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Chapter 16

Management of Restored and Revegetated Sites

Management of restored and rehabilitated ranges can be divided into (1) post-treatment, which we are most concerned with herein, and (2) management of the subsequent mature community. Immediate post-treatment management can positively or negatively affect the ultimate success and longevity of a project, and the actual returns and benefits received. It is essential to follow good post-treatment management practices to obtain the maximum return on investments made. The post-treatment management period may last as long as 10 years following treatment.

Management of restored and rehabilitated ranges will vary depending on the goals or objectives of the project. The most common overall objective of a project is to enhance soil stability. Some companion objectives could be to provide for maximum establishment and maintenance of seeded and desirable indigenous species, increase livestock production, improve wildlife habitat, and improve the appearance of the landscape.

Figure 1—Effect of heavy blacktailed jackrabbit use on seedling establishment and forage production. Mule deer and jackrabbit use on the left, mule deer use only on the right.

The principal immediate post-treatment management objective should be to provide for maximum establishment and development of seeded and desirable indigenous species. Once this has been accomplished, other objectives will likely follow.

An important step in any revegetation project is the selection of species to be seeded. Many species used in rangeland improvement projects are adapted to a wide array of range types. Individual plant species do not respond to various management practices in the same way and to the same degree on all sites.

Amount and distribution of precipitation in the Intermountain West is perhaps one of the most important factors in determining to what degree a range improvement project succeeds or fails during the establishment period. Above-average precipitation can result in some outstanding successful projects. Projects should be planned on the basis of average yearly precipitation. Below-average precipitation during years of establishment will change post-treatment management. Managers have little or no control over climatic factors, outbreaks of rabbits, insects, rodents, or disease, which can affect the success and complicate the post-treatment management of a project (fig. 1). One or all of these factors has the potential of destroying or reducing the success of a project.

Managers must control the influence that human activities and grazing animals have on a project. These factors can positively or negatively affect the success of a project. During the establishment period, livestock grazing and any damaging activities of man must be controlled. Human activities and grazing animals can trample seedlings, pull seedlings up, remove foliage, reduce plant vigor and rate of establishment, reduce growth, retard seed production, decrease or slow down soil stabilization, and spread and increase the abundance of undesirable plant species.

The manager makes the decisions concerning when, where, how much, and what type of grazing and human activity is to occur following treatment. Project objectives and management plans should be based on site potential, expected rate of establishment, plant community makeup, and climatic factors. The presence or absence of rodents, rabbits, insects, and disease must be considered. Plans have to be flexible enough to compensate for any changes from the expected when the decision is made to graze, or not to graze, and how much. Development and condition of the project and not plans should determine post-treatment grazing.

If the project objective is only soil stabilization, establishment and maintenance of seeded species would be simpler than when other objectives are considered. By preventing grazing or other disturbing influences, one should be able to accomplish the desired objective of soil stabilization with less effort and in less time.

As a general rule, treated and seeded sites should not be grazed until at least the end of the second growing season following seeding (tables 1 and 2; Plummer and others 1968; Reynolds and Martin 1968; Vallentine 1980; Vallentine and others 1963; fig. 2). Minimum period of rest following treatment will vary with vegetative type treated; grass, forb, and shrub species seeded; climatic conditions immediately preceding, during, and following treatment; soils; seedbed preparation and seeding techniques employed; presence and severity of competing weedy species; plant disease; and number and kinds of insects, rodents, or rabbits on the site (table 2).

When grazing is allowed, it should be lighter than would normally be allowed with a fully mature community, even if forage production figures suggest that heavier use might be permitted. Grazing should only occur when it is least damaging to the newly established species. Spring and early summer use can be very damaging on newly seeded ranges (fig. 3). Special considerations should be given to seeded and indigenous shrubs, because shrubs establish and develop much slower than grasses and forbs. There are slow growing and fast growing shrubs (table 3; fig. 4). The level of grazing should be controlled to allow seeded and released shrubs to establish, and grow enough that they will not be harmed by grazing. As grasses and forbs mature, cattle and sheep use will be less detrimental. During the establishment period, the intensity of grazing has to be adjusted on a season to season basis, and allowance made for phenological stage of development, as well as for climatic and biotic influences.

The drier the treated site, the slower that planted species will establish and develop. Species seeded on a juniper-pinyon site that receives 11 inches (27.9 cm) of annual precipitation will establish and develop slower

Table 1—Recommended minimum years of nongrazing following revegetation of different vegetative types, and according to special treatments and site conditions.

Vegetative type	Special treatment or site conditions	Recommended growing seasons with no livestock grazing following seeding
Subalpine		3
Aspen-conifer		2
Aspen, Gambel oak, maple	Broadcast seed prior to leaf fall	3
Ponderosa pine		2
Mountain brush		2
Juniper-pinyon	Above 14 inches (36 cm) annual precipitation	2
Juniper-pinyon	Below 14 inches (36 cm) annual precipitation	3
Mountain big sagebrush		2
Basin big sagebrush	Above 14 inches (36 cm) annual precipitation	2
Basin big sagebrush	Below 14 inches (36 cm) annual precipitation	3
Wyoming big sagebrush	Above 12 inches (30 cm) annual precipitation	3
Wyoming big sagebrush	Below 12 inches (30 cm) annual precipitation	4
Black sagebrush		3
Shadscale		3 to 4
Black greasewood		2
Inland saltgrass		1
Blackbrush		3

than the same species on an adjacent juniper-pinyon site that receives 14 inches (35.6 cm) annual precipitation. The drier sites will require at least an additional year or more of nonuse (table 2). If a sagebrush area that receives an average of 15 inches (38.1 cm) annual precipitation is treated and seeded and then receives only 10 to 11 inches (25.4 to 27.9 cm), the first one or two seasons following seeding, grazing may have to be delayed by as much as 2 years beyond what was planned to obtain adequate establishment and growth.

Seeded species need to be given the opportunity to put down substantial root systems, to accumulate carbohydrate reserves, and, in the case of some grasses and forbs, to produce a seed crop. To ensure a healthy vigorous plant community it is essential that grasses and forbs be given the opportunity to produce seed the first few years following seeding and every few years thereafter. Improper grazing and sub-optimal climatic conditions are the two major factors that negatively affect seed production.

Table 2—Additional growing seasons of nonuse (beyond recommended growing seasons indicated in table 1) required due to special conditions.

Site conditions	Years
Burned and broadcast seeded	+1
Slower growing shrubs seeded or released (table 3)	+2 to +4
Seedings in cheatgrass, red brome, medusahead, or halogeton communities	+l to +3
Poor seedbed conditions	+1
Erosive soils	+l to +3
Soils with exposed and disturbed subsoil	+2
Precipitation 2 or more inches (5 cm) less than average during first growing season	+1 to +3
Precipitation 2 or more inches (5 cm) less than average during second and third growing season	+1
Outbreak of insects or disease	+1 to +3
Excessive number of rodents and rabbits	+1 to +3

Figure 2—A highly productive 4-year-old rehabilitation project in a juniper-pinyon-Gambel oak type. The site was grazed lightly at the end of the second growing season following seeding. Light grazing occurred the third year following seeding.

Figure 3—Results of poor post-treatment management. The area was grazed too early and too heavy the second and third year following seeding. The seeded species were weakened and killed by grazing, allowing cheatgrass to once again dominate.

Figure 4—Fast growing white rubber rabbitbrush, fourwing saltbush, and big sagebrush are fully established in this 6-year-old range improvement project in a juniper-pinyon type. Antelope bitterbrush growth is considerably slower. The area was spring grazed by cattle during the 2 preceding years.

The degree of seedling vigor and rate of establishment and growth will influence the timing and intensity of subsequent grazing. Species with exceptional seedling vigor and a fast rate of root and aboveground growth can be grazed sooner than those with less seedling vigor or a slower establishment and growth rate (table 3; fig. 5). A good indication of well established, vigorous plants is excellent seed production. When a mixture of species is seeded, management has to be tailored to accommodate the characteristics and requirements of all the species. Post-treatment management should be directed toward the slower developing species (table 3). Many forbs develop slower than most grasses. Most shrubs develop slower than grasses or forbs. When shrubs are included in the seed mix, more than 2 years, and possibly 5 to 6 years, of nonuse following seeding may be required. A few shrubs such as fourwing saltbush, winterfat, rabbitbrush, forage kochia, and big sagebrush, possess a faster rate of growth and maturation. These species will often produce a seed crop and be within 80 percent of their maximum forage production potential within 3 years following establishment (fig. 4).

Many range improvement projects are conducted on depleted sites having some degree of erosion problem. Because of soil loss, site potential may not be as great

Table 3—Years normally required for certain plant species to establish, mature, and flower.

Fast 2 years	Intermediate 2 to 3 years	Slow 3 to 4 years	Very slow 4 to 6 years
Bluegrass, Kentucky	Alfalfa	Crownvetch	Balsamroot
Brome, mountain	Aster spp.	Lupine spp.	Bitterbrush, antelope
Burnet, small	Brome, Regar	Milkvetch, cicer	Ceanothus, Martin
Kochia, forage	Brome, smooth	Rabbitbrush, low	Ceanothus, snowbush
Orchardgrass	Canarygrass, reed	Rabbitbrush, rubber	Chokecherry, black
Rye, mountain	Dropseed, sand	Ricegrass, Indian	Cliffrose
Squirreltail, bottlebrush	Eriogonum, Wyeth	Sacaton, alkali	Currant, golden
Sweetclover, yellow	Fescue, hard sheep	Sagebrush, big	Elderberry, blue
Timothy	Flax, Lewis	Sagebrush, black	Ephedra, green
Wheatgrass, crested	Globemallow	Saltbush, fourwing	Mountain mahogany, curlleaf
Wheatgrass, desert	Goldeneye, showy	Shadscale	Mountain mahogany, true
Wheatgrass, intermediate	Penstemon, Palmer	Sweetvetch, Utah	Serviceberry, Saskatoon
Wheatgrass, pubescent	Sainfoin	Wildrye, Great Basin	
Wheatgrass, slender	Sweetanise	Wildrye, Russian	
	Wheatgrass, bluebunch	Winterfat	
	Wheatgrass, Siberian		
	Wheatgrass, tall		

Figure 5—Shrubs establish and develop much slower than grasses and forbs. Grazing must be closely controlled until all seeded species become completely established and indigenous species recover.

as it once was. The rate of species establishment and growth is influenced by the soil's productivity potential.

Seedling establishment and growth often vary with site preparation techniques. In soils that have been lightly tilled (plowed or disked), seedlings can develop faster, and may be more numerous the first and second year than on less tilled sites. However, seedlings in tilled soils may be more susceptible to transplanting and pulling damage, due to the loose nature of the soil. Young plants growing in sandy soils are more susceptible to grazing and transplanting damage than are seedlings on areas with heavier soils.

Depleted aspen and Gambel oak areas can be seeded prior to leaf fall, with no other treatment being required. Seedling growth and plant maturity is inhibited under these conditions. Grazing is not recommended on these areas for at least three or four growing seasons following seeding.

Sites with aggressive annuals (cheatgrass, red brome, medusahead, and halogeton) on them prior to treatment, need to be given special management consideration (fig. 3). Care must be taken with grazing. Seeded and indigenous species generally develop slower in the presence of aggressive annuals than on sites without annuals. Livestock grazing in these situations may have to be delayed longer than would normally be needed to allow for proper seedling establishment and community development.

Once a seeded community has become established, grazing must be closely regulated. Most annuals are never totally eliminated from a site. Annuals in a community are waiting for the opportunity to increase, and will do so when the seeded community is weakened through misuse. Annuals can once again become the dominate species with improper management (fig. 3).

It is not fully understood how most seeded (native and introduced) and indigenous species will respond to each other and to grazing. Because of the many physical and biological factors associated with an improvement project, the manager must expect the unexpected, and be flexible enough to adapt management plans accordingly. To do otherwise may harm some species in the community, encourage others, and diminish the potential values and habitats associated with the project.

Some projects may include transplanting. Transplants establish at various rates. Site characteristics, range condition, age and condition of transplants, soil condition and type, soil moisture, and occurrence of post-planting precipitation can all affect rate of transplant establishment. Transplants need to be firmly rooted and producing good top growth before any grazing occurs.

Seeded and transplanted species in riparian situations may require a considerable amount of time to become established and to stabilize the site. Because riparian areas are generally heavily used by livestock and humans, all grazing and human activities should be removed at the time of treatment. Use cannot resume until all seeded and planted species, as well as indigenous species, are completely established or have recovered, and the disturbed areas has stabilized (fig. 6). When grazing is resumed, animal densities, distribution, and duration of use on the area must be closely monitored. Proper distribution of livestock becomes very critical. Human activities must be controlled and monitored, and proper action taken when necessary.

Figure 6—This disturbed riparian site was broadcast seeded. Shrubs were transplanted along the water's edge. Grazing should be excluded until the disturbance is completely stabilized and the shrubs are fully established and reproducing vegetatively.

Excessive use by big game can result in harm to improvement projects. The chances of this happening are small. If this occurs, a reduction in numbers, the exclusion of game animals, and period of nonuse programs can be initiated. This could include the erection of temporary electric fences, implementation of special hunting seasons, or herding of livestock and game. If needed, big game reduction programs should be carried out prior to the project. Animal numbers and degree of use fluctuate seasonally and yearly, depending on weather, conditions of adjacent ranges that big game use, animals' health, reproduction rate, predators, disturbances, and type and timing of hunts and hunter success.

Most project areas require access roads. Unneeded or undesirable roads should be closed and seeded upon completion of each project. When improperly constructed, roads can become erosion channels. New roads can increase human activities on a site, resulting in (a) disturbance of livestock and wildlife activities, (b) reduction in livestock and wildlife use, (c) destruction of seeded and planted species, especially on riparian sites, (d) additional human use of water development, (e) increased on- and off-road vehicle travel, (f) increased fire potential, (g) additional soil erosion, and (h) increased use by horses. New access roads can likewise concentrate livestock use, resulting in depleted areas.

Destructive and harmful human activities that should be controlled on a new rehabilitation project include camping and associated activities, off-road and on-road vehicle travel, horseback riding, fires, gate closure problems (cattle guards can alleviate this problem), wood gathering, livestock trailing and human activity during critical wildlife periods such as breeding, nesting (fig. 7), fawning, calving, periods of deep and crusted snow, low forage availability, and other stressful periods.

Figure 7—A mourning dove nest in an ungrazed juniper-pinyon chaining-seeding rehabilitation project.

Permanent or temporary fences can be used to help control grazing and human activities. Solar-powered electric fences are ideal for temporary protection of rehabilitation sites. Monitoring and repair of fencing is essential to the success of any project.