forbs and grasses can be incorporated into shrub communities as well as forbs and shrubs into grass communities.

Rehabilitation projects should be designed to encourage and increase forbs on all antelope ranges. Prescribed burns are sometimes used as a range improvement technique. Burns should be planned for seasons when they are the least harmful to forbs. Livestock management plans should be designed so that severe competition for forbs between antelope and livestock is avoided.

Antelope consume grasses year-around in small amounts (Urness 1986; Yoakum 1980, 1983). Use is greatest in the spring when new growth is available. They prefer the less coarse species like the bluegrasses and fescues. Grasses should be included in rehabilitation projects, but should not make up the majority of any seed mixture.

Mature antelope generally do not require security cover; but fawns do. Security to mature antelope is clear unrestricted vision and rapid mobility. Antelope prefer low growing vegetation, open valleys, and level to moderate topography. Antelope will, however, modify their behavior according to local conditions. In central Utah, antelope are found in a number of vegetative communities ponderosa pine, aspen parklands, sagebrush grass, and salt desert shrublands.

Barriers to antelope movement include net wire fences, large bodies of water, large rivers, deep canyons, rocky ridges, and dense brush and trees. Dangerous and restrictive fences can be removed or rebuilt and dense shrubs and trees can be removed and trimmed. An inadequate water supply can restrict antelope use. Where needed, consideration should be given to developing and improving water sources.

Bighorn Sheep

Bighorn sheep are generally found in remote, rugged terrain such as mountains, canyons, and escarpments (fig. 20). The major habitat requirements for bighorn are forage, water, thermal cover, escape cover, and adequate rutting and lambing areas.

Bighorn sheep prefer to feed in open areas with low vegetation, like grasses and low shrubs (Hansen 1980). Various sagebrush-bunchgrass communities, and wet and semi-wet meadow communities are preferred. Successional communities that result from wildfire, prescribed burns, and seedings are used if location and composition are suitable. Grass can be the staple of the bighorn sheep diet. They do, however, use a variety of shrubs and forbs (Johnson and Smith 1980). Bighorn sheep are opportunistic foragers, and will adapt their diet to what is available (Browning and Monson 1980). They prefer green forage, and will move to different areas to find more-preferred forage. Bighorn sheep foraging areas usually have tree and shrub cover of

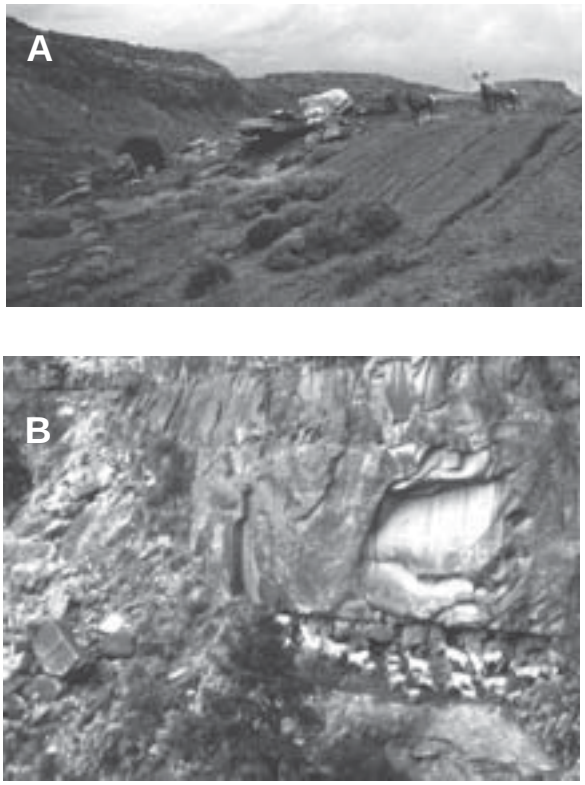


Figure 20—Bighorn sheep prefer remote, steep, rugged terrain. (A) Desert bighorn. (B) Rocky Mountain bighorn.

less than 25 percent with shrub height less than 2 ft (0.6 m) (VanDyke and others 1983).

The availability of water and escape terrain can affect the use of feeding areas. Foraging areas located more than 0.5 mi (0.8 km) from escape terrain, and farther than 1 mi (1.6 km) from water are used very little (VanDyke and others 1983).

Escape and rutting areas are generally associated with cliffs and steep, rough, rocky, inaccessible terrain (fig. 20). Disturbances, and increased human and livestock use can destroy the value of areas for escape, rutting, and lambing purposes. Travel corridors between seasonal feeding areas should be protected, and not disturbed.

Lambing and foraging areas can be improved through rehabilitation projects and water development. Because escape cover and availability of water are so important to bighorn sheep, little to no use of improved areas will occur unless escape cover and water is available. Water developments can be undertaken to improve existing sources and to make new sources available. Development of water near escape cover can make otherwise unused ranges usable.

Location of a proposed improvement project on bighorn sheep range should be considered first. Increasing the amount of open habitat and the quantity of high quality forage should be the primary goals of bighorn sheep habitat improvement projects.

Fire or chaining can be used in opening up tree and shrub stands and in improving forage quality and quantity. Where understory species density and richness is lacking, preferred species can be seeded.

Sage-Grouse

Seventy-five percent of the annual diet of an adult sage-grouse may consist of sagebrush leaves and shoots (Autenrieth 1980a). During the fall and winter over 95 percent of the diet may be sagebrush; during the spring, 85 percent; and during the summer, 40 percent. The species and subspecies of sagebrush used varies among areas. The birds do, however, make more use of shrubs where adequate cover is provided.

Forbs are especially sought out by both adults and young during spring and summer. Insects and forbs are very important to chicks and subadults (Autenrieth 1980a; Roberson 1986). A chick's diet for the first 30 days may consist primarily of insects. Brood-rearing areas, therefore, need to contain a rich diversity of forbs and shrubs; which in turn will help supply an abundance of insects. Wet meadows are important brood-rearing areas, as they provide an abundance of forbs and insects.

Over the past 150 years, hundreds of thousands of acres of prime sage-grouse habitat have been disturbed or destroyed by excessive livestock use, construction activities, mining, petroleum production activities, fire, herbicides, mechanical treatment, and the seeding of grasses (Braun and others 1976, 1977; Fleischner 1994; Swenson and others 1987). All of these factors have resulted in fragmentation and reduction of sagebrush communities. Many remaining sagebrush areas are too small to support viable sage-grouse populations. Populations have been over-harvested in many areas. From loss of habitat and over-harvest, sage-grouse densities have decreased in many areas, and populations have been completely eliminated in others (Autenrieth 1980b; Welch and others 1990).

Range and wildland rehabilitation projects that take into consideration the habitat requirements of sage-grouse provide benefits for both wildlife and livestock. When sagebrush control is being planned, serious consideration should be given to sage-grouse habitat requirements. These requirements have been identified and described by a number of agencies and authors (Autenrieth and others 1982; Braun and others 1977; Call 1979; Call and Maser 1985; Roberson 1986). These authors report sage-grouse require year round, quality sagebrush habitat for breeding, nesting, brood rearing, loafing, and cover.

Hens nest almost exclusively under big sagebrush plants. They prefer tall plants and those with an umbrella type canopy (Autenrieth 1981; Call 1979) (fig. 21). Canopy cover requirement for nesting has been found to be from 20 to 40 percent (Roberson 1984; USDA Soil Conservation Service 1975). If there is too much or too little canopy cover, nesting will not occur. Nest success and early brood survival appear related to residual cover of grasses and forbs during April through June (Drut and others 1994; Gregg and others 1994). It has been found (Beck 1977; Patterson 1952) that winter survival is dependent upon the amount of sagebrush available from January through March. Within each range rehabilitation project, the specific type of use that occurs within the area needs to be identified.

Sagebrush control, thinning, or other efforts aimed at reducing shrub density should not occur on wintering areas, within 2 mi (3.2 km) of a lek (fig. 22), when nesting or brooding habitat is limited, or during periods of nesting and brood rearing. Sagebrush density should not be reduced when live sagebrush canopy cover is less than 20 percent (this does not mean an average of 20 percent of the complete area, but 20 percent where sagebrush reduction is to occur), on shallow soils, or where sagebrush is less than 12 inches (30.5 cm) high (Braun and others 1977; Call 1979; Call and Maser 1985). Mountain big sagebrush adjacent to spruce-fir and aspen should be avoided or treated very sparingly. Ideal brood-rearing areas should have meadows or herbland openings next to or within sagebrush stands. Meadows and herblands can have invading shrubs removed. No sagebrush control should occur within 300 ft (91.4 m) of meadows, herblands, and streams (perpetual or intermittent).

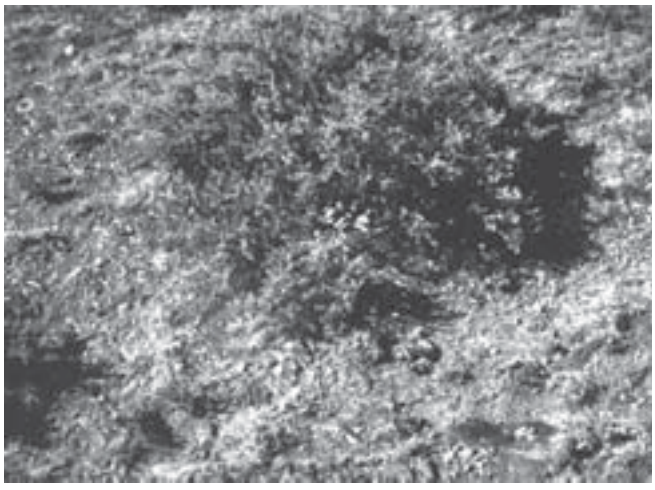


Figure 21—Sage-grouse nest under an umbrella canopy of mountain big sagebrush.

Figure 22—Male sage-grouse on a lek.

Ridgetops and slopes in sage-grouse habitat are generally not treated because sagebrush is generally sparse in these locations. Bottoms and meadows are more likely areas for sagebrush control.

A number of techniques are available for enhancing meadows, increasing herbs within sagebrush stands, increasing edge, and changing the vertical and horizontal structure of a sagebrush stand. Sagebrush stands can be improved for sage-grouse by strict and proper use of a number of herbicides; however, mechanical control and prescribed burns are the most desirable techniques.

The most widely used herbicides are 2,4-D and Roundup. Herbicide application early in the spring, when the ground is still covered with snow, is preferred as it will kill only those sagebrush plants that extend above snow level, and not the forbs. Spraying following snowmelt will increase sagebrush kill and also kill most emerged forbs (Carpenter 1974). Proper use of an herbicide will thin dense sagebrush and release understory forbs and grasses.

Herbicides can also be used to create mosaics in sagebrush stands and to increase edge area. Care must be taken when applying herbicides to ensure that only targeted areas are sprayed. To avoid herbicide drift, spraying should not occur when windspeed is greater than 6 mi per hr (9.7 km/h). Spraying is best done with ground rigs and from low-flying helicopters. When herbicides are used to create openings, only irregular strip and spot spraying should occur. A total of no more than one third of any area should be sprayed (including the area affected by drift). Treated areas should not be wider than 100 ft (30.5 m) (Klott and Lindzey 1990; USDA Soil Conservation Service 1975), and unsprayed areas should be as wide or wider than the sprayed areas.

When range rehabilitation projects are done on sage-grouse areas, anchor chaining, and the use of a pipe harrow is preferable to the use of herbicides. A pipe harrow can be used to: (1) thin sagebrush stands; (2) create edge area and mosaic openings;

(3) encourage forb, grass, and meadow communities by removing competing shrubs; and (4) prepare seedbeds and cover broadcast seed. Meandering strip chaining, pipe harrowing, or light disk-chaining following terrain features are preferred methods (fig. 6). Block and checkerboard clearing and thinning of large areas are not recommended. As with herbicide treatments, treated strips should not be wider than 100 ft (30.5 m) (Klott and Lindzey 1990), nor cover more ground than the untreated areas. When chaining, less damage will occur to shrubs when the chain is dragged somewhat tight rather than in a deep U or J shape between the crawler tractors. Plowing and disking of sagebrush is very destructive to sage-grouse habitat and is not recommended. When disturbance does occur, desirable species should be seeded to establish desirable plant cover and to prevent establishment of annuals. A number of forb species are available that can be seeded successfully into various sagebrush and meadow communities. These include: alfalfa, white and yellow sweetclover, adapted clovers, birdsfoot trefoil, crownvetch, cicer milkvetch, lupine, sainfoin, small burnet, Rocky Mountain and Palmer penstemon, western yarrow, Lewis flax, globemallow, vegetable-oyster salsify, Louisiana sage, alfileria, lomatium, showy goldeneye, and Nevada goldeneye.

Prescribed burns, when used properly, can be beneficial to sage-grouse. Meadow areas and valley bottoms that are being invaded by sagebrush and other shrubs can be burned to remove shrubs. Shrub removal can result in meadow enhancement and healthier insect populations. Fire should occur early in the spring, prior to forb and grass emergence, or in the fall after grasses and forbs have dried. In the spring, snow will leave areas with sparse shrub cover prior to areas with heavier cover. Fire should be set only in the snow free areas (meadows and bottoms). Snow and damp ground can help confine the fire to the desired areas and can result in an improved mosaic burn pattern. Forbs and grasses are generally not out of the ground immediately following snowmelt and are less harmed by fire (Wright and others 1979). Fire can create openings that may be used as leks. Call and Maser (1985) recommended that such lek openings be of l to 10 acres (0.4 to 4.0 ha).

Wet to semiwet meadows are important to sage-grouse. Those that have deteriorated through livestock use lack forbs and desirable species. Proper livestock management of riparian sites will significantly benefit sage-grouse.

Columbian Sharp-Tail Grouse

Columbian sharp-tail grouse are absent from 90 percent of their original range (Marks and Marks 1988) due to loss of habitat caused by farming activities, excessive grazing, fire, herbicides, and mechanical disturbance. Sharp-tail grouse habitat consists primarily of hills, benchlands, and rolling topography dominated by sagebrush and perennial grasses, with adjacent mountain brush and aspen. They also inhabit riparian areas extending out into sagebrush-grass areas (fig. 23) (Klott and Lindzey 1990; Marks and Marks 1988).

The diet of Columbian sharp-tail grouse is made up primarily of seeds, leaves, and floral parts of forbs, grasses, shrubs, and agricultural crops. During winter, buds from chokecherry, serviceberry, mahogany, poplar, maple, rose (hips), aspen, and hawthorn are used extensively (Hart and others 1950; Marks and Marks 1988; Marks and Marks 1987; Moyles 1981).

Once snow is deep enough to allow sharp-tail grouse access to sagebrush seedheads, considerable use is made of the seed, floral parts, and upper leaves. Snow may, however, cover up this important source of food and cover. Insects are very important in the diet of juvenile birds 2 to 4 weeks old.

Cover, feeding, nesting, and brood-rearing areas are closely associated with edge areas, riparian areas, and communities having a rich diversity of shrubs, forbs, and grasses. Lek are very sparsely covered by low stature vegetation, often having numerous bare areas (Kobridger 1965; USDA Forest Service 1985; Waage 1989; Ward 1984). Areas of use can vary between seasons (Marks and Marks 1987; Moyles and Boag

Figure 23—Columbian sharp-tail grouse on a 5-year-old grass-forb seeding.

1981). Movement to wintering areas can be triggered by snow depth and availability of food and cover.

Sharp-tail grouse prefer mixed vegetative communities. Shrub communities with a variety of cover types and a diversity in food items are preferred. Canopy cover of shrubs should not exceed 20 to 40 percent (Marks and Marks 1987; McArdle 1976). Dense sagebrush stands can restrict the grouse's visibility, adversely affect the desired variety and abundance of understory forbs and grasses, and provide ideal habitat for predators. Sharp-tail grouse habitat can be enhanced by proper vegetative manipulation (Autenrieth and others 1977). Reducing the density of sagebrush, creating mosaic patterns within various plant communities, and introducing desirable and adapted grasses, shrubs, and forbs can all improve sharp-tail grouse habitat. Plant communities can be thinned by chaining, disk-chaining, use of herbicides, and fire. The same precautions and concerns expressed for the use of herbicides on sage-grouse range apply to sharp-tail grouse range.

Comparing the effects of chaining, spraying, and burning on sharp-tail grouse activities, McArdle (1976) found that sharp-tail grouse showed a definite preference for rehabilitated areas during spring, summer, and fall, and that chained areas were most preferred. Cover, edge area, and quantity and quality of food were greatest on the chained areas. Mosaic patterns can be effectively created and desirable species seeded with the proper use of a disk-chain followed by seeding (fig. 6). DeByle (1985c) reports that sharp-tail grouse prefer the early successional stages of aspen, which would suggest that fire or logging can be used to remove mature aspen and increase sprouting, thereby increasing sharp-tail grouse use. Variation in vegetative communities, species composition, density, cover, edge area, and disturbance is especially important within a 1 mile (1.6 km) radius of leks (Baydack and Hein 1987; USDA Forest Service 1985; Ward 1984).

Preferred species that can be seeded on favorable sites include: alfalfa, small burnet, Lewis flax, lupine, yellow sweetclover, cicer milkvetch, sunflower, balsamroot, yarrow, showy and Nevada goldeneye, wheatgrasses, perennial and annual grains, Great Basin wildrye, and orchardgrass.

Ruffed Grouse

Aspen is the primary home of ruffed grouse in the Intermountain West. Aspen is heavily used as food and cover throughout most of the year (fig. 24) (Barber and others 1989a,b; DeByle 1985c; Doerr and others 1974; Phillips 1965; Roberson and Leathan 1988). However, an aspen community must possess suitable density and plant species composition to make it good grouse habitat.

Figure 24—Ruffed grouse.

During the spring, ruffed grouse feed almost exclusively on aspen flower buds, catkins, and leaves (Barber and others 1989b). As the season progresses, catkins and leaves of other poplars and willows and leaves of emerging forbs are consumed. During the summer months, leaves, fruits, and seeds of forbs, grasses, and sedges are selected. In the fall, the diet gradually changes to leaves and flower buds of mature aspen. Rose hips, and seeds of forbs, especially those of meadowrue are very important and are used extensively. Winter diets are dominated by buds and twigs of mature aspen, chokecherry buds, and rose hips. Buds of willow, serviceberry, and maple are also used (Doerr and others 1974; McGowan 1973; Phillips 1967). Fruits and seeds are used when available. Chicks use insects very heavily for the first 5 weeks and then start to use increasing amounts of vegetative matter (Barber and others 1989b; DeByle 1985b,c; Gullion 1968; Landry 1980; Phillips 1965).

The home range of males and females is generally small, 20 to 50 acres (8.1 to 20.2 ha). Small home ranges are characteristically found in localized, widely separated patches of suitable habitat, or in areas with considerable diversity of habitat types.

Ruffed grouse do not generally migrate. They are the most widely distributed nonmigrating game bird in North America (Barber and others 1989b). In the Intermountain West they are found year round in aspen, spruce-fir-aspen mixes, and in patches of maple and other shrub species along streams and around springs.

Preferred habitats are those that have a diversity of plant communities. The single most important component of ruffed grouse habitat is brood cover (Barber and others 1989a,b; Landry 1980). Good

brood habitat consists of sapling aspen, intermediate aged aspen, and aspen intermixed with, or adjacent to, mountain brush species along streams with sufficient understory of grasses and forbs to supply quality summer food (Barber and others 1989a,b; Gullion 1990; Runkles and Thompson 1989; Thompson 1989). Summer and fall activities are greatest in sapling and immature aspen stands; winter and spring activities are greatest among mature aspen.

Well planned and executed vegetative manipulation can be beneficial to ruffed grouse. The goal in habitat improvement should be to provide a diversity of aspen age classes so that food, roosting, and cover requirements are met in a manner consistent with the limited mobility of this bird (Gullion 1990; Thompson 1989). A number of recommendations for improving ruffed grouse habitat have been made (Gullion 1968, 1990; Landry 1980; Utah Division of Wildlife Resources 1978). Recommendations include: aspen saplings 5 to 25 years old, with densities in the range of 3,000 to 8,000 per acre (7,400 to 12,300 per ha); small irregular clearcuts up to 10 acres (4.0 ha) in size, but no more than 330 ft (100.6 m) wide; burning of clearcut areas following cutting; use of cutting cycles and cutting patterns that will maintain both young and old aspen in close proximity or interspersed; maintenance of dense shrub borders and the seeding of clearcuts; burns; creation of disturbed areas with succulent forbs (with special emphasis on clovers, vetches, other legumes, and shade tolerant succulent grasses).

Blue Grouse

Blue grouse are migratory. In the summer and fall they can be found in aspen, mountain brush (fig. 25), and mountain big sagebrush. In the late fall they generally migrate up in elevation into Douglas-fir, subalpine fir, Engelmann spruce, and other higher elevation conifers (Roberson and Leatham 1988). Spring migration is triggered by snowmelt. Birds move down in elevation when openings in the snow appear under the aspen, in the mountain brush, and the mountain big sagebrush communities. Fall movement generally occurs in September (Rogers 1968; Utah DWR 1978; Weber 1975).

Conifers are used extensively in the winter for cover and food (Hoffman 1961). In Utah, Douglas-fir needles are the single biggest winter food item. Considerable use is also made of currant bushes as cover. In the summer, adults feed extensively on seeds and leaves of forbs, especially legumes. As the season progresses and the forbs dry up, feeding shifts to leaves of shrubs, particularly serviceberry and snowberry. Juvenile birds' major food item for the first 3 months of life is insects, especially grasshoppers (Weber 1975). Plant material and seeds become more important as they grow and mature.

Figure 25—Blue grouse make extensive use of conifer and deciduous trees for cover and food.

Weber (1975) reports that most nesting occurs under mountain big sagebrush. Diversity in community makeup is very important to blue grouse. They prefer areas with trees, shrubs, open flats, and riparian sites in close proximity to each other.

Vegetative rehabilitation projects can be beneficial to blue grouse if planned and executed properly. Items that should be considered on blue grouse ranges include: creation of small openings or clearcuts up to 5 acres (2.0 ha) in any of the inhabited communities; creation of openings with maximum edge area; and seedings that include the maximum number of succulent forbs, with special emphasis on legumes. Openings can be created by clearcutting, prescribed burns, chaining and proper use of herbicides, plowing, and disking. All treatment methods should result in a mosaic treatment pattern.

Chukar Partridge

The chukar prefers arid, rough foothills, and low mountainous country that consists of steep rugged ranges with cliffs, bluffs, rocky outcrops, talus slopes, and brushy creek bottoms and swales (BLM 1970; Bohl 1957; Roberson and Leatham 1988; Young 1981). Areas inhabited by pinyon, juniper, big sagebrush, black sagebrush, bitterbrush, ephedra, rubber rabbitbrush, broom snakeweed, and bunchgrasses are prime chukar habitat (fig. 26). Cheatgrass can be the principal understory or interspace species.

Chukar migration is very limited. In early fall, birds tend to move to lower elevations. When annual grasses germinate and green up in the hills and canyons, birds move into these areas. Heavy snow will move chukars to lower elevations (USDI Bureau of Land Management 1970; Bohl 1957; Molini 1976). Cover requirements are generally met with rocky outcrops, talus slopes, cliffs, small trees, and sagebrush.

Figure 26—Chukar partridge on winter area consisting of juniper, big sagebrush, and annual and perennial grasses.

Nesting is on the ground next to or under rocks and shrubs.

Chukars will eat grains, fruits, berries, and plant parts including stems, blades, and seeds. Plant material from perennials and annual forbs and grasses are consumed (Bohl 1957; Roberson and Leatham 1988). Alfalfa leaves are highly preferred. Cheatgrass is a major food item, seeds and leaves are consumed year round (USDI Bureau of Land Management 1970; Christensen 1970; Young 1981). Insects, principally grasshoppers, beetles, crickets, and ants are also consumed. Most feeding occurs within 1 to 2 miles (1.6 to 3.2 km) of water. Availability of water can be important on dry, summer ranges.

Most range and wildland rehabilitation projects are designed to reduce the density of cheatgrass and shrubs associated with chukar habitat. Care should be taken to identify areas important to chukars. When major chukar populations exist, rehabilitation projects should not occur that will adversely affect chukar habitat. Projects that leave islands of shrubs and cheatgrass, or irregular edges within these types, can benefit chukars. Seedings in treated areas should not be composed of any one species but should include succulent species. Improving available water sources can be most critical on many ranges.

Water

Water is critical to the survival of all wildlife. All areas must have sufficient water available throughout all seasons. Free or running water or moisture contained in snow may be satisfactory. Most gallinaceous birds are able to satisfy their water requirements from dew and succulent forbs, if available (Barber and others 1989b).

Many rehabilitation projects may be unused by wildlife because water is lacking during specific seasons. Water should be a major consideration of every improvement project, especially on arid desert ranges (Gubanich and Panik 1987; Hervert and Krausman 1986). Water is generally less limiting on more mesic summer and spring-fall ranges. Snow, when present, can provide sufficient water for most species. When water is unavailable, provisions need to be included in rehabilitation projects for the development of water sources. This could include the development of springs or wells, construction of water catchment structures (Frasier 1985; Menasco 1986), and the diversion of water from one point to another.

Care must be taken when developing a spring and transferring water to another area. Some water must be retained throughout the year at the spring or collection site. Water catchment devices and areas need to have water available to all wildlife at all times. Water catchments cannot be emptied by livestock when wildlife remain in the area. Water troughs should not be turned off or accessibility to watering areas restricted when livestock leave the area (fig. 27). All too often, when springs are developed and the water is moved to a trough, the free water that previously existed at the source is eliminated. Such developments also damage or eliminate the attendant mesic vegetation, and riparian values that may be present.

Some water developments may not be beneficial to wildlife. Extending water to new areas can encourage and increase livestock use in areas where they were once seldom grazed, especially on fall-winter-spring ranges. This may be especially harmful if it is an area that presently receives use by wildlife near or above carrying capacity. Water development can also increase livestock and human use of areas during critical periods, such as calving, fawning, lambing, and nesting. Water developments generally require access roads, which may or may not be beneficial to wildlife.

Figure 27—Guzzler water development on sheep and antelope range. Once livestock leave the area, water must be left on for antelope and other wildlife.

Water development requires continual maintenance to ensure that water is available when needed (fig. 28).

Provisions need to be made so that birds, small game, and nongame species can gain entry to troughs and tanks (Hervet and Krausman 1986; Menasco 1986). Escape ramps should be installed to allow escape if they fall into the trough or tank.

Fences

Fences can be both harmful and beneficial to wildlife. Properly placed fences can be used to control intensity, duration, and time of livestock and human activities on wildlife ranges.

Calving, lambing, fawning, and grouse nesting areas need to have livestock and humans excluded and access restricted during these periods. All rehabilitated sites require restricted grazing for various periods of time. Big game and sage-grouse winter and spring ranges need to have human activities limited. This is especially important during periods when animals are under stress due to weather conditions, of limited food supply, and reproductive activity. Both depleted and rehabilitated riparian areas generally require considerable protection from livestock, humans, and in some cases, wildlife, to become healed and stabilized. Fencing can be used to protect riparian sites, springs, seeps, and other water areas.

Figure 28—Water sources require constant maintenance and checking to ensure that water is available when needed by wildlife.

Improperly placed and constructed fences can be harmful to big game by excluding or limiting wildlife use of critical watering, foraging, and cover sites. Fence height can restrict movement of big game. Barbed, smooth wire, netting, or their combinations under 42 inches (1.1 m) tall generally do not restrict movement of healthy mule deer and elk. A few animals may "hang up" on 42 inch (1.1 m) or shorter fences, but the majority of animals that are killed in fences are on those taller than 42 inches (1.1 m). Antelope and bighorn sheep require fences they can go through. Helvie (1971) has given guidelines for fences built in areas occupied by bighorn sheep. He recommends that fences should not be constructed with woven wire, but with smooth or barbed wire strands spaced 20, 35, and 39 inches (0.5, 0.9, and 1.0 m) above the ground, or be a lay-down type that can be let down when needed. Improperly constructed fences can restrict movement and cause mortality, especially for rams that get their horns tangled in the wire (Welch 1971).

Fences can be modified to allow antelope passage (Anderson and Denton 1980). Autenrieth (1983), Kindschy and others (1982), Neff (1986), and Yoakum (1980) describe antelope fencing construction. Smooth wire is the most favorable type with the lowest wire being at least 16 inches (0.4 m) off the ground. This size opening will allow the antelope to pass under. Barbed wire can be used on the upper strands but is not recommended. Net wire fences will not allow antelope and bighorn sheep to pass. When net wire fences are built they should have sufficient strategically located and specifically built openings and pass through spaces so that normal movement to feeding and watering areas, and to seasonal ranges is not disrupted or stopped (Mapston and ZoBell 1972).

Electric fences, when properly constructed, are an effective means of controlling livestock, humans, and big game. Electric fences have been used to prevent use by livestock and big game of hay stacks, and feed yards, and to alter the use of agriculture areas, campgrounds, riparian sites, and small, treated disturbances.

Roads

All rehabilitation projects require access for people and their machines. This may involve construction of some type of road and, in some isolated areas, an air strip. Roads can be beneficial to wildlife by providing: (1) a means whereby rehabilitation projects can be completed, (2) access for habitat management, (3) access for harvest and observation of wildlife, (4) increased and improved law enforcement activities, (5) an increase

in edge area and diversity of plant development and growth along the road, where extra water is collected, (6) road bars, when properly constructed, act as water collection and storage areas, and (7) access for fire control. On the other hand roads can be detrimental to wildlife by: (1) increasing human and livestock activity (especially during critical periods), (2) increasing harvest of game animals, (3) increasing poaching, (4) reducing wildlife use, (5) increasing the chance of human-caused fire, (6) encouraging off-road vehicle travel that can reduce the production and effectiveness of a rehabilitation project, and (7) increasing soil erosion.

All roads associated with a rehabilitation project need to be evaluated prior to construction and following completion of the project. Road location can be critical. Calving, fawning, nesting, brood rearing, riparian areas, travel and migration lanes, leks, and meadow edges should be avoided when locating roads. Nonessential roads and disturbed areas should be closed and revegetated. Properly closed and revegetated roads in forested areas can be used extensively by big game.

In selecting species for the rehabilitation of cuts, fills, and disturbed areas associated with roads and highways, big game feeding habits and preferences should be considered. Establishing evergreen or semi-evergreen species, species that green early or stay green into the summer, and shrubs and trees that provide cover can actually encourage big game use and increase chances of big game-automobile collisions. In an effort to reduce such accidents, low-growing, unpalatable species of grasses, forbs, and shrubs should be used along highways.