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WILDLIFE HABITATS IN MANAGED RANGELANDS-- THE GREAT BASIN OF SOUTHEASTERN OREGON

MULE DEER

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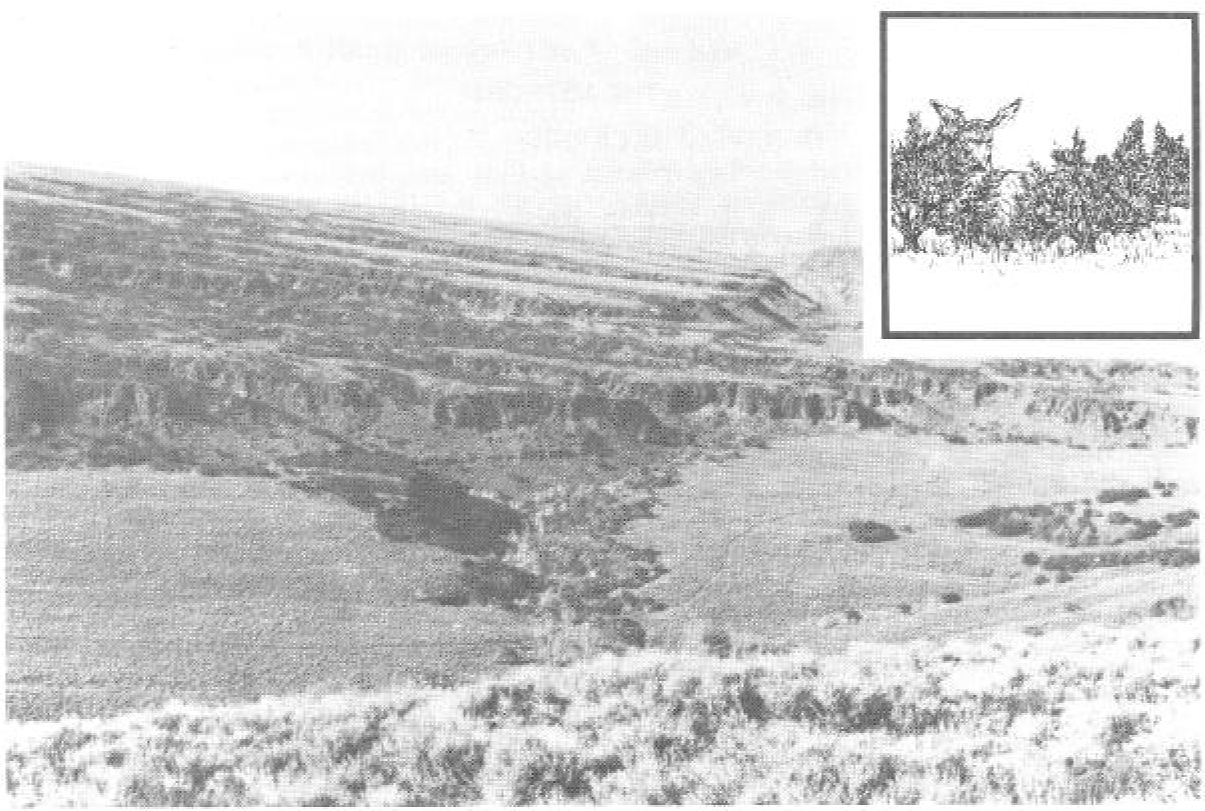

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ABSTRACT

Relationships of mule deer behavior and physiology to management of shrub-steppe plant communities in the Great Basin of southeastern Oregon are presented for application in land-use planning and habitat management. Communities are considered as they are used by mule deer for thermal cover, hiding cover, forage, fawning, and fawn rearing.

KEYWORDS: Deer (mule), wildlife habitat, range management, Oregon (Great Basin).

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This publication is part of the series **Wildlife Habitats in Managed Rangelands–The Great Basin of Southeastern Oregon.** The purpose of the series is to provide a range manager with the necessary information on wildlife and its relationship to habitat conditions in managed rangelands in order that the manager may make fully informed decisions.

The information in this series is specific to the Great Basin of southeastern Oregon and is generally applicable to the shrub-steppe areas of the Western United States. The principles and processes described, however, are generally applicable to all managed rangelands. The purpose of the series is to provide specific information for a particular area, but in doing so to develop a process for considering the welfare of wildlife when range management decisions are made.

The series is composed of 14 separate publications designed to form a comprehensive whole. Although each part will be an independent treatment of a specific subject, when combined in sequence, the individual parts will be as chapters in a book.

Individual parts will be printed as they become available. In this way the information will be more quickly available to potential users. This means, however, that the sequence. of printing will not be in the same order as the final organization of the separates into a comprehensive whole.

A list of the publications in the series, their current availability, and their final organization is shown on the inside back cover of this publication.

Wildlife Habitats in Managed Rangelands–The Great Basin of Southeastern Oregon is a cooperative effort of the USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, and United States Department of the Interior, Bureau of Land Management.

Introduction

Wildlife biologists, planners, resource managers, and interested citizens are increasingly involved in planning and allocating uses of public lands. Planning uses of rangeland often requires predicting effects of management on the habitat of mule deer, *Odocoileus hemionus.* Our objective is to describe optimum habitat for mule deer and provide information to help managers predict the consequences of range management alternatives on deer.

Shrub-steppe rangelands are normally managed to increase forage for livestock, but not intentionally managed to either create or maintain vegetative structure compatible with deer needs. Good livestock management–contrary to conventional wisdom–is not always good deer management. Changes in habitat can be made to benefit mule deer or to attain other goals, if such changes are compatible with the site capability (Baker and Frischknecht 1973; Crawford 1975; Hill 1956; Julander 1962; Leckenby 1968, 1970, 1978a; Leopold 1933; Plummer et al. 1968; Reynolds 1964,1974; Robinette et al. 1952; Thomas et al. 1976,1979; Tueller 1979; Tueller and Monroe 1975; Verme 1965). Benefits to deer depend on how compatible range management systems are with the physiological and behavioral needs of deer. The key to deer management is habitat management. Habitat is also affected by other range uses, such as agriculture, housing, and recreation. Although meeting projected demands for red meat will require more intensive livestock management (Forest-Range Task Force 1972, USDA Inter-Agency Work Group on Range Production 1974), this need not increase competition between livestock and deer for forage. Livestock grazing can be manipulated to make nutritious food available to wild ungulates at critical times (Anderson and Scherzinger 1975, Bell 1971, deBoer 1970, Leckenby 1968, Willms et al. 1980). Range seedings, of crested wheatgrass[1] for example, can increase forage diversity and maintain cover distributions if extensive monocultures are avoided.

1 Common and scientific names and their sources are listed in the appendix.

Shrub-steppe ranges generally occur where annual precipitation is below 37.5 centimeters (15 inches) and are characterized by severe climate. Disturbance of vegetation initiates slow successions that do not regain original conditions, even when areas are excluded from livestock grazing for up to 30 years (Rice and Westoby 1978, Robertson 1971). Because of the severity of such sites, some induced successional stages have lasted many decades.

Resident deer herds occupy some shrub-steppe ranges the year around. Other migratory herds spend only winters there, causing high animal concentrations on a small portion of the annual range. On such ranges the effects on deer of habitat manipulations are magnified.

Our objectives are to: (1) define optimally productive deer habitat on managed shrub-steppe rangelands; (2) tie deer habitat to plant community and structure; (3) apply these concepts to deer habitat management units; (4) compare consequences of habitat management to deer; and (5) present information that can be used in preparing environmental analyses, habitat management plans, allotment management plans, environmental impact statements, and long-range management plans.

The use of livestock grazing to improve mule deer habitat requires an understanding by resource specialists, managers, and administrators of the habitat requirements of deer and the effects of livestock grazing on deer habitat. The key to this understanding, and to communication about deer, is the common knowledge these specialists have about plant communities.

Understanding of plant communities, their structure, and arrangement in time and space can simplify discussions of the relationships of deer to their habitat. This is also basic to understanding interactions of ecological factors, evaluating their relative influences, and predicting the results of manipulation.

The relationships between deer and their habitat and the consequences of management actions described here apply primarily to the Great Basin of southeastern Oregon—specifically the Lake and Owyhee Desert sections (Holmgren 1972:78-87). The information may apply generally to similar areas because: (1) much, generally consistent, data are available on mule deer-habitat relationships; (2) shrub-steppe communities are similar; (3) enhancement of livestock grazing dominates land management activities on most ranges; and (4) the basis for management of mule deer habitat is interpreting deer requirements in terms of plant community composition and structure. Extension of our rationale to other geographic areas must be done with caution and by incorporating applicable principles to new data and new knowledge about relationships of deer to habitat for those places.

This chapter is not a techniques manual, a compendium of treatment prescriptions, nor an evaluation of research publications. It is an examination of habitat relationships. We define cover and forage components of optimum deer habitat and describe how changes in plant community structure and composition affect habitat quality.

While we emphasize optimum habitats that allow deer herds to approach maximum productivity, we recognize that deer exist where habitats are less than optimum. We believe that deer habitats on shrub-steppe ranges can be improved by using livestock grazing as a management tool.

The literature and cumulative knowledge concerning deer is extensive and provides several ways to evaluate deer habitat. To narrow these possibilities and to achieve our objectives, we have made the following assumptions:

1. Manipulation of vegetation to benefit livestock is the primary practice that affects deer habitat and will increase as demands for red meat increase.

2. Resource allocations and management influence the welfare and productivity of deer.

3. Cover, forage, water, and space are required by deer.

4. Cover and forage areas are separable habitat components.

5. The diversity, size, arrangement, juxtaposition, and edges of cover and forage areas can be manipulated to achieve predictable changes in deer use and productivity.

6. While deer use the best cover and forage available, the closer to optimum the size, arrangement, and diversity of habitats, the higher productivity will be.

7. Herd size is limited by the productivity of plant communities.

8. In situations where forage or cover are limiting deer productivity, and there is competition with livestock, we will consider deer needs first and pinpoint how deer habitat can be enhanced by appropriate livestock grazing systems.

9. Since behavior and tradition largely control deer distribution and movement (Gruell and Papez 1963; Leckenby 1977, 1978a; Mackie 1970; Severinghaus and Cheatum 1956; Zalunardo 1965) and prevent subpopulations of deer from leaving home ranges for adjacent forage and cover, the appropriate management unit is a deer subpopulation range.

10. Range treatments produce both immediate, obvious impacts on habitat and long-term, subtle impacts.

11. The plant community is a more obvious and sensitive indicator of present and past environments than combined measures of temperature, insolation, soil, etc. (Daubenmire 1968; DeVos and Mosby 1969; Duffey and Watt 1971; Leckenby 1968, 1970, 1977; Mueller-Dombois and Ellenberg 1974; Roberts 1975).

MANAGEMENT UNITS

Sizes of habitat management units vary with management goals and whether they are based on biological or political grounds, or both. Existing political units, such as States, National Forests, Ranger Districts, and counties can be convenient for administration, but are too large for management of deer habitat. Herd ranges, usually defined by a combination of natural and administrative boundaries (Dasmann 1971, Hunter and Yeager 1956), or seasonal ranges, defined by drainages, ridgelines, or roads, permit increased administrative sensitivity to deer needs, but both are too large to allow managers to identify and monitor specific habitat conditions. The largest unit that is administratively practical and, at the same time, sufficiently sensitive to deer-habitat relationships is the range of a subpopulation. A subpopulation is an aggregation of two types of social groups that occupy a specific area: females with fawns and adult males. A subpopulation range encompasses the separate home ranges of several groups of does with fawns and groups of bucks.

Since our objective is to define optimum habitat for deer, we have adopted the subpopulation range as the most appropriate management unit and use it in this publication. It is large enough to be administered effectively, yet small enough to allow monitoring of deer responses to habitat. Subpopulation ranges are large enough to accommodate livestock grazing allotments, allow manipulation of cover and forage areas over time, and suit pasture rotation designs; yet they are also small enough that two or more can be combined as a larger element of a coordinated management plan.

Subpopulation ranges are usually 10 to 20 times larger than seasonal home ranges of individual deer, which range from 50 to 1,240 hectares (120 to 3,060 acres) and average 260 hectares (640 acres) in widely different habitats (Dasmann 1971, Leckenby 1978b, Leopold et al. 1951, Robinette 1966, Rodgers et al. 1978, Swank 1958, Taber and Dasmann 1958, Zeigler 1978). On steep slopes, ranges of subpopulations appear as corridors. For example, a "subpopulation of the Middle Park deer herd" wintered on Cedar Ridge in an area 6.4 by 1.6 - 3.2 kilometers (4 by 1-2 mi) (Gilbert et al. 1970:17, 20). A California deer herd consisted of two subpopulations; the average area occupied was 347 km^2 (134 mi^2) in summer and 47 km^2 (18 mi^2) in winter (Leopold et al. 1951:16-19, 49). A subpopulation occupied a corridor about 5 by 10 kilometers (3 by 6 mi) on a shrub-steppe winter range (Leckenby 1978b).

In southeastern Oregon, habitat management units between 2,500 and 4,700 hectares (6,400 to 11,520 acres) approximate subpopulation ranges. These units appear either as corridors on sloping range, about 5 by 10 kilometers (3 by 6 mi), or as blocks on more level range, about 8 to 9 kilometers (5 to 6 mi) on a side. These sizes represent a compromise between maximum sensitivity to deer biology and minimum administrative cost. The number of deer in a subpopulation varies widely with quality of habitat and can range from as low as 20 deer up to 2,000.

PLANT COMMUNITIES AND STRUCTURAL CONDITIONS

Plant communities may be grouped in various ways for different management purposes. We identify groups by dominant plant species (Dealy et al. 1981). We have arranged the multitude of plant communities and seral stages in shrub-steppe succession into five structural conditions:[2] grass-forb, low shrub, tall shrub, tree, and tree-shrub.

Use of Plant Communities by Deer

Deer usually require several plant communities. Daily and seasonally, they use a variety of land and vegetation features for cover and forage. Some communities are used only part of each season, but most communities contribute to the well-being of deer sometime during the year. When deer can meet their needs within a relatively small area, deer productivity will be enhanced because maintenance energy costs will be less (Moen 1968b).

Migratory deer use plant communities on three seasonal ranges (Zalunardo 1965). They migrate from lower elevation winter ranges through spring-fall ranges to higher summer ranges (fig. 1). Fawning usually occurs in upper spring-fall and summer ranges. Most deer gradually disperse over the summer range as snow recedes to higher elevations.

Fall migration is largely influenced by weather. Severe storms often precede migration to winter range. In moderate winters, deer may not move to winter range at all, or they may arrive only after spring growth of forage.

[2] Maser, C., and J.W. Thomas. The relationship of terrestrial vertebrates to the plant communities and structural conditions. Unpublished data on file at Pacific Northwest Forest and Range Experiment Station, La Grande, Oregon.

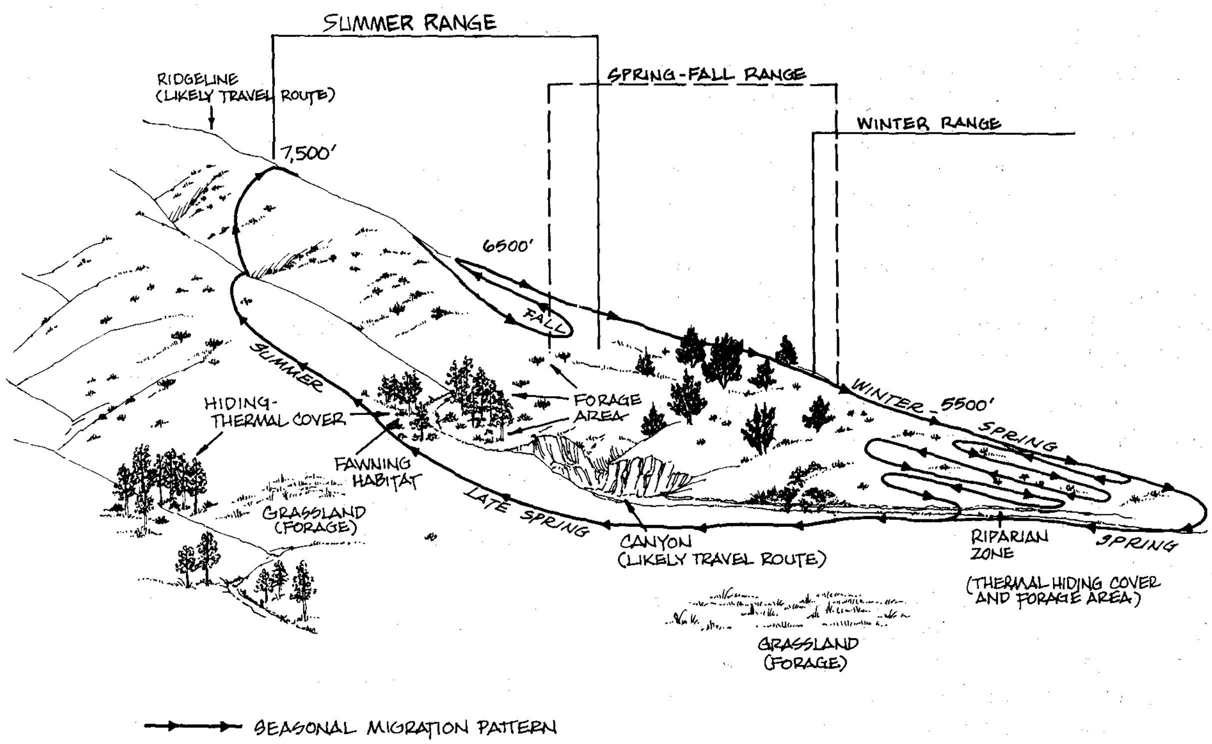


Figure 1. - Use of seasonal ranges depends on how well deer requirements are met by sizes and distribution of habitats relative to ridgelines, canyons, slopes, and flats.

Management Based on Plant Communities and Structure

The number of deer a management unit can sustain is determined partly by the structure, composition, and arrangement of the vegetation, habitat diversity, amount of edge, availability of water, soil productivity, and weather severity. Through manipulation of vegetation structure and composition, habitat diversity, amount of edge, and availability of water, land managers can influence the ability of the land to produce deer.

Plant communities, structural conditions, and land features provide the information managers need to predict responses of both animals and vegetation to management and provide a basis for land-use planning (Crawford 1975, Daubenmire 1968, DeVos and Mosby 1969, Mueller-Dombois and Ellenberg 1974). This information includes:

1. Current composition and structure of the vegetation;
2. Soil depth, stability, and suitability for fertilization;
3. Elevation, steepness, position, aspect, shape, and length of slopes;
4. Present type of use by deer and livestock;
5. Past uses for roads, fences, water sources, and grazing;
6. Probable results of treatment and potential effects on productivity.

Deer production is usually greatest in the shrub and tree-shrub structural conditions (Hill 1956, Leopold 1950, Moen 1973). Structural condition can be retarded or advanced by grazing, fire, chemicals, or machinery (Koehler 1975, Plummer et al. 1968, Roberts 1975, Valletine 1971, Willms et al. 1980, Yoakum and Dasmann 1969). The challenge is to plan diversity of habitat and interspersion of cover with forage that will enhance or maintain deer habitat within each subpopulation management unit in areas managed primarily for livestock grazing.

Habitat Requirements of Mule Deer

Optimum habitat for deer is defined as the amount and arrangement of cover and forage areas which result in the greatest use of the most area. Optimum habitat is described here by sizes of stands and their arrangements in time and space to meet needs of deer for thermal and hiding cover, forage areas, and fawning and fawn-rearing habitat.

Range use by deer is not uniform. Habitat conditions often vary between intensively and lesser used areas (Bertram and Rempel 1977, Leckenby 1978b, Owen 1980, Webb 1948). Just how variations in use are related to conditions is not always clear.

COVER

Deer require protection from weather and predation. Because of the usual structure of shrub-steppe communities, where thermal cover is provided, hiding cover is usually also provided (fig. 2). On most range sites, cover is provided primarily by tall shrub species, which in some seasons, also provide much of the deer forage. On some management units, cover needs may be satisfied by one plant community, juniper/sagebrush, for example.

Thermal Cover

We define optimum thermal cover for deer within the Great Basin of southeastern Oregon as stands of evergreen or deciduous trees or shrubs, at least 1.5 meters (5 ft) tall, with crown closure greater than 75 percent. Deer will use the best available thermal cover, although it may not be optimum (fig. 3). Structure of vegetation is more important than composition, and levels of crown closure greater than 75 percent appear equally preferred. Thermal cover should be at least 0.8-2 hectares (2-5 acres), since the area of thermal protection increases with stand widths greater than 90 meters (300 ft).

The quality of thermal cover for deer is affected by the following factors and relationships:

1. Net radiation flows are modified by crown closure.
2. Snow depth decreases as crown closure increases.
3. Vegetation taller than deer furnishes diminishing benefits.
4. Sixty-percent crown closure meets minimal year-round needs.

Figure 2. - Shrub-steppe plant communities that provide thermal cover usually provide hiding cover also.

5. Production is greater where there is protection from effective temperatures outside the thermal neutral zone.

These relationships have been observed by Dasmann (1971), Leckenby (1977), Loveless (1964), and Moen (1968b, 1973). The zone of thermal neutrality (Brody 1945, Holter et al. 1975) is that range of temperatures over which an animal's metabolic rate, as measured by heat production, is minimal.

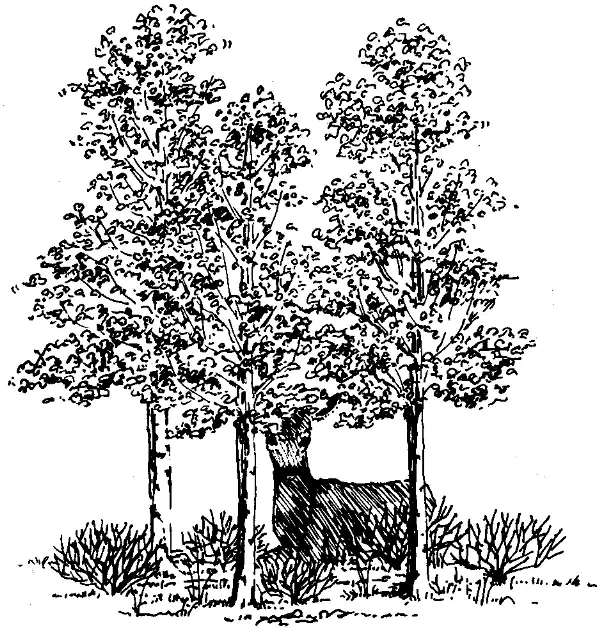
Effective temperature is the result of the combined effects of several factors, including air temperature, wind speed, and radiation (Moen 1968b, Porter and Gates 1969). Wind chill (Siple and Passel 1945) is an example of effective temperature derived from air temperatures and wind speeds only.

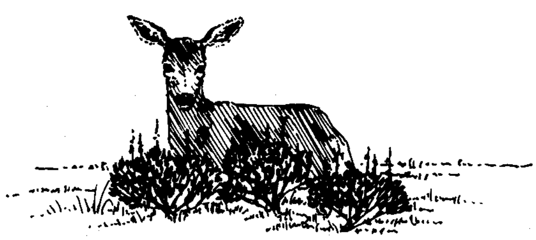
Deer use evergreen trees and shrubs for thermal cover on winter range and deciduous trees and shrubs as well on summer and spring-fall range (Leckenby 1977,1978a; Loveless 1964,1967; Mackie 1970). Topographic features, such as rocky bluffs, enhance the thermal cover offered by vegetation in some locations and may provide the only thermal cover (Grace and Easterbee 1979, Staines 1976).

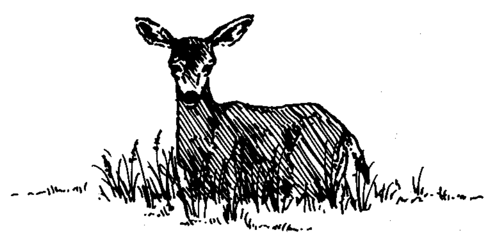
Thermal cover allows deer to conserve energy by protecting them from stresses induced by weather. Energy in excess of that required to maintain basal metabolism, regulate temperature, and provide for tissue replacement and necessary activity is then available for productive processes.

Much of the energy in the food of ruminants is used to satisfy basal and maintenance requirements, or is lost in waste products. Basal requirements are those necessary to sustain life. These include maintaining minimum body temperature and heart rate. Maintenance requirements are in addition to basal requirements and include travel to and from food and water and replacement of hair coats. If

Figure 3. - Deer will use the best available thermal cover, but cover with some thermal qualities is better than none.







basal requirements are not met the animal will die; if maintenance needs are not met the animal will lose body weight. When basal and maintenance needs are met, energy surpluses are used for production, which includes growth, storage of reserves, reproduction, and care of young (Blaxter 1962; Brody 1945,1956; Findlay 1954; Grace and Easterbee 1979; Holter et al. 1975; Mitchell 1962; Moen 1968b,1968c, 1973; Nordan et al. 1970; Ozoga and Gysel 1972; Silver et al. 1969 and 1971).

Temperature regulation in response to thermal stress increases the energy cost of maintenance (fig. 4) and thus takes energy that otherwise could be used in productive processes. Maintenance requirements increase when radiation flows, surface temperatures, air temperatures, wind speeds, and snow depths increase flows of energy **from hot** environments **to** ruminants as well as **from** ruminants **to** cold environments (Chappel and Hudson 1978; Holter et al. 1975; Malechek and Smith 1976; Moen 1968x,1976; Porter and Gates 1969). In attempts to reduce maintenance costs, deer may remain quiet under thermal cover or may move to cover from open areas that offer only low-energy forage but greater thermal stress (Leckenby 1977, Loveless 1964, Ozoga and Gysel 1972). If their diet meets or exceeds maintenance requirements, however, deer and cattle may bed or stand in exposed forage areas during periods of thermal stress (Malechek and Smith 1976; Moen 1968a, 1968c).

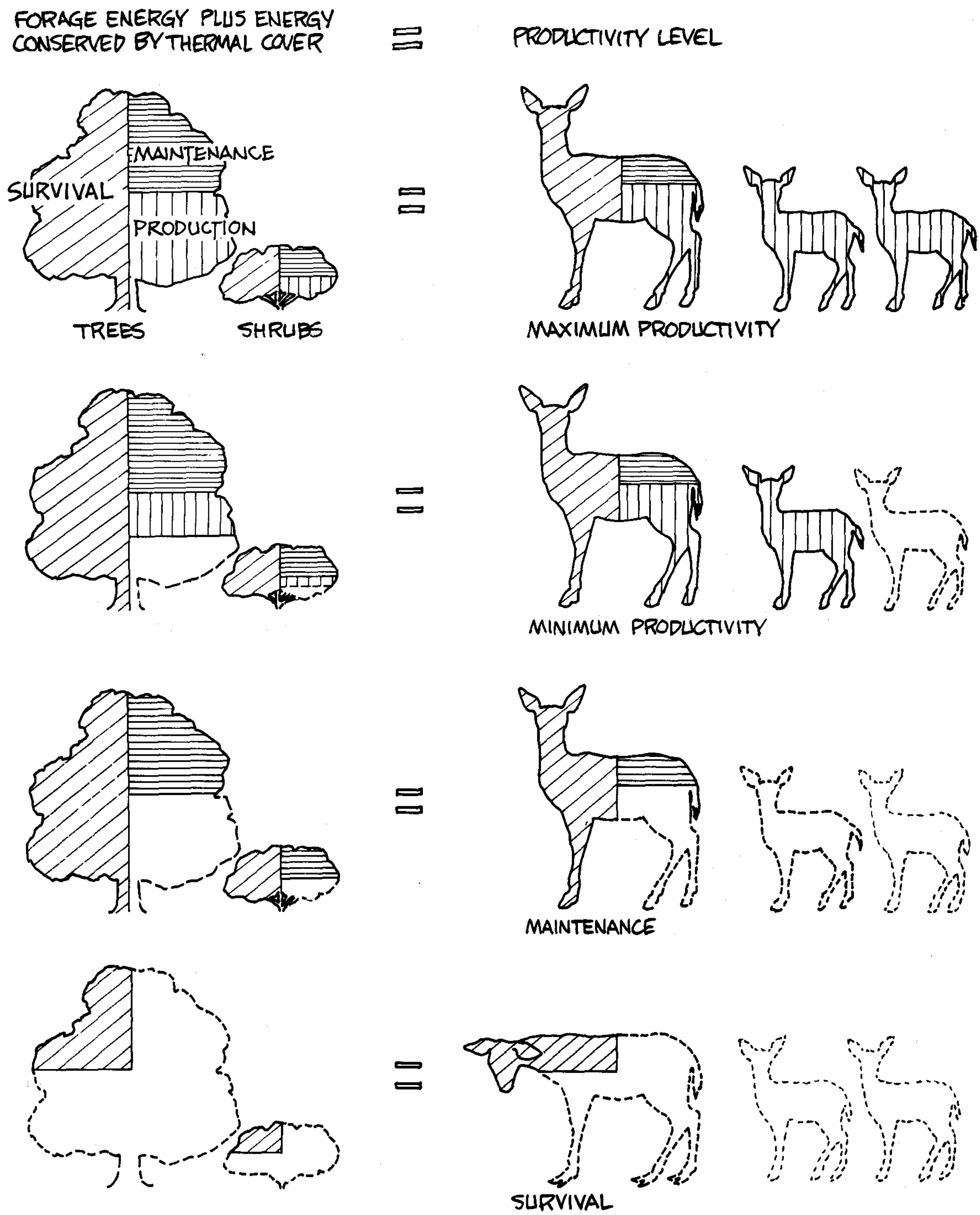


Figure 4. - Productivity of deer varies with the supply of energy available from forage and the thermal cover to conserve it. When quality and quantity of forage and cover is minimal, only survival needs are met. With increasing supplies of both, animals can maintain body weights. As supplies increase further, growth can occur, reserves of fat can be stored, and does can produce fawns and milk.

The thermal neutral zone covers a range of temperatures over which heat production increases only slightly. With temperatures outside that zone, metabolic rate increases rapidly (Blaxter 1962, Brody 1945, Chappel and Hudson 1978, Holter et al. 1975, Moen 1968b). For domestic animals, the shelter and food usually provided the year around broadens the thermal neutral zone, increasing the upper and reducing the lower critical temperatures (Blaxter 1962:116-146). Brody (1945:305-306) suggested that productive efficiency of domestic animals was little affected by temperatures ranging from near zero (18°C) to about 80°F (27°C). The shelter and food available to wild ruminants, however, over much of the year reduces the thermal neutral zone to a narrower range of temperatures.

The thermal neutral zone of white-tailed deer in captivity has been examined in different seasons. A "comfort zone" between 5°C and 20°C (41°F and 68°F) has been suggested for winter, since the estimated minimum level of energy expenditure occurred at about 12°C (54°F), but a thermal neutral zone could not be demonstrated for spring, summer, or fall (Holter et al.1975). In another study, deer in winter coat increased heat production by only 25 percent at temperatures between 0°C and 20°C (32°F and 68°F), but when the temperature was dropped to -15°C (+5°F) a 75-percent increase was seen (Silver et al. 1971).

The cooling effect of wind may either increase or decrease thermal stress. Winds coupled with temperatures below the thermal neutral zone intensify stress due to cold because the effective temperature is reduced by convective cooling (Grace and Easterbee 1979, Porter and Gates 1969, Siple and Passel 1945, Staines 1976, Stevens and Moen 1970). At temperatures above the thermal neutral zone, winds lower effective temperatures and reduce stress from heat.

Effects of radiation, humidity, and snow on flows of energy to and from wild animals are also of great biological importance (Gilbert et al. 1970; Grace and Easterbee 1979; Moen 1968b, 1973, 1974; Moen and Jacobson 1974; Porter and Gates 1969).

Vegetation structure helps create microclimates. Height, canopy closure and depth, and stem density modify temperature, wind speed, precipitation, and radiation within stands. Reifsnyder and Lull (1965:70) wrote "...the forest can reduce monthly maximum air temperature in the summer by about 10°F below that in the open, reduce annual rainfall (through interception) by 15 to 30 percent, and reduce wind velocities by about 20 to 60 percent." Canopy closure in thermal cover reduced snow depths from 10 to 50 percent of that in shrublands (Leckenby and Adams 1978).

Structural effects have been quantified and can be related to the biology of deer (Bergen 1971, 1972, 1974; Cochran 1969; Gary 1974; Geiger 1966; Gifford 1973; Nudds 1977; Ozoga 1968; Ozoga and Gysel 1972; Reifsnyder and Lull 1965; Stevens and Moen 1970; Verme 1965). Shrub communities also influence microclimate, but less than forests.

Thermal protection is as important in summer as in winter. Lack of protection in summer not only reduces immediate productivity but also lowers reserves necessary for survival during the coming winter. Lack of protection in winter not only threatens immediate survival but also reduces productivity during the following summer. The importance of thermal protection in summer could not be fully appreciated until annual cycles in body weight of deer were documented (Robinette et al. 1973, Short et al. 1969, Silver et al. 1969, Wood et al. 1962, Wood and Cowan 1968).

Optimum microclimates for deer require more than 50-percent canopy closure (Verme 1965). Incoming and outgoing radiation will substantially increase or decrease surface temperatures at less than 50-percent closure. Canopy closures greater than 50 percent create more constant and less stressing microclimates by minimizing fluctuations of incoming and outgoing radiation. In the Great Basin, where temperatures are often outside the thermal neutral zone for deer, 60-percent canopy closure is the minimum criterion for thermal cover.

The severity of temperature, wind, precipitation, and radiation in forage areas surrounded by cover stands increases with the ratio of forage area diameter to height of the adjacent cover stand; density of nearby cover has an important but smaller effect (Cochran 1969, Geiger 1966, Gifford 1973, Reifsnyder and Lull 1965, Verme 1965).

Riparian habitats in rangeland areas are extremely valuable for thermal cover and are used intensively by wildlife, livestock, and people. This habitat usually combines in a small area the vegetative and topographic components that together fulfill most deer requirements. Riparian zones also receive intensive livestock use because of the availability of thermal cover, green forage, and water. People prefer riparian habitats for fishing and water-oriented recreation. Thus, when thermal stress occurs, deer compete with other big game, livestock, and people for riparian zones.

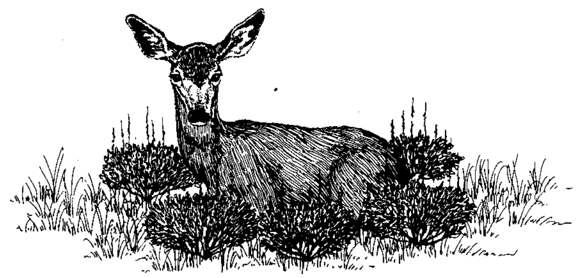
Hiding Cover

Managers assume that deer require hiding cover (also called escape or security cover by some authors) to make maximum use of a range (Bertram and Rempel 1977, Dasmann 1971, Nudds 1977, Owen 1980, Reynolds 1972). We define optimum hiding cover on shrub-steppe rangeland as vegetation at least 60 centimeters (24 inches) tall and capable of hiding 90 percent of a bedded deer from view at 45 meters (150 ft) or less (the sight distance after Thomas et al. (1979:109), figs. 5 and 6). Owen (1980) detected significant associations between visual density of vegetation and activities of free-ranging mule deer.

Sight distances differ between stands because of differences in plant characteristics and seasonal changes caused by plant phenology. Tall shrubs provide adequate hiding cover for some activities. Low shrubs often hide bedded fawns at less than 1.5 meters (5 ft) during summer. But both shrubs and trees are often required to hide deer against a snowy background at less than 800 meters (1/2 mi).

Areas of hiding cover should be between four and eight sight distances wide (190 to 380 meters or 600 to 1,200 ft). Patches of hiding cover as small as 2 to 10 hectares (6 to 26 acres) are probably sufficient for social groups of deer. Optimum distribution of hiding cover within a management unit consists of continuous, interconnecting zones and scattered patches (fig. 7). Canyons and ravines supplement and enhance vegetative hiding cover. Although topography may produce a visual barrier between an animal and a predator or a road, and distance may improve security, deer

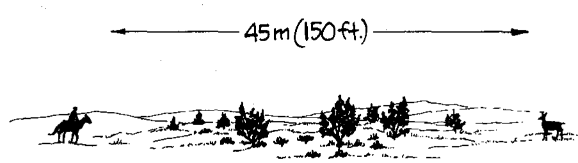
DEER 90 PERCENT HIDDEN AT 45m. (150 ft.) IN MOUNTAIN BIG SAGEBRUSH



DEER 90 PERCENT VISIBLE AT 45m (150ft) IN LOW SAGEBRUSH

Figure 5. - Vegetation that hides 90 percent of a bedded deer from view at 45 meters (150 ft) qualifies as hiding cover, provided the stand is at least 190 meters (600 ft) wide. Low shrub communities offer little hiding cover.

Figure 6. - The distance at which a deer is 90 percent hidden from view is defined as the "sight distance" (after Thomas et al. 1979). Hiding cover requires that sight distance be no more than 45 meters (150 ft).



ONE SIGHT DISTANCE

may still feel vulnerable without vegetative cover. On short sagebrush and grass rangelands, deer substitute distance and topography for vegetative cover. "Safe" distance varies with time of year, health and activity of the animal, and experience and conditioning of the animal to varied forms of disturbance and harassment. Although distance and topography, by definition, do not provide optimum hiding cover in large open areas, they may provide a partial substitute.

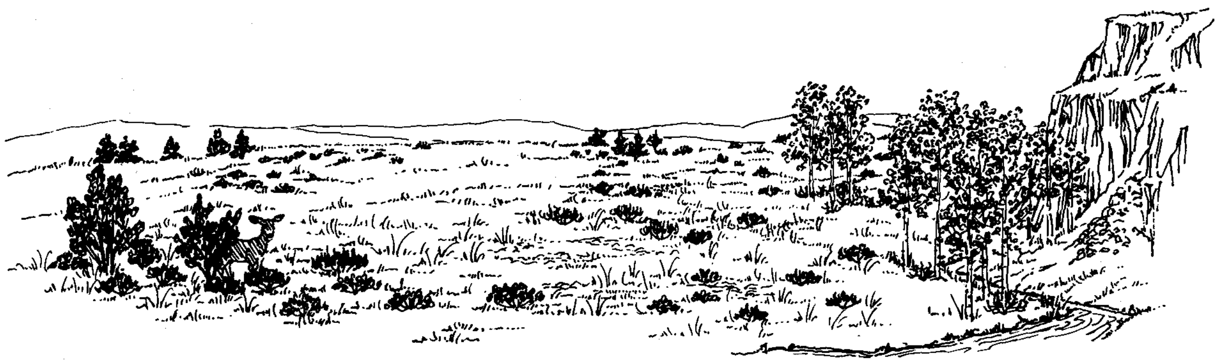


Figure 7.- Ideal mule deer range consists of a mosaic of plant communities arranged to provide thermal cover, hiding cover, and forage areas of optimum structure and size.

FORAGE

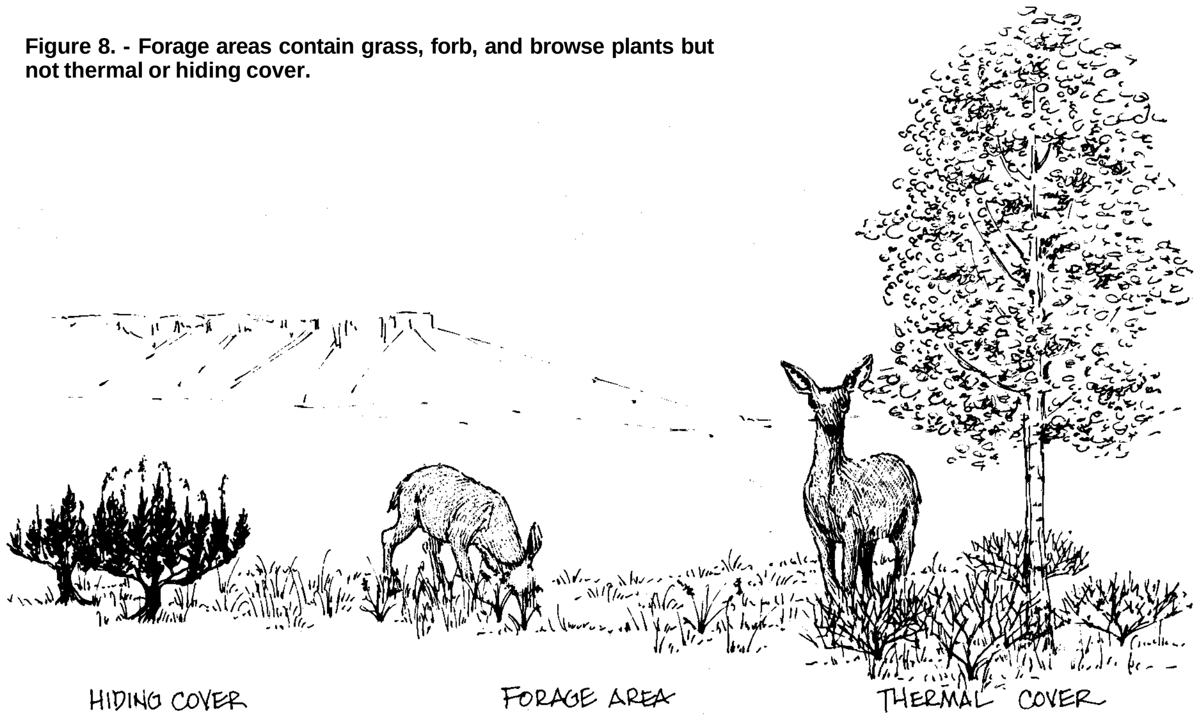
Forage areas are vegetation stands used by deer for grazing or browsing which do not fit the definitions of thermal or hiding cover (fig. 8). This definition assumes that optimum forage areas do not constitute optimum cover areas, although plant species that provide forage at one season often are used primarily for cover at other seasons. For example, big sagebrush and bitterbrush forage may satisfy survival or maintenance needs in fall and winter but are used primarily for cover in spring, when forb and grass species are available to meet maintenance and production requirements (Holl et al. 1979; Leach 1956; Leckenby 1978a, 1978c). Forage and cover types are seldom mutually exclusive on shrub-steppe rangelands, but such habitat division is useful for planning and management.

Livestock and deer often eat the same forage species but the overlap varies with range, season, and class of livestock. It is greatest if livestock and deer occupy the same range when young, green grass and forbs are prominent in the diet of both (Dusek 1975, Hansen and Clark 1977, Hansen and Reid 1975, Longhurst et al. 1979, Smith and Julander 1953). Such dietary overlap works to the advantage of management because livestock graze the cured grasses of species that deer also eat. Thus cattle grazing in summer exposes green forage for deer in fall, and winter grazing by cattle improves forage for deer in spring.

Grazing livestock on mule deer range at appropriate times minimizes direct competition for available forage and assures continued health of range plants. Fall grazing of livestock on deer summer range can be beneficial, provided deer have migrated from the area. Fall grazing by livestock on deer winter ranges can also be beneficial, provided it occurs before greenup and the arrival of deer. Maximum benefits will be realized if livestock remove little of the dormant browse. Spring turnout of livestock on deer winter range should occur following spring greenup and after most of the deer have migrated. It is critical that livestock be removed from deer winter range when soil moisture is still adequate to permit grasses to grow new leaves to replenish nutrient reserves in their roots. If livestock removal is delayed beyond this point, the vigor of forage plants will decline. Continued abuse of plants by such extended grazing will eventually reduce plant productivity, and declines in the productivity of both deer and livestock will soon follow.

Where annual grasses, such as some cheatgrass stands, persist in spite of continued attempts to convert them to native bunchgrass, it might be wiser and more economical to manage those sites for annual grasses instead of seeding them with exotic perennials. Permitting cheatgrass islands in expanses of sagebrush or crested wheatgrass would maintain greater forage diversity than reseeding entire blocks. Fall burning of cheatgrass stands can make nutritious growth available, but the hazards of erosion should be

Figure 8. - Forage areas contain grass, forb, and browse plants but not thermal or hiding cover.



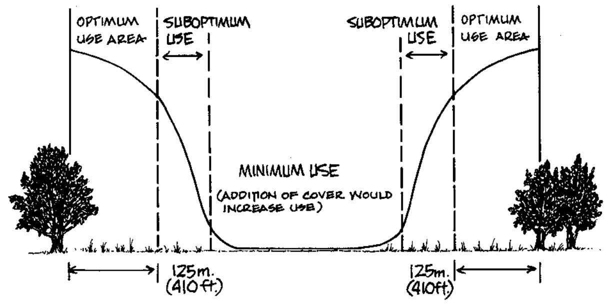
considered. Young cheatgrass is nutritionally rich and it develops earlier in both fall and spring than many native perennials. It is very tolerant to intensive grazing. Because they mature rapidly, however, annual grasses also decline more quickly in forage value than perennial grasses.

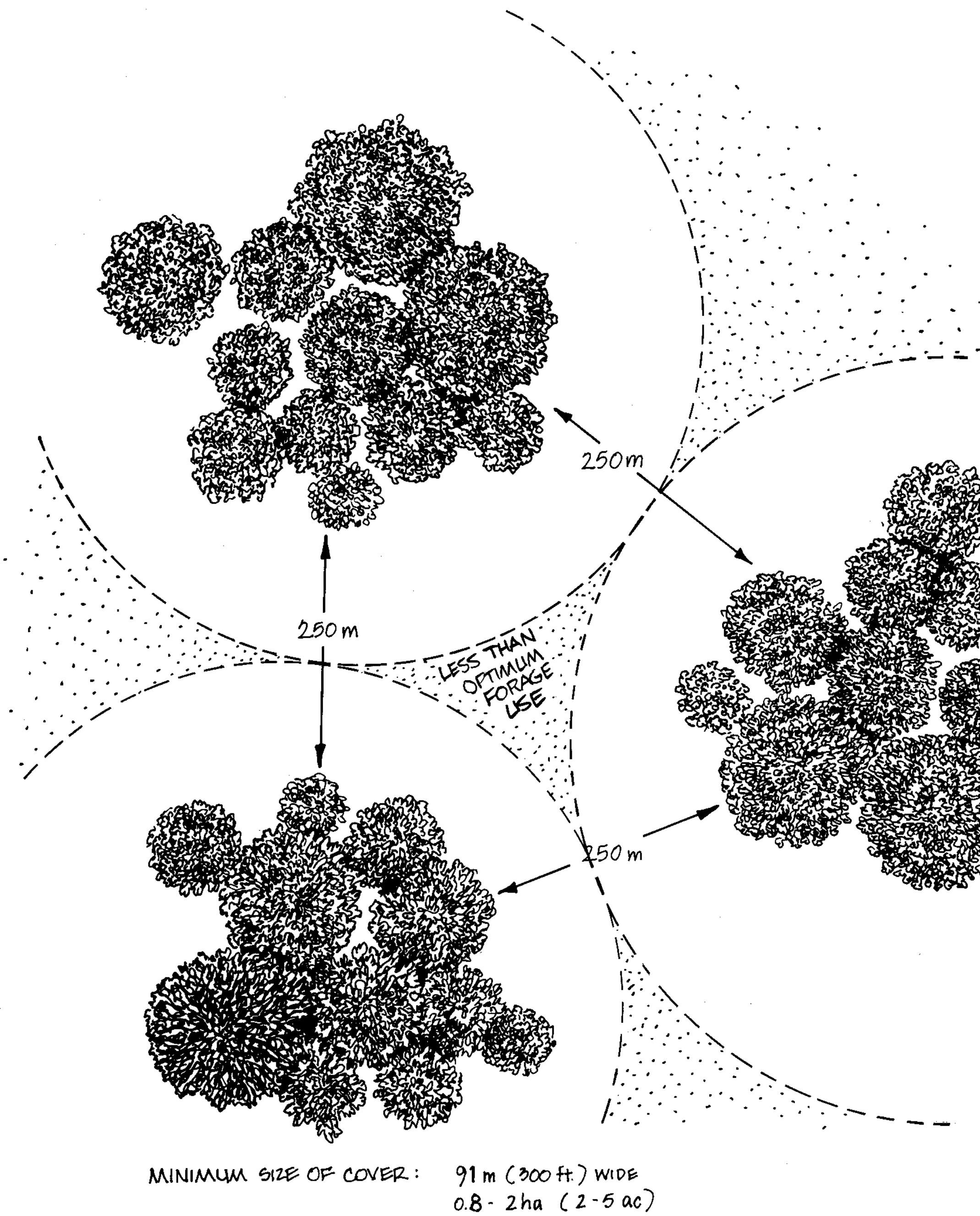
The use deer make of forage areas depends on the size and interspersion of cover areas as well as size and arrangement of the forage areas. Deer do not fully utilize forage areas that are too far from cover (Reynolds 1962, 1964, 1966; Terrel 1973); they conserve energy by this strategy. Travel to cover and seasonal migration to more favorable ranges increases the amount of energy required for maintenance (Holl et al. 1979, Moen 1973, Wallmo et al. 1977). Forage areas wider than 250 meters (820 ft) create less than optimum conditions (fig. 9); walking requires from 18 to 67 percent of the energy expenditures of deer, elk, and pronghorns (Moen 1973:358-361). Appropriate arrangements of forage areas, thermal cover, and hiding cover can minimize energy losses caused by exposure, travel, and anxiety (figs. 7 and 10 are stylized examples). Exposure to thermal stress is most severe in openings with diameters more than five times the height of adjacent cover, and energy drain from movement and tension associated with alertness also increase with distance to cover. The production of muscle, fat, and milk and prospects for survival all decline (fig. 4) when energy, protein, carbohydrates, fats, and minerals from forage do not surpass maintenance requirements (Blaxter 1962; Brody 1945, 1956; Holl et al. 1979; Moen 1973; Sadleir 1969).

A diversity of plant species tends to maintain forage quality and availability over the seasons and to provide a buffer against plant losses to diseases or insects. Digestibility and nutrient content of forage are controlled by phenological stages of growth, recognized by changes in plant form—bud burst, leaf expansion, stem lengthening, and flowering (Hickman 1975; Hormay 1943, 1956, 1970; Hyder and Sneva 1963; McIlvanie 1942; Subcommittee on Feed Composition 1969). Quality generally declines with weathering and from spring through winter. The phenologically young leaves of most species contain approximately equivalent high levels of digestible nutrients (Subcommittee on Feed Composition 1969). Some species attain that stage only in spring; others also produce nutrient-rich foliage in fall.

Figure 9. - Deer do not fully utilize forage areas that are more than 125 meters (410 feet) from cover.

Figure 10. - Centers of forage areas wider than 250 meters (820 ft), or 125 meters (410 ft) from cover edges, are used less than centers of smaller areas.





Deer of all ages need high quality, succulent food to recover from weather stress, replenish body reserves, and grow and reproduce at optimum rates. This is especially important to nursing does. Young plant tissue is required because only in the early stages of growth does it contain an optimum balance and high concentrations of maximally digestible nutrients needed to produce muscle, fat, and milk.

Deer and other ungulates have foraging habits tied to their physiological requirements for survival and reproduction, and adapted to cycles of plant phenology. They cope with declining forage quality by selecting plants and plant parts that are phenologically younger (Bell 1971; deBoer 1970; Holl et al. 1979; Hungerford 1970; Leach 1956; Leckenby 1968, 1969, 1978a, 1978c; Spalinger 1980:106); thus they need a diversity of forage plant species that reach equivalent phenological ages at different times. For example, Sandberg bluegrass begins leaf growth in late winter and has flowered by late spring; bluebunch wheatgrass does not begin growth until late spring and flowers in midsummer.

Because grazing and burning affect the phenology of forage plants, appropriate management can prolong the availability of high quality forage for mule deer (Anderson and Scherzinger 1975; Leckenby 1968, 1978c; Tueller and Tower 1979; Willms et al. 1979, 1980).

SPECIAL HABITAT NEEDS

Fawning and Fawn-rearing

Compact areas that contain a diversity of thermal cover, hiding cover, succulent forage, and water are needed by does during fawning and fawn-rearing (Reynolds 1974, Sheehy 1978, Stuth 1975). These areas become their activity centers during fawning in spring and remain central to their movements during the fawn-rearing period of summer.

Fawning habitat consists of vegetation stands used by does during birth and by newborn fawns for a brief sedentary period of about 1 week. Although fawningoccurs in various habitats and farther than 1 mile from trees,[3] optimum fawning habitat is an area of low shrubs or small trees taller than .7 meter (2.2 ft), with at least 40-percent canopy closure, that lies within 50 meters (160 ft) of taller tree cover. It is located on slopes of 0 to 30 percent and within plant communities where forage is succulent and plentiful in June (Sheehy 1978) (fig. 11).

In ideal fawning habitat of 2 to 10 hectares (5 to 26 acres), a doe expends only a minimum of energy to meet her daily requirements. Surplus energy can then be transferred, through milk, into fawn growth (fig. 4). Water should be available within 600 meters (2,000 ft). Elder (1956) surmised that succulent forage meets only marginal water requirements. The farther a doe has to range from her fawn to satisfy daily requirements for water or food, the more energy she expends and the less energy she has for milk production. A reduced supply of milk decreases fawn growth and jeopardizes fawn survival. Absence of the doe from the area in which the fawn is concealed also increases the potential for predation since the doe is frequently too far away to protect the fawn.

Although one doe requires a relatively small area, habitat for several does fawning at the same time must be larger. When the density of animals in optimum fawning areas is high, and cover patches are converted to forage areas, does may be forced to use sub-optimal habitats or accept crowding. Crowding causes strife between does and their actions probably attract and help predators locate hiding fawns.

Fawn-rearing habitat may include the area used for fawning but is usually larger and more diverse (fig. 12). Optimum rearing habitat contains a diversity of plant communities and structural conditions in close proximity and assures that fawns maintain adequate growth rates as they depend more on forage and less on milk. Plant communities that satisfy hiding and thermal cover requirements are generally used from mid-morning until late afternoon. These characteristically contain a tree overstory with at least 50-percent canopy closure, and shrub or riparian communities more than 0.6 meters (2 ft) high with canopy closures of more than 23 percent. Shrub sites used during rearing are usually located within 100 meters (330 ft) of trees. Stands that do not provide thermal or hiding cover are infrequently used during the day; and are generally used for forage during morning and evening (Sheehy 1978). In most rangeland the need for thermal and hiding cover is greater than the supply.

3 Nellis, C. Unpublished data on file at Idaho Fish and Game Department, Jerome, Idaho.

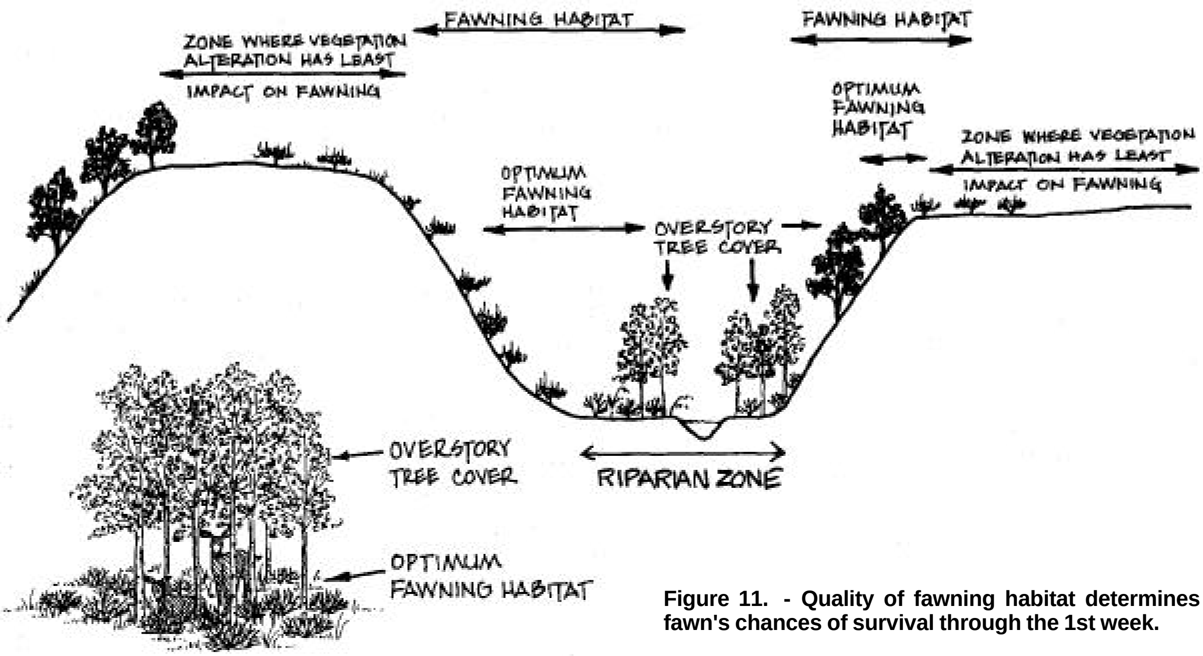


Figure 11. - Quality of fawning habitat determines a fawn's chances of survival through the 1st week.

Sheehy (1978) found that during the rearing period, fawns usually stayed within 1 kilometer (0.6 mi) of the fawning site. In the 1st month of life, movement averaged 0.6 kilometer (0.4 mi); thereafter single fawns moved less (0.5 kilometer or 0.3 mi) than twins, who moved 0.8 kilometer (0.5 mi). The optimum size for fawn-rearing areas appears to be about 160 hectares (395 acres). On Steens Mountain, in Harney County, Oregon, 90 percent of the fawn-rearing areas observed were this size or smaller; they ranged from 16 to 367 hectares (39 to 907 acres); the median was 81 hectares (200 acres). Twin fawns tended to occupy larger rearing areas than single fawns.

Fawn-rearing areas should not be regarded as independent units because there is considerable overlap in use of areas. It is important to identify and manage generalized fawn-rearing habitat rather than focusing on individual rearing areas.

Rehabilitation of fawning habitat may be desirable where stands appear decadent. Since control of shrubs replaces cover areas with forage areas, herd requirements and the probable impacts of reducing cover should be evaluated prior to treatment.

Proportion of Cover to Forage

We suggest that optimum mule deer range should contain a mixture of plant communities and structural conditions that provide areas of optimum size and spacing that add up to at least 55 percent forage areas, 20 percent hiding cover, 10 percent thermal cover, 10 percent fawn-rearing habitat, and 5 percent fawning habitat (fig. 13). On winter ranges where the option is available, thermal cover should be emphasized in place of habitat for fawning and fawn-rearing and up to 20 percent of the hiding cover, because thermal cover usually also provides hiding cover. Agreater shift is not desirable because hiding cover contributes more to winter browse than thermal cover.

Success in managing habitat for mule deer should be measured in part by herd productivity. Goals for producing animals that survive in good condition and produce the desired number of fawns can be used to measure the success of habitat management in satisfying cover and forage requirements. Based on data adapted from another study (Leckenby 1978c, Leckenby and Adams 1978) an index of productive survival (PS) was estimated for four subpopulations of a herd near Silver Lake, Oregon. Productivity was estimated from a ratio of the maximum count of deer for each subpopulation to the population of the entire herd. Survival for each unit was estimated from the proportionate decline from fall to spring in the number of fawns per adult.

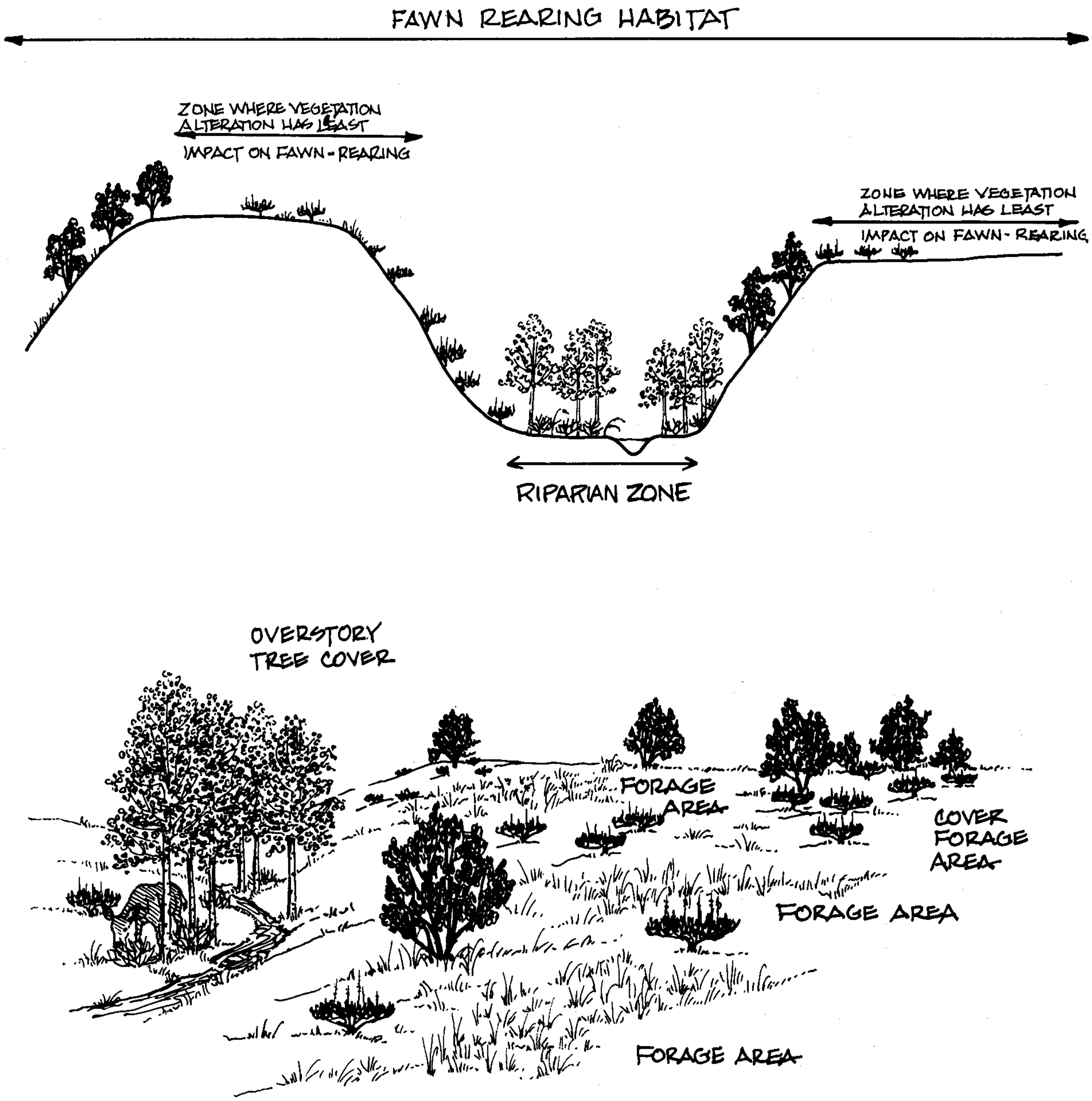


Figure 12. - Quality of fawn-rearing habitat determines the growth rate and survival of fawns through the 1st year.

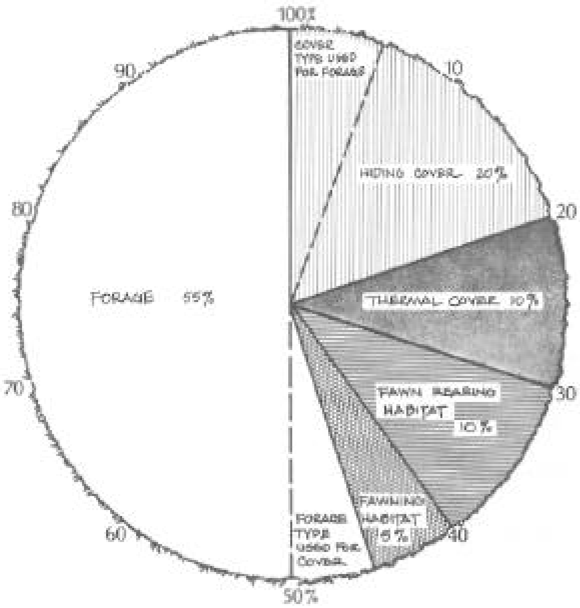


Figure 13. - Optimum mix of cover and forage for deer on shrub-steppe rangeland. Where there is a choice, thermal cover should be increased.

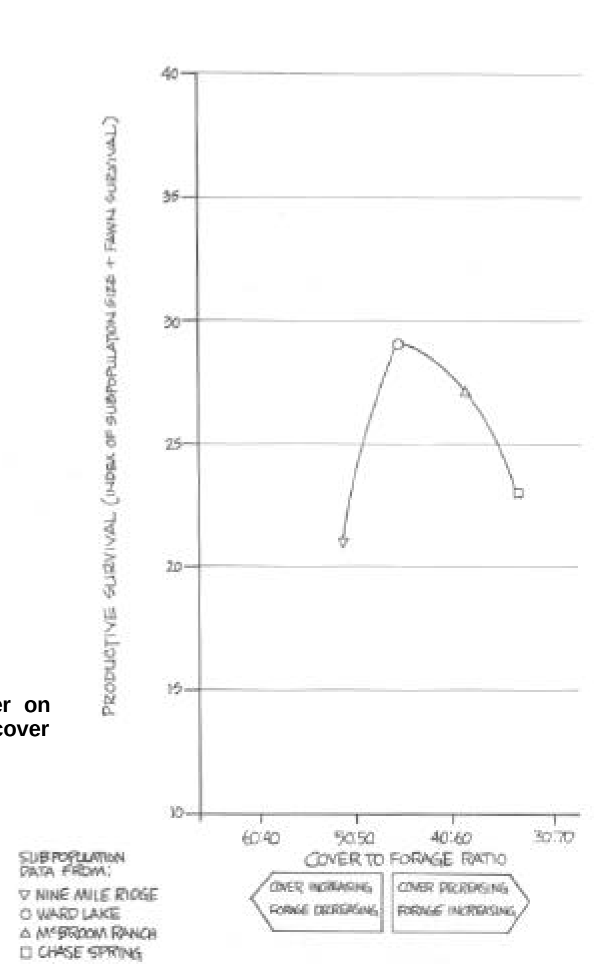


Figure 14. - Productive survival appeared maximum when cover areas made up 45 percent of mule deer winter range and forage areas made up 55 percent (adapted from Leckenby 1978c, Leckenby and Adams 1978).

$$PS_i = (100)\,\frac{(d/ha/t)i}{\sum_{i=1}^{n} d/ha/t} + (100)\,\frac{1.0 - (f\text{-}s/f)i}{\sum_{i=1}^{n} 1.0 - (f\text{-}s/f)}$$

where: d is the maximum count of deer
ha is the area of a unit in hectares
t is the number of counting periods
f is the count of fawns per count of adults in fall times 100
s is the count of fawns per count of adults in spring times 100
i is a sample unit of the herd range

Comparison among the four subpopulation ranges, based on new analyses of data (Leckenby 1978c, Leckenby and Adams 1978) on the number of deer, amount of plant community use, number of fawns, and severity of weather suggest that maximum productive survival was attained where cover areas comprised about 45 percent of a subpopulation range (fig. 14). Ratios of cover to forage were computed independently from plant communities within each management unit.

Management actions that might shift the ratio of cover to forage should be based on both the total area that is currently occupied by each plant community and the area that may reasonably be expected to produce cover or forage within the usual treatment period.

A ratio of 40 percent cover to 60 percent forage appears to be consistent with proportions observed, estimated, or recommended by several authors who have studied deer herd ranges (Leopold et al.1951:23,129; Reynolds 1969x,1972; Taber and Dasmann 1958:55; Terrel 1973; Thomas et al. 1979).

Riparian Zones

Because rangelands tend to be arid, streamsides, spring areas, and moist sites are important for mule deer. Riparian zones contain the only permanent or seasonal water and often enclose the most vegetationally productive sites found over long distances. They provide a diversity of plant species that usually offer good thermal and hiding cover and prolong the availability of succulent forage. They are especially important during fawn-rearing because supplies of basic needs are concentrated in them. The intense competition for cover, food, and water in riparian zones attests to their value (fig. 15), and unregulated use by livestock and people often reduces the availability of these resources to deer (Johnson and McCormick 1978, Owen 1980). Sheehy found that riparian vegetation was contained within every home range of fawns he observed. [4]

Water Sources

Although some studies suggest that deer require potable water for maximum production, others show that deer survive in regions where water sources are either far apart or seasonally intermittent (Dasmann 1971, Elder 1956). Numbers of deer fluctuate more in marginal habitat than on optimum ranges. We consider ranges less than optimum where water sources are farther than 320 meters (1,050 ft) apart.

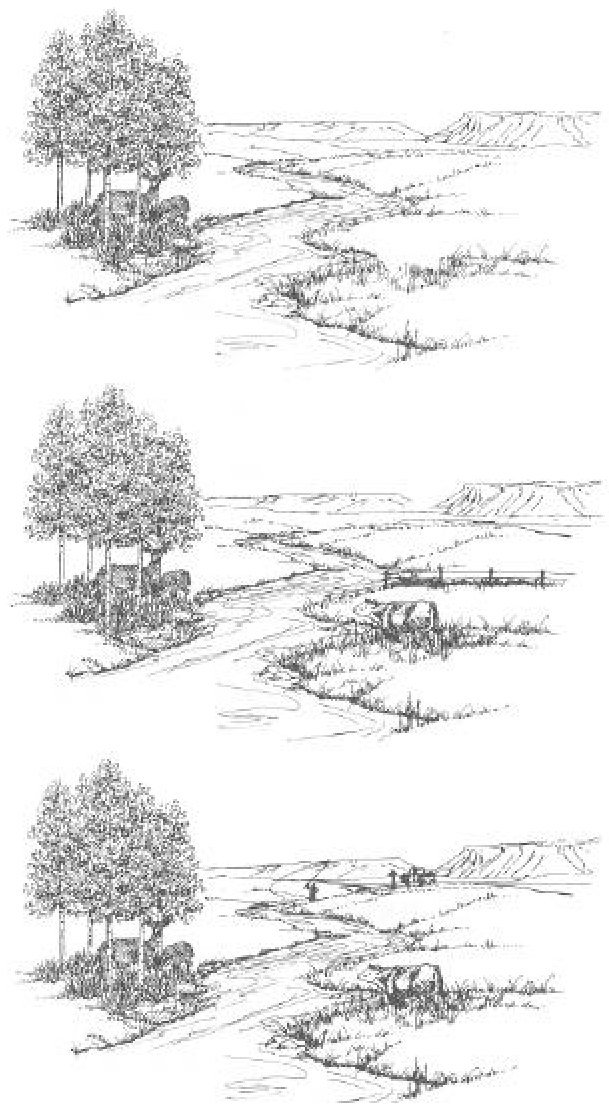


Figure 15. - Planning for riparian zones is singularly important. In them deer face increasing disturbance and competition from livestock and people.

Energy expended for travel to water reduces the amount available for survival or production. For example, a 68-kilogram (150-1b) doe would expend about the same amount of energy to walk 1 kilometer (0.6 mi) on level ground as she would use to produce 22 grams (0.7 oz) of milk or to raise a liter of water from 0°C (32°F) to her body temperature of 39°C (102°F). But she would use three times the amount of energy needed to walk that distance if water was not available and she consumed the equivalent as snow. These comparisons arecalculated from estimates of the energy costs of walking on the level, producing milk, melting snow and heating water (Lange and Forker 1961:1539, 1549; Moen 1973:349, 354-356).

[4] Sheehy, D.P Personal communication.
Information on file at Pacific Northwest Forest and Range Experiment Station, La Grande, Oregon.

Various techniques for improving water sources or creating new ones have been developed to enhance habitat use and improve distribution and production of animals (Dasmann 1971, Yoakum and Dasmann 1969).

Management of Great Basin Plant Communities for Mule Deer

In this report, we have placed 28 plant communities of the Great Basin of southeastern Oregon in nine management groups, compared the characteristics of each with cover and forage requirements of mule deer, and contrasted unmanaged conditions with those induced by management practices. Dealy and others (1981) described the structural and floristic detail of the 28 plant communities. We identify communities by the species that dominate or characterize them (table 1). This method is used to save space; it does not indicate the importance of the identifying species to deer. Ecological requirements of each species present in a community provide information relevant to management of the site.

Where data from southeastern Oregon were lacking, we reviewed published information on the interactions of deer with cover and forage in similar plant communities for indications of relationships.

BIG SAGEBRUSHES

Although the various forms of big sagebrush (Beetle 1960, Hanks et al. 1973, Winward 1980, Winward and Tisdale 1977) differ in importance to mule deer, all are used for cover, forage, or both (Leckenby 1968, 1978c; Owen 1980; Sheehy 1975, 1978; Tueller and Monroe 1975).

Deer Use

The evergreen nature of big sagebrushes sustains their cover value throughout the year. Basin big sagebrush offers thermal and hiding cover because of its height, upright growth, and relatively dense crown. A tree-like form is often the result of livestock grazing. Mountain big sagebrush also forms good thermal and hiding cover because it usually has a dense canopy both vertically and horizontally, although it has a table-like form and does not grow as tall as basin big sagebrush. The close association of foothill big sagebrush with western juniper makes it somewhat less important as cover, although it can resemble the mountain form. Stands of Wyoming big sagebrush and alpine big sagebrush usually do not offer good hiding or thermal cover because of low height, low density, and open distribution.

Deer do not browse big sagebrush forms equally. Sheehy (1975) ranked their palatability as follows: foothill big sagebrush, good; mountain big sagebrush, good to fair; Wyoming big sagebrush, fair; alpine big sagebrush, poor; and basin big sagebrush, poor. Big sagebrushes generally receive greatest use in winter, moderate use in fall and spring, and lightest use in summer (Kufeld et al. 1973). Big sagebrush is more digestible when eaten in mixed diets than alone; but deer lose weight under winter weather conditions when fed only big sagebrush (Bissell et al. 1955, Dietz et al. 1962, Smith 1950). Yet, because they are evergreen, big sagebrushes are often the best available forage. Many plants associated with big sagebrushes are important deer forage (Kufeld et al. 1973).

Because of its form, palatability, and distribution, mountain big sagebrush offers optimum habitat for fawning and fawn-rearing within the shrub-steppe region (Sheehy 1978). The other big sagebrushes are used when they provide the best habitat available, but they are generally inferior to mountain big sagebrush.

Response to Management

Plans to manipulate big sagebrush stands to benefit mule deer must specify the plant community, the subspecies of sagebrush, the method of treatment, the size and arrangement of existing stands and proposed treatments, and the livestock grazing system.

Reducing big sagebrush cover can benefit deer in the following situations: (1) homogeneous blocks of big sagebrush wider than 380 meters (1,250 ft) which lack diversity within the grass7forb layer; (2) seasonal range where green forage is insufficient but cover is excess, such as at lower elevations where favorable exposure permits early greenup; (3) where big sagebrush is less desirable than meadow and riparian plant communities. Deer productivity can increase following reduction of big sagebrush, provided diversity, size of treatments, and cover-to-forage ratios are near optimum.

Table 1 — Habitat values and importance of plant communities for deer

Plant community and key plant	Elevation	Habitat value	Range	Importance[1]
Tall sagebrushes:				
Mountain big sagebrush	Above 3,500 ft (common)	Hiding and thermal cover (good), forage (fair), fawning (good), fawn-rearing (good)	Summer, winter, and spring-fall	1
Foothill big sagebrush[2]	Below 5,000 ft (limited)	Hiding and thermal cover (good), forage (good), fawning (fair)	Spring-fall	2
Alpine big sagebrush	Above 3,500 ft (limited)	Hiding and thermal cover (poor), forage (poor)	Summer	2
Wyoming big sagebrush	Below 6,500 ft (common)	Hiding and thermal cover (poor), forage (fair)	Winter	1
Basin big sagebrush	Below 7,000 ft (common)	Hiding and thermal cover (good), forage (poor)	Winter	1
Silver sagebrush	Above 4,000 ft (limited)	Hiding and thermal cover (fair or poor), forage (good)	Summer and winter	2
Short sagebrushes:				
Low sagebrush	Below 9,000 ft (common)	Hiding and thermal cover (poor), forage (good)	Summer, winter, and spring-fall	1
Stiff sagebrush	Below 7,000 ft (limited)	Hiding and thermal cover (poor), forage (fair)	Summer, winter, and spring-fall	2
Black sagebrush	Below 9,000 ft (limited)	Hiding and thermal cover (poor), forage (poor)	Summer and winter	3
Early low sagebrush	6,000 - 8,000 ft (limited)	Hiding and thermal cover (poor), forage (poor)	Spring-fall	3
Other shrubs:				
Bitterbrush	4,000 - 7,000 ft (common)	Hiding and thermal cover (good), forage (good)	Summer, winter, and spring-fall	1
Greasewood	Below 5,000 ft (common)	Hiding and thermal cover (poor), forage (poor)	Winter	3

Table 1 — Habitat values and importance of plant communities for deer, continued

Plant community and key plant	Elevation	Habitat value	Range	Importance[1]
Shadscale	Below 5,000 ft (limited)	Hiding and thermal cover (poor), forage (fair)	Winter	3
Snowberry	5,000 - 8,000 ft (limited)	Hiding and thermal cover (good), forage (good), fawning (good), fawn-rearing (good)	Summer and spring-fall	1
Snowbrush	Above 5,000 ft (limited)	Hiding and thermal cover (good), forage (good), fawning (good), fawn-rearing (good)	Summer	1
Chokecherry; bitter cherry	4,000 - 7,000 ft (limited)	Hiding and thermal cover (good), forage (good), fawn-rearing (good)	Summer	1
Willow	All elevations (common in riparian habitat)	Hiding and thermal cover (good), forage (good), fawn-rearing (good)	Summer	1
Squawapple	2,500 - 6,000 ft (limited)	Hiding and thermal cover (fair), forage (fair or poor)	Spring-fall and winter	2
Trees:				
Quaking aspen	5,000 - 9,000 ft (common in moist sites)	Hiding and thermal cover (good), forage (good), fawning (good), fawn-rearing (good)	Summer and spring-fall	1
Mountain-mahogany	5,000 - 7,000 ft (limited)	Thermal cover (good), forage (fair)	Summer and spring-fall	1
Mountain-mahogany/shrub	5,000 - 7,000 ft (limited)	Hiding and thermal cover (good), forage (good), fawn-rearing (fair)	Summer and spring-fall	1
Western juniper	Below 6,000 ft (common)	Hiding and thermal cover (good), forage (fair), fawn-rearing (fair)	Summer, winter, and spring-fall	1
Western juniper/shrub	Below 6,000 ft (common)	Hiding and thermal cover (good), forage (good), fawning (fair), fawn-rearing (fair)	Summer, winter, and spring-fall	1

Table 1 — Habitat values and importance of plant communities for deer, continued

Plant community and key plant	Elevation	Habitat value	Range	Importance[1]
Cottonwood	2,500 - 4,000 ft (limited riparian)	Hiding and thermal cover (good), forage (good), fawning (good), fawn-rearing (good)	Summer	1
Special communities:				
Riparian	All (limited)	Hiding and thermal cover (good), forage (good), fawning (good), fawn-rearing (good)	Summer, winter, and spring-fall	1
Grassland	All (common)	Forage (good, especially fall and spring greenup)	Summer, winter, and spring-fall	1 2
Bluebunch wheatgrass	All (common)	Forage (good, needs livestock grazing to maximize availability of new growth)	Spring, some fall, and winter	2
Idaho fescue	All (common)	Forage (good, needs livestock grazing to maximize availability of new growth)	Spring, some fall, and winter	2
Cheatgrass	All (common)	Forage (good)	Spring, fall, and winter	1
Crested wheatgrass	All (in treatment areas)	Forage (good, needs livestock grazing to maximize availability of new growth)	Spring, fall, and winter	1
Sandberg bluegrass	All (common)	Forage (good)	Spring, fall and winter	1
Bottlebrush squirreltail	All (common)	Forage (good, needs livestock grazing to maximize availability of new growth)	Spring, fall, and winter	2

[1] Importance to deer, based on habitat value and distribution: 1 high, 2 moderate, 3 least.
[2] Unrecognized variant of big sagebrush (Sheehy 1975).

Conversely, reducing the cover reduces deer productivity in the following situations: (1) where fawning and fawn-rearing habitat is limited; (2) on winter ranges with limited cover; (3) where big sagebrush provides the only cover, for example, big sagebrush islands or draws within expanses of scabland sageflats and big sagebrush around rimrocks in open desert; and (4) where riparian vegetation is not desirable or cannot be developed and big sagebrush provides a needed buffer zone of cover around springs and seeps.

Deer productivity can improve where big sagebrush cover is increased. Planting or management to favor its increase should be considered where there is a documented need; for example, creating islands of big sagebrush in vast areas of crested wheatgrass, or reestablishing a shrub layer in some juniper plant communities.

On many big sagebrush sites, herbaceous forage for deer can be increased by .appropriate livestock grazing and by reducing shrub density and planting grasses and forbs (Koehler 1975, Plummer et al. 1968, Roberts 1975, Winward 1980). Cattle will eat standing dead grass. The subsequent regrowth of the shorter nutritious young leaves will then be more available to deer (Leckenby 1968, Willms et al. 1980). But when deer and livestock occupy seasonal ranges simultaneously they compete for forage. Deer select the new growth of grass, forb, and shrub species that are also eaten by cattle, sheep, horses, and goats. Separating livestock from deer by season of grazing or by fences is the key to reducing direct competition. Plant vigor is best maintained by grazing livestock during periods of plant dormancy. The next best management for plant vigor is to alternate short, intensegrazing periods with periods of nonuse that coincide with soil moisture levels which allow regrowth and recharge of plant nutrients. Intensityof livestock grazing is important, but so is the season, duration, and frequency. The relative impact of these four grazing variables depends on how a grazing system interacts with the plant community (Hanley 1979). Livestock grazing can create tree-like cover in basin big sagebrush, but the cover value of other big sagebrush communities is reduced when their forage value is increased. Although observations indicate that mountain big sagebrush does not survive severe browsing as well as bitterbrush or mountain-mahogany, "hedging" effects of browsing by cattle on most shrub species may create a crown that is better protected from overuse by deer. In decadent stands of mountain big sagebrush, cattlegrazingappears to stimulate plant reproduction by clearing away dead debris which retards seedling establis hment.

SCABLAND SAGEBRUSHES

Several short sagebrush species (low sagebrush, early low sagebrush, black sagebrush, and stiff sagebrush) occupy harsh, rocky, shallow-soil scablands throughout the range of mule deer (Beetle 1960). These small sagebrushes provide little cover but offer forage of varying importance to deer (heckenby 1968, 1978c; Sheehy 1978; Tueller and Monroe 1975).

Deer Use

Because of their small stature, short sagebrushes offer little thermal or hiding cover. Deer feed in the exposed habitats of short sagebrush scablands, principally during the mild weather of sunny, calm days in winter and near sunrise and sunset in summer.

The short sagebrushes are closely browsed throughout their distribution. In trials with deer and sheep, Sheehy (1975) ranked preference for low sagebrush as fair and black sagebrush as poor. Preference for stiff sagebrush is probably fair and may be seasonal because it is deciduous. Preference for early low sagebrush is probably fair and use may be influenced by its very early flowering and seed ripening (see footnote 4). Black sagebrush appeared to be slightly more digestible than big sagebrush, perhaps because of its small stems and leaves (Smith 1950). Sheehy (1975) measured digestibility of low sagebrush at 44.3 percent. Kufeld and others (1973) reported moderate use in fall, winter, and spring. Use throughout the year has been observed (Leckenby 1969).

In spring and early summer the forbs and grasses associated with short-sagebrush communities are important to deer. New growth is early and abundant in these scablands because the shallow, rocky soils warm quickly, especially on southerly aspects. Phenological development influences the timing of use by deer. Sandberg bluegrass, crested wheatgrass, and starved milkvetch are used very early, but migratory deer seldom have an oportunity to feed on bluebunch wheatgrass and curvepod milkvetch because these plants normally initiate growth too late in the season. The immature stages of bluebunch wheatgrass, western needlegrass, and similar species are of value to nonmigratory deer, however, because their slower development provides digestible forage later in summer.

Although short sagebrush stands do not provide the cover essential for hiding and protecting fawns from predators and the elements, they are desirable in fawning and fawn-rearing areas since they often have abundant forbs and water during the early fawn-rearing period.

Response to Management

Present range treatment methods offer little potential for improving the cover value of scabland sites to mule deer. It is not practical to increase cover, although more cover would be beneficial. The sites are too harsh to support tall plants which could improve cover, and techniques for establishing them are not available.

Methods have not yet been developed for increasing deer forage on many short-sagebrush scablands (Winward 1980), but forb, grass, and browse composition of some stands has been improved by manipulation with fire, machinery, and chemicals. The shrubs can be eliminated and grasses emphasized by flooding, the management practice termed "water spreading," but this treatment decreases winter forage.

In stands of low sagebrush that appear to be dying because of competition with rank bunchgrass, livestock grazing could make the young growth of the grasses available to deer. Grazing would also tend to promote growth of low sagebrush browse.

Spring and early summer are times when livestock management can effectively modify forage production, but also times when competition between livestock and deer for forage is maximum. Periodic rest from grazing has to be adjusted to the early initiation of growth and late seed maturity of forbs in low sagebrush communities.

SILVER SAGEBRUSHES

Silver sagebrush communities are unique habitats that contribute to diversity and increase edge in areas dominated by tall sagebrush, short sagebrush, juniper, and pine communities. They are closely associated with drainage ways and basins. Beetle (1960) recognized at least two subspecies: a Bolander form that occurs in closed desert basins and a mountain form associated with riparian habitats. Leckenby (1978c) found that deer preferred Bolander silver sagebrush communities on winter range. Dealy (1971) considered mountain silver sagebrush communities of low value to deer on summer range.

Deer Use

The medium stature of silver sagebrush provides some hiding cover for mule deer, but plant density and canopy cover are usually low and offer little protection from weather.

Deer browse silver sagebrushes in fall, winter, and spring[5] (Kufeld et al. 1973). In browsing trials with captive mule deer, Sheehy (1975) found that Bolander silver sagebrush was one of the most preferred.

Site, phenology, and the availability and diversity of forage plants influence the degree and season of deer use of silver sagebrush basins. Lengthy spring flooding-normally up to a month-is characteristic of these communities and encourages lush growth of native forbs and grasses adapted to flooding. Associated forage plants that deer apparently prefer to sagebrush when they are available are muhly, Newberry's cinquefoil, Fremont combleaf, and other grasses and forbs in early growth stages. These are more nutritious than the older silver sagebrush browse.

Riparian zones dominated by mountain silver sagebrush communities provide fair cover and forage near water during much of the fawn-rearing period and are sufficiently valuable to mule deer to warrant protection. Persistent springflooding, however, makes Bolander silver sagebrush communities unsuitable; after they dry, the flats are of little value for fawn-rearing because hiding cover, thermal cover, and forage are inadequate.

5 Leckenby, D.A. Unpublished data on file, Pacific Northwest Forest and Range Experiment Station, La Grande, Oregon.

Response to Management

Current techniques for manipulating habitat cannot increase the cover value of silver sagebrush communities and will decrease the little value they possess. The extremes of flooding and drying each year eliminate introduced shrubs which might otherwise provide increased cover.

Reducingcover, with or without soil disturbance, does increase forb and grass forage. Leckenby (1969) found that unusually long ponding significantly reduced Bolander silver sagebrush cover in closed basins in south-central Oregon for several years. This was followed by an increase in Newberry's cinquefoil and desert combleaf forage which was significant in the diet of mule deer through a mild winter. Most of the grasses and forbs planted to produce forage in range communities will not survive the inevitable spring flooding and summer drying in Bolander silver sagebrush stands (Leckenby and Toweill 1979a, Winward 1980).

Water holes and drainage ditches that are frequently dug in silver sagebrush basins quickly concentrate runoff water into deeper reservoirs. These retain water much longer than the wide, shallow ponds that collect water naturally and allow it to evaporate rapidly. Created water holes have an obvious positive benefit for wildlife and livestock, but they also have adverse impacts on wildlife. Some drain the basin so efficiently that big sagebrush and rabbitbrush are able to invade and replace the silver sagebrush.

Other methods have provided valuable water reservoirs without sacrificing the unique qualities of silver sagebrush communities. For example, it guzzlers" (catchment aprons with storage tanks) have been installed in adjacent expanses of tall and short sagebrush or western juniper.

Livestock grazing of mountain silver sagebrush stands can benefit mule deer by removing cured grass from summer range; however, this must be managed to protect plant vigor and prevent damage to the riparian zone. Competition between deer and livestock for forage is likely to occur in these riparian communities on summer range (Dealy 1971, Dusek 1975). We found that summer cattle grazing of silver sagebrush basins on deer winter range resulted in late spring and early summer compacted the soil and altered plant composition (Ixckenby 1978c).

ANTELOPE BITTERBRUSH

Although it forms pure stands elsewhere (Daubenmire 1970, Nord 1965), antelope bitterbrush is usually oneof several shrub species found in browse stands in the Great Basin. Managers have historically considered this species one of the most important deer browse plants in the West. Its stature, crown, form, and abundant fruit offer both obvious and subtle benefits for many species of wildlife. Its structural and foliage attributes greatly influence microclimate and provide cover and forage values associated with high levels of use by both deer and livestock (Hormay 1943, Leckenby 1978c, Tueller and Monroe 1975).

Deer Use

On many winter ranges, antelope bitterbrush provides exceptionally good hiding cover in both big and short sagebrush stands. Although deciduous, bitterbrush contributes to thermal cover on winter range because it is taller and has larger crowns than the sagebrushes, but it is not tall or dense enough to make good thermal or hiding cover under overstories of western juniper, ponderosa pine, and lodgepole pine on summer ranges.

Antelope bitterbrush is eaten by deer in all seasons, but major use occurs in late summer, fall, and early winter (Kufeld et al. 1973, Leach 1956, Leckenby 1969). Weather, seasonal moisture, and availability of other foods greatly affect browsing. Secondary peaks in use are noted during dry springs; following cool, moist summers major use may not begin until fall. Hormay (1943:3, 7) found that bitterbrush produces flowers and seed only on the previous year's wood and not on the current shoots. He also concluded that at least 40 percent of each year's current leader should remain following grazing. Adams (1975) and Hormay (1943) both suspected that declines in bitterbrush populations in Oregon and California had resulted from insufficient seed production caused by severe browsing.

Others have found that bitterbrush alone is not digestible enough to provide sufficient energy for maintenance under winter stress. For example, Dietz and others (1962) and Bissell and others (1955) found that deer fed bitterbrush alone or in combinausually seek foods more digestible and richer in energy than bitterbrush, such as younggrasses and forbs, even when unused leaders of bitterbrush are abundant. When better forage is not available, however, deer browse bitterbrush severely, even clipping off 0.6-centimeter (1/4-inch) diameter branchlets 2 to 4 years olds (Hormay 1943).

Because of their unusual density, height, and canopy closure, stands of antelope bitterbrush can provide good fawn-hiding cover; however, the usual ecological situation in which bitterbrush occurs (Nord 1965) does not assure fawn-rearing success because distances to water are usually too great, forbs and grasses mature rapidly, and temperatures are frequently extreme.

Response to Management

In most areas where bitterbrush forms a large part of communities important to deer, reducing cover has adverse impacts on deer productivity. On the other hand, where decadent shrubs are not producing as much forage as wildlife and livestock need, replacing older canopies with youngshrub crowns is beneficial. This requires either new plants or rejuvenation of old shrubs (Koehler 1975, Plummer et al. 1968). Grass and forb production can be increased without reducing bitterbrush cover by phenologically scheduled spraying of herbicides to control sagebrush and release the herbaceous layer.

Livestock grazing in bitterbrush stands in spring and early summer before soil moisture is depleted will benefit deer in fall and winter; livestock grazing in other seasons will cause direct competition with deer for forage and reduce plant vigor and reproduction; continuous grazing in summer and fall will magnify stress on plants. Unwise grazing management results in conditions which gradually alter the value of bitterbrush communities for wildlife and livestock as well.

To produce sufficient seed to continue bitterbrush stands, Hormay (1943:7) suggested that cattle be allowed to graze shrubs and shape them into more compact form that will protect shrubs from overuse and allow 15 to 20 percent of the new shoots to escape future browsing. He recommended one season of rest from cattle browsing every 4 or 5 years. Where bitterbrush is dying and not being replaced, we concluded that 2 years of rest would be needed to maximize seed production < nd perpetuate threatened stands. Hormay also found that height growth was restricted by cattle browsing, which prevented the shrubs from growing out of the reach of deer.

Cattle grazingcan also be used to reduce competition of forbs and grasses for water and nutrients (Smith and Doell 1968, Tueller and Tower 1979). Livestock grazing in bitterbrush stands makes more forage available to deer by removing the cured foliage so deer can reach new leaves of grass. As a result deer rely less on bitterbrush for forage.

WESTERN JUNIPER AND JUNIPER/SAGEBRUSH

The pygmy forests - juniper woodlands of south-central and southeastern Oregon - are important to mule deer and other wildlife. They form habitats for deer which are analogous to the pinyon-juniper woodlands found elsewhere in the Great Basin and the Rocky Mountains (Holmgren 1972). .During winter stress, western juniper communities were used more than any other type (Leckenby 1978a, Leckenby and Adams 1978). This woodland type comprises many communities. Juniper stands tend to be either predominantly young (40 to 80 years) or old (200 to 500 years) (Adams 1975). The structuralcomponents which juniper communities add to habitat diversity are apparently important to all aspects of deer use and range management on such sites (Leckenby and Toweill 1979a, 1979b; Reynolds 1972; Short et a1.1977; Tueller and Monroe 1975).

Deer Use

Western juniper stands provide excellent hiding and thermal cover for wildlife because they are short, dense-canopied, and evergreen. The arrangement and mixture of juniper in shrubland and grassland communities, however, is often less than optimum, a factor which probably contributes to the loss of some deer to weather stress and starvation, no matter how mild the winter. Better distribution of cover may be the

[6] Leckenby, D.A. Unpublished data on file at Pacific Northwest Forest and Range Experiment Station, La Grande, Oregon.

reason some deer survive even the severest winters. Leckenby (1978c) found that in winter deer used juniper for thermal cover more than they used grassland forage areas or shrubland cover-forage areas. They also used juniper intensively for thermal cover on spring and fall ranges. Spalinger (1980) found they used juniper cover for bedding in Nevada.

Weather stress was 40 percent less under a young juniper stand with a 25-percent canopy closure than where canopy closure was 5 percent or less (Leckenby 1978a, Leckenby and Adams 1978). Young juniper stands generally make better hiding cover than thermal cover. They also provide more grass, forb, and shrub forage than older stands. As juniper stands age and develop larger crowns and greater canopy closure and crown depth, thermal cover is improved.

Deer use juniper in all seasons, particularly during stress caused by weather and food shortages. They will browse other forage if they have the chance, probably because juniper is not digestible enough to meet their energy needs during weather stress. Although chemical analysis of Utah juniper was similar to sagebrush (Smith 1952), it was less preferred than bitterbrush or mountain-mahogany. Juniper browse probably does not provide a maintenance diet but rather a survival diet.

Old juniper stands occupy harsh sites, and current management policies prevent development or renewal of other forage within such stands. Although forage plants do grow under juniper, they cannot sustain the same intensity and frequency of cropping by ungulates they do in other settings. Native forage plants grow better than most exotics, but seeds are not commercially available (Leckenby and Toweill 1979a, 1979b).

Western j uniper can hide fawns, but the aridity of stands and their lack of succulent forage through the nursing period limit their value as fawn-rearing habitat. Their usefulness depends on forage in adjacent plant communities and availability of nearby water. Patches of j uniper may be used for fawning and fawn-rearing as Sheehy (1978) found aspen patches were used within expanses of sagebrush.

Response to Management

Where juniper forms extensive, nearly monotonous stands of woodland various treatments can increase forage, edge, and diversity. Revegetation projects on sloping ranges should be restricted to corridors about 1 kilometer (0.6 mi) wide which lay across elevational contours. Projects on more level ranges should radiate from fawnrearing areas and riparian zones. Habitat quality, defined by optimum sizes and distribution of cover and forage areas, edge distances, and diversity can be improved by appropriate cutting, chaining, and burningof units distributed within a larger project area. Such planning of treatment projects within management units is most compatible with ranges of deer subpopulations (Leckenby 1977, 1978a, 1978b).

Weather stress in the Great Basin makes thermal cover exceptionally important on all mule deer ranges. The vegetation influences on microclimates determine how much juniper communities can be manipulated while preserving thermal cover. Sizes of patches and distances between them must be considered.

Deer utilize forage better in smaller openings within juniper stands. Created forage areas, therefore, should be irregular, long, and no wider than 60 meters (200 ft), assuming an average j uniper height of 6 meters (20 ft). Openings up to five tree heights in width allow wind speeds only 30 percent of speeds in areas where there is no cover at all (Geiger 1966). But compact openings smaller than recommended, increase turbulance in eddies which can exceed the speed of winds above the canopy (Bergen 1971, Geiger 1966, Gifford 1973). The long axis of forage openings should lie perpendicular to prevailing winds on winter ranges to minimize chilling and east-west on summer ranges for optimum shading. Temperature extremes in forage areas also vary with adjacent cover height (Bergen 1972, 1974; Cochran 1969; Geiger 1966; Moen 1968c, 1973).

The effectiveness of juniper cover depends primarily on structure and secondarily on how well stand sizes match the space required by social groups of deer. Juniper cover areas should be at least 91 meters (300 ft) wide to create adequate thermal protection and at least 183 meters (600 ft) wide to meet hiding requirements.

The latter dimension probably allows sufficient space for most social groups. Little additional effect or microclimate results when thermal cover stands are wider than three stand heights (Geiger 1966, Reifsnyder and Lull 1965). Wider stands, however, can accommodate more deer by providing enough preferred habitat to reduce conflicts between animals. Deer use increased in pinyon-juniper islands when 30 percent of treatment areas were retained in cover patches at least 152 meters (500 ft) wide, 10 hectares (25 acres) in size, and areas were no farther apart than 0.8 kilometers (0.5 mi) (Reynolds 1972).

Habitat diversity and structural qualities unique to juniper should be retained where stands comprise less than 40 percent of a management unit. Even though control techniques work better on larger junipers, it is not wise to concentrate treatment in older stands because recovery of their unique structural qualities will probably require several centuries.

The competition and seasonal availability of forage within juniper communities will indicate whether changes in livestock grazing or revegetation are necessary to provide additional forage. Manipulation of grazing intensity or season may enhance nativeforage by selective release. Several options are available when revegetation is selected as a way to increase forage (Koehler 1975, Plummer et al. 1968, Vallentine 1971). Planting forage species under standing juniper can increase spring forage without reducing cover (Leckenby and Toweill 1979b).

It is more difficult to attain a beneficial effect from livestock grazing in juniper stands than in most other habitats. On most sites, establishment and growth of deer forage is hindered by aridity, temperature extremes, shallow soils, and low fertility. The adverse impacts of severe grazing are prolonged by these harsh conditions. Although heavy livestock grazing in the past eliminated forage species in many stands, grazing can improve forage for deer if cattle graze coarse, mature plant parts. As always, requirements of forage plants must be satisfied before grazing is permitted. Livestock must be restricted to either those seasons when plants are dormant or when soil mositure levels will permit regrowth and recharge of plant reserves following grazing.

MOUNTAIN-MAHOGANY AND MOUNTAIN-MAHOGANY/SAGEBRUSH

The evergreen nature of mountain-mahogany and sagebrushes, which are regular community associates, make stands of these species important year around habitat for mule deer. The value of each stand is determined by composition and structure. Observed deer use of mountain-mahogany communities was very high for short periods in spring and fall and low, but consistent, in other seasons (Leckenby 1969,1978c). Owen (1980), in multivariate analyses, found that bedding, moving, and feeding were primarily associated with structural characteristics of mountain-mahogany and other plant communities and secondarily with compositional characteristics. Tueller and Monroe (1975) found moderate to low densities of pellet groups in mountain-mahogany communities compared to other types.

Deer Use

Mountain-mahogany stands are generally short and canopies nearly closed. Cover values, therefore, are high throughout the year. These communities frequently grow in ecotones between timber and shrubland. Often they provide exceptional hiding and thermal cover close to forage areas, for example, where mountain-mahogany and short sagebursh communities adjoin.

Mountain-mahogany is browsed wherever it is found (Kufeld et al. 1973). The forage value of a particular stand depends primarily on community composition and condition, which reflect current and past grazing intensity. In most stands past use has been severe enough to create high browse lines, and the present forage value of mountain-mahogany communities is primarily in the associated shrubs, grasses, and forbs. The microclimate created by mahogany cover is thought to promote dense forbs and grasses (Owen 1980).

Excellent cover and usually good forage make mountain-mahogany stands potentially valuable habitat for fawning and fawn-rearing. But factors in adjacent areas; such as the availability of potable water and quality forage throughout the lactation period, determine their real value.

Patches of mountain-mahogany within expanses of shrubland may be focal points of fawning and fawn-rearing as Sheehy (1978) observed with aspen overstory.

Response to Management

Present knowledge of mountain-mahogany germination, establishment, growth, reproduction, and sprouting is limited (Dealy 1975). Thus, results of manipulating mahogany to increase cover and forage are unpredictable and often fail to meet treatment objectives. Management can reduce mountain-mahogany cover and produce more forage, but at the cost of habitat diversity. The present lack of understanding of the intensity of use by mule deer suggests that it is not wise to manipulate cover in stands of mountain mahogany that are narrower than 90 meters (300 ft).

Severe browsing by deer and livestock has detrimentally affected many mountain-mahogany stands. On the other hand, livestock grazing on accumulated grass and forb litter in the understory can increase forage availability for deer. Grazing should be permitted only when plants are dormant. Numerous examples show that too much grazing, grazing at thewrongtime, grazing at the same time every year, as well as too little grazing can all reduce forage availability.

SALT DESERT SHRUB: BLACK GREASEWOOD, SPINY HOPSAGE, AND SHADSCALE

Few mule deer utilize black greasewood, spiny hopsage, or shadscale communities. Although these communities provide sufficient hidingcover for bedded deer, thermal cover is poor, and most associated forage species are available for only short periods in early spring. Mule deer frequent the adjacent tall- and short-sagebrush communities much more. Where they are interspersed as small stands among expanses of sagebrush, the black greasewood, spiny hopsage, and shadscale communities improve habitat diversity and offer additional forage species, such as bud sagebrush and desert saltgrass. Salt desert shrub communities appear generally unimportant to deer management in this area.

NON-SHRUB COMMUNITIES, GRASSLANDS IN GENERAL

Bunchgrass communities, burned areas, seedings, and cheatgrass stands are considered together asnonshrubcommunities. Grasslandsare not usually considered cover areas, but Nellis' has found that giant wildrye stands are used as fawn-rearing cover in Idaho. Grasslands adjacent to cover may provide valuable forage, depending on the interactions of stand size, grazing management, and season (Roll et al. 1979; Leckenby 1978c; Reynolds 1962,1964; Tueller and Monroe 1975; Willms et al. 1979).

The interspersion of forage types, particularly as small areas within cover types, results in maximum effective use of forage by both deer and livestock. Forage was most intensively used around the edges of large (80 hectares or 200 acres) areas that had been seeded and burned, while average use over the entire stand was 40 percent.' In smaller stands (8 hectares or 20 acres) in the same area, 90 percent of available forage was used.[9]

Deer use was greater in small stands grazed by cattle in previous seasons. Deer grazed 80 to 96 percent of the grass plants, primarily crested wheatgrass, and removed 40 to 65 percent of the available spring growth in pastures grazed by cattle in the previous summer, but on pastures from which cattle had been excluded by fences, deer grazed only 16 to 20 percent of the grass plants and ate only 10 to 20 percent of the available springgrowth (Leckenby 1968). Similar patterns of use by deer following cattle use were observed where range treatment or wildfire had produced grass stands dominated by bottlebrush squirreltail.

Nonshrub plant communities are most valuable tomuledeerduringfall, spring, and summer because of the lush green growth produced by

' Nellis, C. Unpublished data on file at Idaho Fish and Game Department, Jerome, Idaho.

a Bolstad, R. Unpublished data on file at Lakeview District, Bureau of Land Management, Lakeview, Oregon.

[9] Leckenby, D.A. Unpublished data on file at Pacific

precipitation in fall and ample soil moisture in spring. Fresh immature forage is high in nutrients, digestibility, and moisture and low in fiber, regardless of plant species (Subcommittee on Feed Composition 1969). Fall greenup permits deer to add to nutrient reserves before the stresses of winter. Rich and digestible new growth may also increase ovulation rates. Spring and early summer greenup supplies quality forage at a critical time when body reserves are nearly depleted, fetuses are growing rapidly, does are lactating, and deer are migrating.

SPECIAL PLANT COMMUNITIES

The Great Basin contains additional plant communities that are unique or different from the majority of habitats in the area. They are especially important to deer because they are limited in extent and because they provide valuable habitat within expanses of less hospitable habitat or satisfy deer needs during certain times of the year. They include riparian zones, pine and fir forests, and aspen, squawapple, snowbrush, snowberry, chokecherry, and bitter cherry communities. Management of these environments requires especially careful evaluation, and maintenance is often the best choice.

Riparian

Riparian zones are especially valuable for fawn-rearing, summer and winter thermal cover, and late season forage. Willow, dogwood, cottonwood, and other characteristic riparian plant communities provide concentrations of what Leopold (1933:29) called welfare factors - cover, food, and water. Because of these factors, riparian zones areoften centers of intensecompetition among wildlife, livestock, and people. Agricultural activities, housing subdivisions, and recreational developments reduce habitat and increase conflicts. Mule deer are subject to more frequent and more intensive disturbance in riparian communities than in any other habitat throughout the Great Basin. Any development or overuse of riparian zones reduces their value as deer habitat.

Pine and Fir Forest

Pine and fir forest types are limited in the Great Basin and aregenerally restricted to relict stands in unique situations. Because seed sources are isolated, environments are harsh and exacting, successional stages are persistent, and tree growth is slow, these forests will probably not respond to management practices in the same manner recommended for other forested areas (Thomas et al.1979). The foregoing factors make these forests ecologically much different from the pine and fir stands elsewhere - in the Blue Mountains, for example. Management proposals to manipulate or exploit these environments require careful evaluation. The precarious existence of these stands, their small size, their unique contributions to habitat diversity, and their importancetowildlifesuggestthatmanagement to perpetuate and preserve them has a far sounder basis than management for timber production or livestock forage.

Aspen

Quaking aspen communities add considerably to the beauty and diversity of the Great Basin shrub-steppe.and are second only to riparian zones in importance to mule deer. They provide extremely valuable cover and forage during fawning and fawn-rearing (Sheehy 1978). They also provide patches of valuable hiding and thermal cover within expanses of sagebrush. They contain grasses, forbs, and shrubs that provide good summer and autumn forage (Smith et al.1972). Snowberry, for example, is a common and important browsecomponentofthesestands.

Competition between mule deer and livestock for aspen habitats is high because of the excellent cover and forage they provide. Alteration of cover and severe grazing within these communities can have adverse impacts on deer. Severe browsingof aspen sprouts appears to limit regeneration of the overstory and probably results from the competition for forage and space (Smith et al.1972). While removal of aspen is usually detrimental to the welfare of mule deer, the value of decadent stands may be improved by prescribing burning, cutting, and grazing management (DeByle 1978, Patton and Jones 1977, Reynolds 1969b, Smith et al. 1972). Aspen stands should receive special evaluation during planning.

Squawapple

Squawapple communities provide cover and forage for mule deer. Associated grasses and forbs are particularly valuable during early spring growth. These plant communities are often semiriparian, occurring in moist swales in association with scabland vegetation types. Their value is heightened because of their association with adjacent communities that are deficient in cover. Like riparian zones, squawapple communities are focal points for competition between livestock and deer, especially in late spring. Nearby conifer stands often provide fawning habitats. The stands should be managed to enhance their cover and forage attributes while maintaining their contribution to habitat diversity of rangelands.

Snowbrush

The stature, form, density, and evergreen nature of snowbrush make it particularly valuable to deer in all seasons. It quickly invades burns and establishes large forage areas. It is important in summer and fall diets (Leach 1956). In late summer, fall, and winter, the evergreen foliage is more nutritious than stems of many deciduous browse species. On productive sites, within 10 years after burning snowbrush will produce a canopy of adequate height and closure to provide thermal and hiding cover on summer and spring-fall ranges. On sites near intermittent or permanent water, the thermal and hiding cover provided by snowbrush communities can be excellent[10] (Sheehy 1978).

Since snowbrush quickly becomes tall and dense on good sites, optimum production and availability of understory plants lasts only a few years. Prescribed burning can perpetuate cover and forage diversity over extended periods (see footnote 10). Burning is necessary to break seed dormancy and regenerate snowbrush; mechanical and chemical treatments do not create adequate cover or forage stands as quickly as fire.

[10] Grogan, F. Oregon Department of Fish and Wildlife, Lakeview, Oregon. Personal communication. Information on file at Pacific Northwest Forest and Range Experiment Station, La Grande, Oregon.

Snowberry

Communities dominated by snowberry are neither extensive nor common in the Great Basin. Where they occur, however, they are intensively used by mule deer. They tend to be associated with specific plant habitats, such as stands of wax currant and big sagebrush on rimrocks and quaking aspen in moist locations.

Cover values of snowberry communities are generally moderate to low, although in some areas they provide excellent hiding cover. Snowberry types are used by deer as cover from spring through fall (Sheehy 1978).[11]

Snowberry is browsed the year around. Use is generally greatest in late summer and early fall but is also high in late spring at lower elevations. Spalinger (1980:123) conjectured that snowberry may be more valuable than digestion trials indicate.

Manipulation of snowberry communities in the Great Basin is detrimental to mule deer and other wildlife. This is especially true where these communities occur on rimrocks or aspen sites and provide the only diversity in uniform stands of big sagebrush.

Chokecherry and Sitter Cherry

Stands of wild cherry species are like quaking aspen communities in many respects. Theygrow on moist sites in rich shrub, forb, and grass communities that often retain phenologically young forage species longer than adjacent communities and provide important mid- to latesummer habitats. These plant associations add considerable diversity to rocky rims, stream canyons, and grassland slopes in many areas. Wild cherry communities are often used intensively by livestock because they provide mild microclimates and the resulting competition with deer for space and forage is often substantial.

Chokecherry and bitter cherry, like aspen, can provide excellent thermal and hiding cover from spring through summer. Stands vary considerably in density, but spread by suckering tends to create dense irregular patches that provide cover favorable to deer.

[11]Nellis, C. Unpublished data on file at Idaho Fish and Game Department, Jerome, Idaho.

Although used all year, wild cherry species are browsed most intensively in fall and spring, and deer regularly consume the ripe fruit. Associated forbs also provide excellent summer forage.

Because the stands are limited and important, and since current management techniques cannot improve the cover and forage qualities of these communities, maintenance is the best management.

Management Tips

1. Habitat management units should not exceed 4 700 hectares (11,500 acres). They should be parallel to primary drainages and ridges. On ranges with an average slope of more than 2 percent, units should be about 5 kilometers (3 mi) wide and no more than 10 kilometers (6 mi) between upper and lower elevations. On level ranges, units may approximate squares, 8 kilometers (5 mi) on all sides, or circular areas with a radius of 4 kilometers (2.5 mi).

2. Because livestock is usually the major product of managed rangelands, grazing provides the most economical tool for manipulating forage over large areas. Grazing systems can be used to manipulate vegetation and providefor all needs of deer. This requires careful planning of sizes and boundaries of pastures and rotation schedules adapted to deer subpopulation areas and seasonal movements. The usual system of rotating three or four large pastures does not allow rest periods tailored to the physiological requirements of browse species and may not leave enough forage in an intensively grazed pasture that encompasses the range of. a deer subpopulation. If only lightly grazed or rested pastures encompass the range of a subpopulation, then adequate new growth of grasses will not be available. A four- to six-pasture system that includes rest and rotation may be needed to maintain or enhance preferred browse species, such as bitterbrush.

3. Riparian zones are of great importance to desert mule deer. They satisfy requirements for cover, food, water, and plant species diversity in a small space. Management of these zones requires extremely careful planning, based on comprehensive analysis of a multitude of variables (fig. 16). It is difficult to implement a livestock grazing system that will adequately protect unfenced

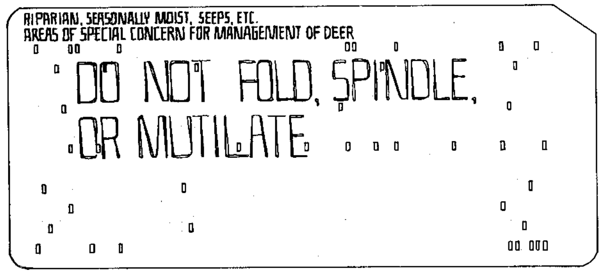


Figure 16.-Computer techniques are helping to store and analyze data to assist managers in understanding the importance of managing riparian zones with sensitivity appropriate to their high value as habitat for deer, livestock, and people.

riparian vegetation (Duff 1979, Olson and Armour 1979, Storch 1979), but management has reversed vegetation trends and deterioration on some sites (Behnke and Raleigh 1978). Reductions in stocking may not produce the desired results, since cattle tend to concentrate in riparian zones during summer and fall and use streamside vegetation intensively. Some livestock use of riparian areas may be beneficial, however, since livestock tend to break down or thin out streamside growth that becomes too thick for deer movement or browsing. Classification of riparian zones by elevation would associate zones with summer, winter, and spring-fall ranges and help managers develop grazing systems compatible with the seasonal needs of deer.

4. In units where deer depend on livestock watering devices, such devices should remain in operation after the livestock grazing season. Overflow water piped from troughs into managed pastures or livestock exclosures can promote forage for deer and cover for other wildlife. The benefits from such water management must be balanced against loss of cover providedby juniper and sagebrushes, which are intolerant of soil saturation.

5. Most vegetation conversions replace cover and browse with livestock forage, chiefly exotic grasses. Such treatments can reduce deer use through loss of cover and winter forage. Grass monocultures wider than 366 meters (1,200 ft) are poor deer habitat. Removal of woody, nonforage species is not always desirable because they may provide thermal and hiding cover for deer. Good deer range requires a mixture of grass, forbs, browse, and cover species.

6. Vegetation improvement projects to benefit mule deer should be implemented only after five conditions have been met:

(a) Biological data show a need for range improvement.

(b) Moderate techniques, such as changes in livestock grazing or herd size, have not improved conditions.

(c) Plant communities have been identified.

(d) The probability of attaining project objectives on that site within a reasonable time is high.

(e) Effects on ecosystems and probable future land uses and management options have been evaluated.

7. The success of habitat rehabilitation projects should be measured by impacts on all resources, as well as costs of treatment.

8. Size of areas to be treated by plowing and seeding or other programs should be selected to produce the appropriate ratio of cover to forage, desired plant diversity, and optimum amount of edge. If range treatment includes seeding, native and adapted exotic plants should be selected to maintain a diversity of green, succulent forage over as long a time as possible.

9. Since forage productivity declines when plant requirements are not met, managers need to beasconcernedwiththeamountofherbageleftat the end of the growing season as they are with the amount consumed by deer and livestock.

10. Forage should be allocated to deer on the basis of:

(a) season of use;

(b) seasonal availability;

(c) seasonal nutrient requirements;

(d) number of deer planned for, by sex and age classes;

(e) conversion of available forage to deer unit months, a measure similar to animal unit months (AUM) but also accounting for overlap of diet and season and area of range use.

11. Management practices that encourage human use of mule deer habitat should be carefully planned so that uses are compatible.

Conclusion

Flexibility in managing public rangelands to keep pace with society's changing demands for products is dictated by laws, such as the Forest and Rangeland Renewable Resources Planning Act of 1974 sec 2(3). As public land administrators prepare to manage all rangeland resources as intensively as they currently manage livestock, livestock management will evolve into range management, and habitat for wildlife will be maintained, increased, and enhanced. Management of range ecosystems will include refinements that account for impacts of old uses as well as new ones, as land managers decide which resources are to be emphasized and the intensity of management to be applied. Although the flow of products from most rangelands can be sustained, with more careful planning, more detailed inventories, and tighter management, we can meet the constraints of shrub-steppe ecosystems and reap additional benefits. The trick is to make management decisions that maintain harmony among natural interrelationships and human goals.

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Appendix
Common and Scientific Names of Plants[1]

Name in text	Scientific name
Antelope bitterbrush	*Purshia tridentata*
Basin big sagebrush	*Artemisia tridentata tridentata*
Big sagebrush	*Artemisia tridentata*
Bitter cherry	*Prunus emarginata*
Black cottonwood	Populus *trichocarpa*
Black greasewood	*Sarcobatus vermiculatus*
Black sagebrush	*Artemisia nova*
Bluebunch wheatgrass	*Agropyron spicatum*
Bolander silver sagebrush	*Artemisia cana bolanderi*
Bottlebrush squirreltail	*Sitanion hystrix*
Bud sagebrush	*Ariemisia spinescens*
Cheatgrass brome	*Bromus tectorum*
Common chokecherry	*Prunus virginiana*
Crested wheatgrass	*Agropyron desertorum*
Curvepod loco	*Astragalus curvicarpus*
Desert combleaf[2]	*Polyctenium fremontii*
Desert saltgrass	*Distichlis stricta*
Dogwood	*Cornus stolonifera occidentalis*
Early low sagebrush	*Artemisia longiloba*
Foothill big sagebrush[3]	*Artemisia tridentata* form *xericensis*
Giant wildrye	Elymus *cinereus*
Idaho fescue	*Festuca idahoensis*
Lodgepole pine	Pinus *contorta*
Low sagebrush	*Artemisia arbuscula arbuscula*
Mountain big sagebrush	*Artemisia tridentata vaseyana*
Mountain-mahogany	*Cercocarpus ledifolius*
Mountain silver sagebrush	*Artemisia cana viscidula*
Muhly	*Muhlenbergia richardsonis*
Newberry's cinquefoil[2]	*Potentilla newberryi*
Pinyon[4]	*Pinus edulis,* and *P. monophylla*
Ponderosa pine	*Pin us ponderosa*
Quaking aspen	*Populus tremuloides*

Appendix

Common and Scientific Names of Plants[1] continued

Name in text	Scientific name
Sandberg bluegrass	***Poa sandbergu***
Shadscale	***Atriplex confertifolia***
Snowberry	***Symphoricarpos albus,*** **and** ***S. oreophilus***
Snowbrush	***Ceanothus velutinus***
Spiny hopsage	***Grayia spinosa***
Squawapple	***Peraphyllum ramosissimum***
Starved milkvetch	***Astragalus miser***
Stiff sagebrush	***Artemisia rigida***
Subalpine big sagebrush	***Artemisia tridentata spiciformis***
Utah junipers	***Juniperus utahensis***
Wax currant	***Ribes cereum***
Western juniper[5]	***Juniperus occidentalis***
Western needlegrass	***Stipa occidentalis***
White fir	***Abies concolor***
Willow	***Salix*** **spp.**
Wyoming big sagebrush	***Artemisia tridentata***
wyominensis	

[1]Scientific and common names are from Garrison et al. (1976), except as noted.
[2] Hitchcock and Cronquist (1973).
[3] Sheehy (1975).
[4] Holmgren (1972).
[5] Smith (1952).

WILDLIFE HABITATS IN MANAGED RANGELANDS

THE GREAT BASIN OF SOUTHEASTERN OREGON

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