MIXTURE SEEDING FOR WILDLIFE

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Abstract. Monotypic stands of big sagebrush and pinyon-juniper cover vast areas throughout the western United States. Millions of acres of these vegetative types have been converted to monoculture grasslands rather than mixture seedings. The consequence has been the harmful alteration of wildlife habitat for many wildlife species. Mixture seedings that result in the establishment of a variety of shrubs, grasses and forbs provide four basic advantages. These advantages involve satisfying wildlife food and cover requirements, and are described as: (1) variety in nourishment; (2) extended succulence; (3) early forage as well as a long-term source of food and cover; and (4) protective vegetatative cover.

INTRODUCTION

Within the western United States there are approximately 146 million acres of big sagebrush (Artemisia tridentata) (Beetle 1960) and 60 million acres of pinyon-juniper (Pinus monophylla - Juniperus osteosperma) (Blackburn 1967). Land managing agencies and private land owners have converted millions of acres of big sagebrush and pinyon-juniper to grasslands, primarily the exotic, crested wheatgrass (Agropyron cristatum). These efforts have been largely directed toward improving range conditions for increased livestock production.

While such vegetation conversions have been important in improving forage for livestock many have been detrimental to wildlife. Harmful effects to wildlife are attributed to the loss of diversity of native shrubs, grasses and forbs. Such diversity is required to meet seasonal food and cover requirements for many species of wildlife inhabiting the western rangeland. When considering the variety of wildlife associated with big sagebrush and pinyon-juniper types in Nevada alone (Table 1) the impact to wildlife comes into focus. Wildlife managers have not been silent relative to these impacts. To the contrary, wildlife managers have been expressing concern for many years (Girard 1937; Patterson 1952; Martin 1967; and Peterson 1971).

Efforts to change the historical pattern of converting monotypic native rangeland to monocultural grasslands, as compared to mixtures, are not new. During the past 30 years the Intermountain Range and Experiment Station, Ephriam, Utah has been engaged in the conversion of 120,000 acres of pinyon-juniper and sagebrush to mixed communities of desirable plant species (Plummer, Christensen and Monsen 1968). Within the past six years, the Bureau of Land Management in eastern Nevada and elsewhere, has applied results of research to varying field conditions in an attempt to further document the advantages of using a variety of plant species in planned mixture seedings.

As a consequence, considerable knowledge is available on the use of seed mixtures as a means of converting native rangelands to more desirable environments for the benefit of a diversity of wildlife on western rangelands. Even though a few land managers now recognize the value of mixture seedings for multiple use, there are still many who do not. Therefore, the practice of changing large areas of native rangeland to pure grass types continues to reduce or endanger wildlife habitats. Likewise, the need to document the value of mixture seedings increases.

Table 1. Estimated numbers of wildlife associated with the big sagebrush and pinyon-juniper types in Nevada

Wildlife Species	Big Sagebrush	Pinyon-Juniper
Mammals	42	49
Birds	47	73
Reptiles	44	21
Amphibians	9	1

SELECTING AND PLANTING SEED MIXTURES

There are no "cook book" procedures recommended to properly plant and implement seed mixture practices. Instead it is important that seed mixture practices be developed according to: (1) objectives of the proposed mixture seeding; (2) particular climatic and edaphic conditions existing in the proposed seeding site; (3) methods used to prepare a seed bed; and (4) techniques available for planting seed. Preplanning procedures such as those developed and documented by Plummer et al. (1968) and Cain (1971) are helpful to determine proper components in a seed mixture.

The selection of seed mixtures for maximum wildlife benefits must be based on biological needs of the wildlife inhabitating the proposed seeding site during any season of the year. To do this, an inventory of wildlife resources and a documentation of their seasonal food and cover requirements are needed as a part of the preplanning efforts.

Plummer et al. (1968) describes some 94 plants suitable for planting in the big sagebrush and pinyon-juniper types. These plants have certain characteristics which, when planted in mixtures, make them particularly useful in meeting wildlife food and cover requirements. The most commonly used shrubs, grasses and forbs in seed mixtures are shown in Table 2.

An assortment of ways are available for reducing sufficient competition from big sagebrush and pinyon-juniper for the introduction of seed mixtures. Chaining is the most commonly used method of controlling pinyon-juniper. Various control methods are available for use in big sagebrush. These methods range from plowing, railing and chaining to the use of herbicides. Chaining and railing big sagebrush have the advantage of resulting in partial control of brush rather than eradication. Plowing and herbicide spraying are usually designed to remove 95 percent or more sagebrush plants. Sagebrush plants remaining after chaining or railing can be used as a

natural component in the mixture seeding. This technique may also result in sufficient release of native grasses and forbs to alleviate the need for planting seed mixtures (Cain 1971).

Controlled burning is another effective means of reducing competition from big sagebrush and pinyon-juniper.

Aerial seeding usually is utilized in connection with chaining big sagebrush and pinyon-juniper for it is economically feasible. Expensive or scarce seed is often hand planted in disturbed areas. Specially designed rangeland drills are usually used in areas where sagebrush is plowed, railed or sprayed. Seed dribblers attached to crawler tractors are effective in planting expensive or scarce seed in big sagebrush or pinyon-juniper.

To insure maximum seeding success, 12 to 20 pounds of seed mixtures are planted in the pinyon-juniper type, while 5 to 10 pounds are required in big sagebrush (Plummer et al. 1968; Cain 1971). At least 1/2 pound of each species in a seed mixture should be planted per acre to insure success of the species. A general rule is to strive for a mixture of a minimum of six species each of shrubs, grasses and forbs.

Wildfires usually result in a sufficient removal of big sagebrush and in some instances pinyon-juniper, to provide an excellent opportunity for the application of seed mixtures. In this case, aerial seeding, followed by chaining is an inexpensive, yet effective, means of planting and covering seed. Other worthwhile techniques include the use of rangeland drills to plant grass and forb seed and specially designed browse seeders to plant expensive browse seed. However, this is more expensive to the accomplishment of the total rehabilitation project.

Table 2. Plants suitable for inclusion in seed mixtures for the pinyon-juniper and big sagebrush types. Note: shrubs are often hand planted in disturbed areas, or planted by seed dribblers attached to crawler tractors.

Plant Species	Pinyon-Juniper	Big Sagebrush
Shrubs:		
Big sagebrush	x	
Black sagebrush	x	
Bitterbrush	x	
Rubber rabbitbrush	x	x
Fourwing saltbush	x	x
Curlleaf mountain mahogany	x	
True mountain mahogany	x	
Stansbury cliffrose	x	
Golden current	x	
Grasses:		
Fairway crested wheatgrass	x	x
Standard crested wheatgrass	x	x
Siberian wheatgrass	x	x
Intermediate wheatgrass	x	x
Bluebunch wheatgrass	x	x
Smooth brome	x	x
Russian wildrye	x	x
Forbs:		
Alfalfa (four strains)	x	x
Small burnet	x	x
Sainfoin	x	x
Yellow sweet clover	x	x
Utah sweetvetch	x	x
Chickpea milkvetch	x	x
Sicklepod milkvetch	x	x
Arrow-leaf balsamroot	x	x

ADVANTAGES

There are at least ten basic advantages in planting properly balanced seed mixtures which result in the establishment of desirable proportions of shrubs, grasses and forbs (Plummer et al. 1968; Cain 1973). These advantages are associated with multiple-use management of the western rangelands. Such multiple-uses include increased livestock forage production, improved watershed cover, improved aesthetics and improved wildlife food and cover.

Four of the advantages are directly related to improving or maintaining habitat conditions for wildlife. Therefore, the following discussion will be centered around those four advantages. Essentially, they are related to furnishing a variety of food and cover for a diversity of wildlife.

1. Nourishment

The quality of a range plant is primarily judged on how readily it is eaten by some animals and its nutritive content with respect to its phenological development.

Individual plant species, during their annual life cycles, vary materially in nutrient content. Most forage plants are high in nutrients during their early growth but lose these nutritive values with maturity. Early maturing plants decrease in their nutritional value, while slower maturing plants remain high in nutritive content over a longer period of time. Other plants retain comparatively high quantities of nutrients after maturity. According to Cook (1971) the nutritive value of native rangelands (and therefore mixture seedings) is based on how much carotene, protein, energy and phosphorus are in the forage plants.

The true test of the nutritive value of a forage species in a mixture seeding is the ability of shrubs, grasses and forbs to meet nutritional requirements of many wildlife species through various seasons of the year. Mixture seeding, consisting of an assortment of shrubs, grasses and forbs provide such nourishment throughout the various seasons (Plummer et al. 1968; Yoakum and Dasman 1969). To illustrate this, a discussion on the nutritive value of the components in seed mixtures is necessary. Comparative nutritive values of shrubs, grasses and forbs are discussed by their ability to meet the nutritive requirements of larger animals.

Shrubs

Shrubs, in most cases, contain higher levels of lignin, phosphorus, calcium and protein than associated grasses and forbs (Cook 1971). The carotene content of shrubs decreases only slightly from early growth to maturity because of a high carotene content in the bark of young twigs. Because of this, shrubs in all stages of growth furnish sufficient carotene to meet vitamin A requirement of animals, even during their lactating and growing periods. Shrubs are good sources of digestible protein during most of their active growth. Those shrubs that retain green leaves are generally considered good sources of phosphorous for animal maintenance and gestation. Shrubs are good sources of energy until fruit development, after which time they do not supply enough energy for animals in gestation (Cook 1971). A variety of shrubs are therefore essential on big game ranges to sustain mule deer (Odocoileus hemionus), pronghorn antelope (Antilocapra americana), elk (Cervus canadensis), and bighorn sheep (Ovis canadensis).

Several workers have stressed the importance of shrub diversity in providing big game animals with a balanced diet (Smith 1952; Plummer et al. 1968; and Dasmann 1971). For example, Robinette, Julander, Gashwiler and Smith (1952) found that winter losses of mule deer in Utah were inversely related to shrub browsed, particularly that of the preferred species. Martinka

(1967) in Montana observed severe winter loss of pronghorn antelope in an area where sagebrush was scarce, but light to moderate where it was available in adequate quantities.

On big game ranges shrubs that retain green leaves are especially desirable for planting in seed mixtures. Among them, are big sagebrush, black sagebrush (Artemisia nova), antelope bitterbrush (Purshia tridentata), rubber rabbitbrush (Chrysothamnus nauseosus), fourwing saltbush (Atriplex canescens), curlleaf mountain mahogany (Cercocarpus ledifolius), true mountain mahogany (C. montanus), Stansbury cliffrose (Cowania mexicana) and golden currant (Ribes aureum).

The value of shrubs to wildlife is not confined to big game. Nearly every shrub provides food for one or more species of wildlife. Martin, Zim and Nelson (1951) reported that 117 wildlife species indigenous to the United States use shrubs as food. Among these are a wide variety of small animals which show seasonal preferences for different shrubs, as well as shrub parts; i.e. foliage, twigs, buds, bark, flowers, nectar, fruit, seed and roots. Fruit and seeds of shrubs are often concentrated sources of starch, sugar, protein or fat and are particularly sought after by birds and rodents.

The winter diet of sage grouse (Centrocercus urophasianus) is almost exclusively sagebrush leaves, shoots and seed stalks (Bean 1941). The overall importance of sagebrush to sage grouse as a food was made evident by Patterson (1952) in Wyoming where 99.7 percent of the sage grouse diet from November through March was sagebrush. Martin et al. (1951) shows that various species of sagebrush serve as food for two species of small mammals, bitterbrush serves two small mammals, rabbitbrush serves two songbirds and three small mammals, fourwing saltbush serves two small birds and five small mammals, curlleaf mountain mahogany serves two blue grouse (Dendragapus obscurus) and three small mammals, and golden currant serves the blue grouse, three small birds and two small mammals.

Grasses

Green annual and perennial grasses are of significant nutritional value to wildlife. At this early stage of growth they are high in water and mineral content, and low in crude fiber. During active growth, grasses have the characteristics of a concentrated food rich in protein (Guilbert and Hart 1946). Grasses that retain their seed at maturity maintain higher food values than those that do not.

Grasses rapidly lose their carotene during advanced stages of maturity. Therefore, when mature they fail to furnish minimal requirements of vitamin A for gestating animals. Generally grasses are poor sources of digestible protein. They are also considered poor sources of phosphorous after seed formation. Drought periods cause most grasses to lose phosphorous content. However, when precipitation again occurs and more growth results phosphorous content increases enough to meet most animals' lactation requirements. An important value of grasses is that when they reach maturity they are good or excellent sources of energy, because of high cellulose content (Cook 1971).

Grasses play a seasonal importance in the diet of most big game animals. In many areas mule deer consume available grass by choice during the early spring season. They prefer green grass free of stubble. The use of grass by deer peaks shortly after the onset of active spring growth and falls off rapidly after broad-leafed forbs appear (Dasmann 1971).

A study of the Doyle mule deer herd in Nevada indicates that grasses account for the difference between good and poor winter survival (Lassen,

Ferrel and Leach 1952). Yoakum (?) states that good pronghorn antelope habitat in a grassland-sagebrush community is composed of 40 to 60 percent grasses, with five to ten species of grass present. Martin, et al. (1951) lists five species of grass important to elk. Studies by Yoakum (1971) show that the diet of bighorn sheep on the Silver Peak Range in Nevada includes 59.5 percent grass in a vegetative composition of 22 percent grass, 4 percent forbs and 74 percent shrubs.

Grasses are the staple food for grasshoppers and many other insects, ground squirrels (Citellus sp.), marmots (Marmota sp.), meadow mice (Microtus sp.), rabbits (Lepus sp.), and cottontail (Sylvilagus nutallii). Grass seeds are eaten by various insects, mourning dove (Zenaidura macroura), many sparrows (Spizella sp.), Zonotrichia sp., etc.) and chipmunks (Eutamias sp.).

Forbs

A variety of annual and perennial forbs are important in fulfilling nutritional requirements of a diversity of wildlife. Most forbs are intermediate between shrubs and grasses in chemical content (Cook 1971). Carotene content of forbs at the time leaves defoliate and stems are dry or dormant is not sufficient to furnish minimal vitamin A requirements for gestating animals. During most seasons, forbs are intermediate between shrubs and grasses on energy furnishing constituents. Like shrubs, they fail to meet energy requirements for gestation after reaching maturity.

Forbs are seasonally important to the diet of most big game animals. Among the important forbs are legumes. Smith (1952), in Utah has shown that the mule deer diet during July consists of legumes, primarily clover. In this same study, lupine made up 57 percent of the food eaten in shrub cover type, although it constituted no more than six percent of the available food. According to Yoakum (1972) desirable vegetative composition in a grass-sagebrush type for antelope should include 10 to 30 percent forbs, with 20 to 40 species of forbs present. Forbs are of a lesser importance to elk (Martin et al. 1951). In the Silver Peak Range Yoakum's (1971) studies showed that bighorn sheep utilized 32 percent forbs in a vegetative composition of only four percent forbs while there were 32 percent grass and 74 percent shrubs.

Klebenow and Gray (1968) documented the importance of forbs in the diet of juvenile sage grouse in Idaho. They stated that the importance of forb components in the habitat must be recognized if native ranges are to be properly managed for sage grouse. Giezentanner (1973) found that vegetation manipulation practices that favor the growth of forbs are beneficial to mourning dove.

Generally, annual forbs, with their large seed crops are more valuable than perennials to seed-eating wildlife, especially for ground feeding birds and mammals. Gullion (1964) lists at least 150 forbs which provide food for a diversity of birds and mammals.

2. Succulence

A variety of plants in a seed mixture prolongs the period when succulent forage is available for many wildlife species. The presence of such forage may often extend the period of time when big game animals inhabit a seasonal range. As discussed earlier, the extended period of succulence is also related to the increased time most grasses and forbs are highest in nutritive values.

Shrubs that retain green leaves are succulent throughout most of the year. Smooth brome (Bromus inermis), Russian wildrye (Elymus junceus), Great Basin wildrye (E. cinereus) and bluebunch wheatgrass (Agropyron smithii) are green

throughout the growing season and, therefore, help extend the period of succulent forage. Forbs that retain considerable succulence throughout the growing season include rangeland alfalfa (Medicago sativa), small burnet (Sanguisorba minor), sainfoin (Onobrychis viciaefolia), Utah sweetvetch (Hedysarum boreale utahensis), arrowleaf balsamroot (Balsamorhiza sagittata), chickpea milkvetch (Astragalus cicer) and sicklepod milkvetch (A. falcatus). In eastern and northern Nevada, rangeland alfalfa, small burnet and sainfoin are particularly useful in maintaining succulence during the dry season. All species remain green until early fall frost.

3. Early vs. Persistent Growth

Openings created in dense stands of pinyon-juniper and big sagebrush often attract wildlife. This is illustrated in eastern Nevada where mule deer, pronghorn antelope and rabbits have been attracted to newly established pinyon-juniper chainings, i.e., Kern Mountain Chainings and Horse Thief Chaining. Because of this, there is a need to include in seed mixtures plants that will provide early forage for wildlife. In addition, heavy use by big game and small animals may cause severe damage to young seedlings.

Therefore, it is desirable to plant a variety of rapidly developing species which will provide needed forage during the establishment of slower species. Big sagebrush, rubber rabbitbrush, black sagebrush, yellow sweetclover (Melilotus officinalis), rangeland alfalfa, small burnet, crested wheatgrass, Siberian wheatgrass (Agropyron sibiricum), intermediate wheatgrass (A. intermedium) and smooth brome develop quickly and supply forage within three years. Forage produced by these plants is often sufficient to deter grazing use on slower developing plants. It also is desirable to plant slower developing but more persistent shrubs and forbs which will gradually increase in forage production and growth form to add to the value of a mixture seeding. Slower developing and persistent shrubs and forbs include antelope bitterbrush, curlleaf mountain mahogany, true mountain mahogany, Stansbury cliffrose, arrowleaf balsamroot and Utah sweetvetch.

4. Cover

The value of shrubs as cover for mammals has not been extensively studied. Shrub cover is unquestionably important to many mammals as shade during hot weather. It is also known to be important during the winter in colder regions because it moderates temperature and wind velocity (Loveless 1967). Many mammals use shrub cover to hide or escape from predators, and some predators use shrubs for concealment while stalking prey. Cottontails rarely venture far from brush piles or dense patches of shrubs during the winter. Most big game with non-precocious young often use cover in the form of shrubs for concealing their young for two or three weeks following birth (Robinette 1971). Burt and Grossenheider (1964) list at least 86 species of small mammals which associate shrubs with cover.

Birds require shrub cover for shade, protection against the elements and predators, loafing or roosting and during the breeding season for perching and nesting sites (Johnston 1970). Many birds nest in or under shrubs. Within the United States and Canada shrubs furnish, in whole or in part, nesting cover for at least 181 species of birds (Peterson 1961). The importance of shrubs to nesting birds is exemplified by Patterson's (1952) work when he found 92 percent of approximately 300 sage grouse nests under sagebrush. The height of sagebrush used by sage grouse for nesting appears to vary from 7 to 25 inches. However, Patterson (1952) and Klebenow (1969) found the tallest shrubs available were used. These same workers found that stands of sagebrush with 20 to 30 percent canopy coverage were most frequently selected for nesting.

Doty (Personal comm.) lists 53 species of reptiles in Nevada which rely upon shrubs for cover.

Grasses, particularly when growing with shrubs, also serve to provide protective cover for many birds and medium-sized mammals. Burt and Grossenheider (1964) list at least 50 small mammals which associate grass with cover. According to Storer and Usinger (1973) horned larks (Eremophila alpestris), meadow larks (Sturnella neglecta), savannah sparrows (Passerculus sandwichensis) and other birds find cover in grasslands.

Doty (Personal comm.) reports on 49 species of reptiles of Nevada which rely upon the association of shrubs and grass for cover.

No particular species of grass appears to be preferred as cover. Nearly all grasses, depending upon the intensity of grazing, have the capability to produce rank growth.

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