Grassland and Shrubland Habitat Types of the Shoshone National Forest

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GRASSLAND AND SHRUBLAND HABITAT TYPES

OF THE

SHOSHONE NATIONAL FOREST

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During the summers of 1978 through 1980, fieldwork was conducted to identify, describe, and map habitat types in the non-alpine grasslands and shrublands on the Shoshone National Forest. This document describes the habitat types and their distribution over the Forest, as well as discussing their implication to land management.

Acknowledgements

Most of the habitat type descriptions and range management information in this report are adapted from two grassland/shrubland habitat type classification projects; Grassland and Shrubland Habitat Types of Western Montana (Mueggler and Stewart, 1980) and Non-Forest Habitat Types of Idaho (Hironaka and Fosberg, 1978, unpubl.). These two reports provided the classification system and background information used in this report. Much of this background information, particularly that dealing with trends in succession and management implications, has been incorporated with little alteration in order to take advantage of the extensive literature research done in both the Montana and Idaho projects. Detailed total productivity information comes primarily from Mueggler and Stewart's (1980) work but has been correlated with productivity data from the Shoshone National Forest wherever possible. Although these grassland/shrubland habitat types were developed for other areas, with some modifications they are useful as descriptors for the land units of the Shoshone National Forest.

Soils and landform information for this project has been provided in part by Kent Dunstan and Larry Ross, past and present Shoshone National Forest Soil Scientists. Lack of time precluded the addition of detailed soils information to these descriptions.

Valuable assistance and guidance has been provided by many people, including: Monte Barker, Kent Dunstan, Jim Guest, Bruce Haflich, Ronn Julian, Steve Mealey, Hoot Murray, Dave Reeder, John Ross, Larry Ross, Jack Sanders, Diane Spencer and Larry Strecker.

Susan J. Tweit
Kent E. Houston

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INTRODUCTION

The highly varied environment of the Shoshone National Forest creates a mosaic of forest, shrubland, and grassland vegetation. Species composition, productivity, and consequent uses, differ greatly between and within these major vegetation types. A land classification system based on the inherent capability of these land units to produce various resources as well as identifying their response to management activities will facilitate resource management and planning on the Shoshone National Forest.

The range vegetation type classification was developed in 1937 as a means to characterize and describe vegetation for range inventory and management purposes. This classification system has been useful and has served an important function in range management. With increasing demands for range resources, a more sophisticated classification scheme is needed to better identify the various kinds of rangelands. The current range type classification is based on existing vegetation and its nomenclature is a mixture of life form and common name such as type 4 - sagebrush, type 18 - annuals, type 2 - meadow, etc. The vegetation types are further subdivided on the basis of subjectively determined dominant and co-dominant species. Such classifications tend to stress current site occupancy and identity by a few presently dominant plants. Little consideration is given to the ecologic parameters or successional status of the existing vegetation or to the ultimate productivity potential of the environment as reflected by the potential or "climax" vegetation.

A rangeland classification based on habitat types indicating the potent-

ial climax vegetation and productivity potential will complement the existing range vegetation type classification. The two classification schemes when superimposed on the same lands will indicate what the present vegetation is and also the potential or climax vegetation. Such classification will facilitate land uses which maintain the resource base at optimum productivity levels.

Habitat Type Concept

In the past decade, the habitat type concept of environmental classification developed by Daubenmire has gained increasing acceptance in the West, particularly by forest managers. This concept stresses use of the entire plant community as an environmental integrator, thus permitting identification of environments (habitats) with similar biotic potentials. The climax plant community is considered to be the ultimate response to the combined environmental factors of the site. Identification of the potential climax plant community therefore, identifies a great deal of information about the site. All environments with the potential to support approximately the same mix of plant species at climax are considered to be within the same habitat type regardless of current successional status. This approach to classification has been used successfully to classify both forest vegetation and grassland-shrubland vegetation throughout the Northern Rocky Mountains. More recently, Steele et al (1979) used this approach to develop a classification of forest lands on the Shoshone while Mueggler and Stewart (1980) developed a complementary system for mapping the grasslands and shrublands of western Montana. These classifications are being used for standardizing mapping of forests and rangelands according to site potential in the areas for which they were developed. They also provide the framework essential

for organizing in a sensible and useful manner information on resource potentials, limitations, and responses to management activities. The habitat type provides a basis to communicate with current research work and with other resource managers concerning the same habitat type.

It is important to distinguish between plant association and habitat type or ecological land unit. The plant association is the climax community type. The habitat type or ecological land unit is the physical environment that supports or can support a particular plant association. The habitat type is the collective area (site) that has the potential to support a given climax vegetation regardless of the current vegetation. As an example, all areas on which the climax vegetation is of the Agropyron spicatum/Poa sandbergii association is referred to as the Agropyron spicatum/Poa sandbergii habitat type even though Junegrass (Koeleria cristata) and needle and threadgrass (Stipa comata) may be the current dominant and codominant species on the site. The habitat type is the total area that has the potential of producing the same plant association (climax vegetation), regardless of the nature or kind of vegetation that may be presently occupying the area. Potential climax vegetation is used as the basis for defining the limits of the habitat type. Climax vegetation integrates environment, reflects the habitat and provides a means of classifying the landscape.

Objectives and Uses of the Project

The major aim of this project is to provide a classification system based on site potential for the non-alpine grasslands and shrublands of the Shoshone National Forest. The resultant habitat types have been used to map grassland/shrubland sites outside designated wilderness areas on the Forest.

The habitat type system lends itself particularily well to storage of information about vegetation communities and the impacts of management activities on these communities for two reasons: 1) the system provides a basis to compare different vegetation communities and/or land units by relating them to similar units under the classification scheme, and 2) it is based on land site potential or the potential of a certain land unit (habitat) to produce particular vegetation communities and, consequently, other resources. Therefore habitat types may be used to predict responses to management activities based on biological potential of particular land units. Habitat types will complement and may be used to categorize information on existing vegetation, soils, outdoor recreation, socio-economic conditions, hydrology, and wildlife. Used in combination with existing vegetation mapping (range and forest cover types), habitat types will provide a model for predicting effects of management activities.

Some of the potential uses of habitat types include:

1) range and wildlife management - assessing relative forage production, range suitability and wildlife habitat values;
2) watershed - estimating relative plant available moisture levels and evapotranspiration rates, recognizing potential areas of

heavy snowpack/high water yield, high water tables, etc.;

3) recreation - assessing suitability for various types of recreational use, impacts of recreational use on the plant communities and sites, and recovery rates for visual quality following disturbances;

4) communication - provide a common framework for site recognition and interdisciplinary activities;

5) natural area preservation - help identify unique areas for future study in research natural areas;

6) research - stratification tool for designing studies and reporting results meaningfully for management purposes;

7) observation - framework for organizing field observations to add to existing knowledge and management options.

Several considerations caused by limitations of the project are discussed below:

1) The habitat types and descriptions used in this report are adapted from those developed for nearby areas (Montana and Idaho) rather than being classified specifically for the Shoshone National Forest. This does not mean that they are not useful here, simply that in some cases they may contain information which is more reflective of Montana or Idaho environments and land units than those of the Shoshone National Forest. Field observations about each habitat type should be continued to be added to the descriptions in order to modify each habitat type more specifically to the Shoshone National Forest. Addition of field observations and data collected in allotment analyses, winter range studies, and other projects will make the habitat type even more useful over time as predictors of the effects of management

activities. As more specific information is added, more uses can be found for the system.

2) The scope of the project is limited to the non-alpine grassland and shrubland areas outside of currently designated wilderness areas. Therefore no attempt has been made to classify or map the grassland and shrubland habitat types in the wilderness areas on the Shoshone National Forest, although the classification system could be used to map the non-alpine areas in wilderness if so desired. Alpine community types have been classified on the basis of field observations even though they fall outside the scope of the project owing to limitations in time, and difficulties which are inherent in classifying and mapping alpine land sites. Alpine land sites generally occur in a mosaic of small patches with widely differing environmental conditions controlled by microtopography. Very small changes in topography (as small as 1 foot or less) may mean the difference between a windswept area or an area of snow accumulation, changing the potential productivity and plant community drastically.

3) Latin names and taxononic usages in this report follow Hitchcock and Cronquist (1973) Flora of the Pacific Northwest. Some of the new taxonomy may be unfamiliar to the reader, including: Poa sandbergii instead of P. secunda; Agropyron caninun, the name for a complex of high elevation Agropyron sp. such as A. trachycaulum and A. subsecundum which are hard to separate in the field; and the subspecies of Artemisia tridentata (see Appendix 2, for a key to these). Because of difficulties in separation of the Carex species, they are often not speciated in the text but references are made to

a group of dryland Carex species including C. filifolia and C. stenophylla, among others. Festuca idahoensis is used throughout the text for both F. idahoensis and F. ovina, although in the Alpine series it is probably mostly F. ovina. These two species intergrade, making identification difficult for the non-taxonomist.

4) Habitat types endemic to the Lander Ranger District are quite different from the habitat types of the remainder of the Forest and as such are not based on Mueggler & Stewart's (1980) work from Montana, but on Hironaka and Fosberg's (1978) work from Idaho. These types are based on a relatively small amount of fieldwork and some such as the PUTR/FEID habitat type have never been described elsewhere. Therefore, these habitat type descriptions are the least well-developed of any on the Forest and would benefit by further input of field observations on distribution, site environment and vegetative composition.

Contents of the Report

Before using the grassland/shrubland habitat types, it is suggested that the user familiarize her/himself with the material contained in this report and accompanying appendices. This will enable the user to take full advantage of the diverse types of information contained in this report.

Included in this report are:

1) Key to the grassland/shrubland habitat types including a list of habitat types occurring on each Ranger District. This key should be used in determining the habitat of a particular site.

2) Descriptions of each habitat type including:

   (a) distribution throughout the Forest and on each Ranger District.

   (b) descriptions of the habitat type or site including climate range, soils, landform, and other environmental factors.

   (c) vegetation composition of the climax plant community and seral stages.

   (d) discussion of the inherent resource productivity of each habitat type as well as potential uses and management.

3) Appendices including:

   (a) a list of scientific names, common names and abbreviations of the plants used in this report.

   (b) a key to the species and subspecies of the genus Artemisia (sagebrush) treated in this report.

KEY TO GRASSLAND AND SHRUBLAND

HABITAT TYPES

KEY TO GRASSLAND AND SHRUBLAND HABITAT TYPES

Instructions: This key applies specifically to non-forest vegetation not severely altered from pristine conditions--allow for changes in community composition caused by abusive grazing, spraying, or other man-related disturbances. Unavoidably, relative amounts of species are sometimes used as separation criteria. In most instances of questionable separation, the key will lead eventually to the same habitat type under either alternative. Occasionally a community will be identified correctly even though one of the species constituting the habitat type or phase name is absent. This can happen because habitat types are determined by the entire floral composition and not just by the "name" species. The key is workable with a taxonomic knowledge of common species which can be readily identified by range technicians. The key is excerpted from Mueggler and Stewart (1980) and Hironaka and Fosberg (1978).

1. Grassland or herbland aspect; woody plants, if present, are widely scattered individuals. Alpine sites are not included in this key; see Alpine Series.

    2. Festuca idahoensis usually abundant; at least more than 5% canopy cover.

        3. Agropyron spicatum abundant (more than 5% canopy cover); perennial Bromus absent or extremely scarce (see other half of couplet).

            4. Stipa occidentalis usually absent; if present, only in small amounts greatly exceeded by Stipa comata. . . . . FESTUCA IDAHOENSIS/AGROPYRON SPICATUM h.t. (p. 39)

            4. S. occidentalis conspicuous, not exceeded by S. comata. . . . . FESTUCA IDAHOENSIS/AGROPYRON SPICATUM h.t. (p. 40)
            STIPA OCCIDENTALIS phase

        3. A. spicatum either absent or a relatively minor species with less canopy cover than other Agropyron species; only abundant if perennial Bromus is prominent.

            5. Artemisia frigida present.

                6. Agropyron smithii and/or Agropyron dasystachyum present . . . . . FESTUCA IDAHOENSIS/AGROPYRON SMITHII h.t. (p. 45)

6. A. smithii and A. dasystachyum absent.

7. Stipa occidentalis absent . . . . . FESTUCA IDAHOENSIS/AGROPYRON SPICATUM h.t. (p. 39)

7. S. occidentalis conspicuous . . . . . FESTUCA IDAHOENSIS/AGROPYRON SPICATUM h.t. (p. 40)
STIPA OCCIDENTALIS phase

5. A. frigida absent.

8. Deschampsia caespitosa present; Phleum alpinum and Trisetum also often present; A. spicatum absent . . . . . FESTUCA IDAHOENSIS/DESCHAMPSIA CAESPITOSA h.t. (p.55)

8. D. caespitosa absent; usually P. alpinum and Trisetum also absent.

9. Geranium viscosissimum and/or Potentilla gracilis present . . . . . FESTUCA IDAHOENSIS/AGROPYRON CANINUM h.t. (p. 49)

9. Both G. viscosissimum and P.gracilis absent.

10. Stipa occidentalis absent. Agropyron smithii and/or A. dasystachyum present . . . . . FESTUCA IDAHOENSIS/AGROPYRON SMITHII h.t. (p. 45)

10. Stipa occidentalis present. Both A. smithii and A. dasystachyum absent. . . . . FESTUCA IDAHOENSIS/AGROPYRON SPICATUM h.t. (p. 40)
STIPA OCCIDENTALIS phase

2. Festuca idahoensis absent or rare (less than 5% canopy cover).

11. Agropyron spicatum usually more than 10% canopy cover.

12. Rhizomatous wheatgrasses and usually Carex stenophylla (dryland Carex) present . . . . . AGROPYRON SPICATUM/AGROPYRON SMITHII h.t. (p. 32)

12. Rhizomatous wheatgrasses absent.

13. Stipa comata absent . . . . . AGROPYRON SPICATUM/POA SANDBERGII h.t. (p. 29)

13. S. comata present . . . . . AGROPYRON SPICATUM/POA SANDBERGII h.t. STIPA COMATA phase (p. 30)

11. Agropyron spicatum absent or rare (less than 5% canopy cover).

14. Festuca idahoensis (or Festuca ovina) present (see Alpine Series for other alpine habitat types) . . . . . FESTUCA IDAHOENSIS/DESCHAMPSIA CAESPITOSA h.t. (p. 55)

14. F. idahoensis (or F. ovina) absent. . . . DESCHAMPSIA CAESPITOSA/CAREX h.t. (p. 57)

1. Shrubland aspect; woody plants abundant.

15. Shrubby aspect caused at least partly by species of Artemisia.

16. Dwarf sagebrush species are the dominant sagebrush species on the site (see Appendix 2 for keys to Artemisia species).

17. Festuca idahoensis is the dominant graminoid; Agropyron spicatum may be present but in lesser amounts than F. idahoensis.

18. Artemisia tripartata is the dominant shrub (Lander R.D. only) . . . . . A. TRIPARTATA/FESTUCA IDAHOENSIS h.t. (p. 85)

18. Artemisia arbuscula is the dominant shrub (Wind River R.D. only) . . . . . A. ARBUSCULA/FESTUCA IDAHOENSIS h.t. (p. 83)

17. Agropyron species is the dominant graminoid.

19. A. smithii and/or A. dasystachyum the dominant graminoid(s). Artemisia longiloba dominates the shrub layer. Soils usually heavily textured, poorly drained (Wind River R.D. only) . . . . . A. LONGILOBA/AGROPYRON SMITHII h.t. (p. 81)

19. Agropyron spicatum and Stipa comata are the dominant graminoids. Artemisia nova is the dominant sagebrush species. . . . .A. NOVA/AGROPYRON SPICATUM h.t. (p. 78)

18. The shrub layer is predominately of the taller woody Artemisia species instead of members of the dwarf sagebrush group (see Appendix 2 for keys to Artemisia species).

20. Artemisia tridentata ssp. wyomingensis is the principal sagebrush species. A. tridentata ssp. wyomingensis can be differentiated from other big sagebrush subspecies by its low, rounded-topped growth form, and short, rather bell-shaped leaves.
Agropyron spicatum is the principal understory species.
Stipa comata is present in varying amounts. . . .A. TRIDENTATA SSP. WYOMINGENSIS/AGROPYRON SPICATUM h.t. (p. 87)

20. Artemisia tridentata ssp. wyomingensis is absent and replaced by sagebrush species that grow in more mesic and cooler conditions.

21. Artemisia tridentata ssp. tridentata is the principal sagebrush member. The differentiation of A. tridentata ssp. tridentata from other big sagebrush can often be based on shrub height. Average stand height of greater than four feet and leaves that are narrowly strap-shaped characterize the A. tridentata ssp. tridentata plants on the Shoshone National Forest.
Agropyron spicatum is the principal understory species. . . . . .A.TRIDENTATA SSP. TRIDENTATA/AGROPYRON SPICATUM h.t. (p. 92)

21. Artemisia tridentata ssp.vaseyana (mountain big sagebrush) is the principal sagebrush species. The distribution

of this species is widespread from mid to high elevations with a lower elevation limit at 4500 to 5000 feet.

22. A. tridentata ssp. vaseyana is the principal shrub species. Other shrubs, if present, are widely scattered individuals. Festuca idahoensis the principal graminoid.

    23. Geranium viscosissimum, Potentilla gracilis, and Agropyron caninum or Bromus carinatus present. . . . . A. TRIDENTATA SSP. VASEYANA/FESTUCA IDAHOENSIS h.t. GERANIUM VISCOSISSIMUM phase (p. 95)

    23. Above mentioned forbs and grasses absent . . . . . A. TRIDENTATA SSP. VASEYANA/FESTUCA IDAHOENSIS h.t. (p. 95)

22. Other shrubs such as Purshia tridentata and Symphoricarpos oreophilus co-dominate mixed shrub communities along with A. tridentata ssp. vaseyana (Lander R.D. only).

    24. Agropyron spicatum, Stipa comata, and/or Hesperochloa kingii are the principal graminoids. Symphoricarpos oreophilus present with at least 5% cover. . . . . A. TRIDENTATA SSP. VASEYANA/SYMPHORICARPOS OREOPHILUS h.t. (p.105)

    24. Festuca idahoensis is the principal graminoid. Agropyron spicatum rare or absent. Purshia tridentata usually with more than 1% coverage (may be small, heavily browsed shrubs hidden by taller ARTR-V). . . PURSHIA TRIDENTATA/FESTUCA IDAHOENSIS h.t. (p.106)

17. Shrubby aspect created by shrubs other than *Artemisia* species. These habitat types are minor ones occasionally found as inclusions in other habitat types.

    25. *Potentilla fruticosa* abundant, or with potential to increase in density . . . . . POTENTILLA FRUTICOSA/FESTUCA IDAHOENSIS h.t.(p.111)

    25. *P. fruticosa* absent.

        26. *Rhus trilobata* abundant or present in large, scattered patches (well-drained hills or uplands). . . . . RHUS TRILOBATA/AGROPYRON SPICATUM h.t. (p.115)

        26. *Sarcobatus vermiculatus* abundant (poorly-drained, saline or alkaline soils). *Elymus cinereus* a conspicuous associate . . . . . SARCOBATUS VERMICULATUS/ELYMUS CINEREUS h.t.(p.113)

    25. Not as above, refer to habitat type booklet.

GRASSLAND AND SHRUBLAND

HABITAT TYPE

DESCRIPTIONS

Distribution of Grassland/Shrubland Habitat Types on the Shoshone National Forest

In general the occurrence of grassland and shrubland habitat types on the Shoshone National Forest is restricted to those sites which, due to one environmental factor or a combination of factors, are too arid to support tree reproduction. This may be due to such general factors as elevation, annual precipitation, and regional weather pattern; or to more site specific factors including: soil depth, landform, topographic position, and available nutrients.

A few grassland/shrubland habitat types are characteristic of sites at the other end of the environmental spectrum--that is, sites where soils are waterlogged throughout the growing season and consequently too poorly aerated for tree growth.

Grassland and shrubland habitat types on the Shoshone National Forest dominate the foothill zone where low elevation climates and lack of precipitation combine to make moisture stress severe.

In the montane (forested) zone these habitat types are restricted to sites where one or more factors make the normally adequate annual precipitation inadequate for tree production. Characteristic sites include convex or well-drained landforms; extensive southerly or westerly exposures; areas of thin or poorly developed soils; and highly windswept sites.

Above the montane zone in the alpine, grassland and shrubland habitat types again dominate due to the effects of the severe alpine environment. The combination of extreme temperature fluctuations, dessicating winds, a short growing season, and other factors effectively prevents tree growth in the alpine.

Natural fire undoubtedly effects the distribution of grassland and shrubland seral communities but generally does not affect the distribution of the habitat types unless site environmental conditions are drastically altered by fire.

Grassland and shrubland habitat types are distributed differently throughout the Forest due to substrate and local weather pattern variations induced by the different mountain ranges within the Forest. Specific distributions are discussed in the series introductions and in the habitat type descriptions.

GRASSLAND INTRODUCTION

Grassland communities comprise about half of the grazing land on the Shoshone National Forest. Grasslands are found from the lowest elevations where bunchgrasses dominate to the high alpine where sod forming bluegrasses predominate.

Available moisture is often the limiting factor in maintaining the bunchgrass communities as grasslands instead of shrublands. Shrub establishment in the bunchgrass communities may be limited by several other factors including: toxins secreted by bunchgrasses which inhibit shrub (or tree) establishment, and low amounts of precipitation. Available moisture may be limited by elevation, soils, and/or topographic position.

Grazing pressure on the bunchgrasses may reduce them to the point that shrubs may effectively compete for resources and continued disturbance may change the community to a shrubland. This represents a regression from the potential vegetation (habitat type) and, depending on the increaser shrub species, reduced forage production. Shrub establishment at the highest elevations is limited mainly by snow depth since snow accumulation protects the plants from windkill in the winter, but may also be limited by the dense sod formed by rhizomatous grasses and forbs.

Distributions of grassland habitats vary greatly across the diverse substrates and climatic regimes of the Shoshone National Forest. General descriptions of distributions follow for each Ranger District.

Clarks Fork Ranger District

Alpine grasslands comprise roughly half of the grassland habitat types on

the Clarks Fork Ranger District. The broad expanse of the Beartooth Plateau above treeline is one of the largest contiguous areas of alpine grassland on the Forest. Other extensive areas of grassland habitats on the Clarks Fork Ranger District include the Festuca idahoensis-dominated grasslands of Bald Ridge and the dry grasslands of Riddle Flat in the Sunlight Basin, dominated by Agropyron species. The occurrence and extent of these three major grassland areas is strongly correlated to the soils and landforms they characterize. All occur on gently to moderately sloping, slightly dissected landforms associated with past glaciation and deposition of glacially worked materials.

In contrast, grassland habitat types found on the steep, dissected topography of the Absaroka volcanics generally represent small "baldlike" areas on south and west facing upper slopes and ridgetops. Although extensive areas of montane grassland habitat types are not common in the Absarokas, a few remnants of the original plateaulike, high elevation surfaces remaining on the Clarks Fork Ranger District support large areas of alpine grasslands such as those on Hurricane Mesa. Those grasslands are not however, either as extensive or as diverse as those of the Beartooth Plateau.

Bunchgrass-type low elevation grasslands are not well represented on the Clarks Fork Ranger District, dominating only the lowest elevations along the eastern margin of the District.

Wapiti Ranger District

Because the Absaroka Mountains dominate the Wapiti Ranger District, much of the montane grassland is in the scattered, dry, baldlike patches of Festuca idahoensis series described for the Absaroka topography of the Clarks Fork Ranger District. Distribution of Alpine series grasslands on

the Wapiti Ranger District is also comparable to the Absarokas of the Clarks Fork, occurring on remnants of the original high plateaulike surface. The distribution patterns of these two grassland series are very typical of the grassland areas of the Absaroka Mountains across the whole Forest.

Greater diversity in grassland habitat types occurs outside the Absarokas on the Wapiti Ranger District. Agropyron spicatum dominated arid bunchgrass rangelands are found below lower treeline on soils developed mainly from slump-landslip landforms in the lower South Fork Valley. These sites represent the largest areas of arid low elevation Agropyron spicatum habitats on the Forest and are more typical of Big Horn Basin vegetation than montane vegetation.

In the northeastern section of the Wapiti District, two moderate sized Festuca idahoensis series grasslands occur on gentle, relatively undissected topography. One, the Trout Peak grassland area, is unique since such topography is not normally developed on the Absaroka volcanics. It is primarily a dry Festuca idahoensis grassland, however, like the typical Absaroka grassland balds. The other area, Monument Hill, corresponds to the Bald Ridge grassland in characterizing gently sloping, undissected landforms associated with past glaciation.

Greybull Ranger District

Montane grasslands on the Greybull Ranger District are generally the typical scattered Absaroka baldtype, Festuca idahoensis-dominated grasslands, found on steep upper slopes and ridgetops. This District, however, has large areas of alpine grasslands due to the presence of extensive undissected areas of high elevation plateau surfaces remaining in the Absaroka Mountains. These alpine grasslands, while extensive, are drier and less diverse than those of

the Beartooth Plateau due to differences in substrate and soil development.

Wind River Ranger District

The Wind River Ranger District covers a great variety of substrates, topographic landforms, and wide ranges in elevation and precipitation. Grassland and shrubland habitat types are therefore quite diverse from the very arid Agropyron spicatum dominated bunchgrass grasslands occurring below lower treeline to large areas of alpine grasslands.

Grasslands are most extensive on that portion of the Wind River Mountains within the District. The massive limestone formations flanking the Wind River Mountains develop thin, well-drained soils supporting nearly continuous grasslands (such as the Whiskey Mountain area) from the lowest elevations up into the alpine. Forested zones interrupt these grasslands, but forest communities may be narrow and discontinuous.

Other major areas of grassland habitat types are found on gently rolling glacial tills around Union Pass at the summit of the northwest end of the Wind River Range.

Lander Ranger District

Grasslands on the Lander Ranger District are not as well developed as on some of the other Ranger Districts, but are found extensively on the flanks of the Wind River Range on thin, well-drained soils developed from the massive exposed limestone formations. These arid bunchgrass habitat types are analagous to those discussed for the Wind River District.

Dry Festuca idahoensis dominated grassland habitat types occur as patches in the forested zone on the thin, sandy soils developed from the crystalline

rocks forming the core of the mountain range.

Alpine grasslands are not common on the Lander Ranger District due to the glacially scoured nature of the substrate at high elevations. Soil development above timberline on these sites is minimal.

Agropyron spicatum Series

The Agropyron spicatum series consists of two grassland habitat types dominated by Agropyron spicatum: the Agropyron spicatum/Poa sandbergii habitat type and the Agropyron spicatum/Agropyron smithii habitat type. These habitat types occur most frequently below lower treeline on the Shoshone National Forest. The Agropyron spicatum/Poa sandbergii habitat type is one of the most widespread grassland habitat types on the northern two Districts but does not occur on the south end of the Forest. Although the Agropyron spicatum/Agropyron smithii habitat type is more widely distributed across the whole Forest, it is less common than the AGSP/POSA habitat type, found most frequently on the limestone formations flanking the Wind River Mountains on the Lander Ranger District. The Agropyron spicatum series is least well represented on the Greybull Ranger District because of the lack of low elevation sites.

Management Implications

Mueggler and Stewart's (1980) work in Montana shows grazing relationships for the species in this series.

The major forage species that declines with grazing is Agropyron spicatum. Artemisia frigida, A. tridentata ssp. wyomingensis, Bouteloua gracilis, Chrysothamnus nauseosus, Guitteirizia sarothrae, and Stipa comata are the other principal species in this series which will increase with overgrazing. Mueggler (1972a) found that a decrease in flower stalk numbers is a more sensitive indicator of vigor decline for this grass than either herbage production or leaf and flower stalk lengths. The most crucial period of use for this grass appears to be after the date when substantial regrowth is

impossible, yet before the plant matures, or about the flowering growth stage (Blaisdell and Pechanec, 1949). At this time stored foods in the roots are low and the plant is unable to produce regrowth because soil moisture is usually limiting. Heavy utilization and lack of regrowth leaves the plant without the means for producing carbohydrates to build up the root reserves. Wilson, et al (1966) found that Agropyron spicatum was most sensitive to clipping when in the boot stage of floral development. Lack of adequate stock water may limit use during the summer and early fall periods.

Management of the habitat types in this series should be directed specifically at Agropyron spicatum. It is both the major forage producer and is most sensitive to abusive grazing. The average stubble height at the end of the grazing season is often used as an indicator of proper use. Mueggler (1972a) found that 50 percent weight removal just before full emergence of inflorescence caused a 50 percent reduction in total weight and 95 percent reduction in flower stalk numbers the following growing season. When competition from surrounding vegetation was reduced by clipping, the vigor loss in Agropyron spicatum was neither as immediate nor as great but was still substantial. Less than 50 percent removal, perhaps no more than 30 percent, is necessary if this species is grazed during the peak of growth. McLean and Marchards (1968) indicate that grazing Agropyron spicatum in the spring should not occur until the grass is at least 4 inches (10 cm.) high. They state that root reserves of this grass are minimal when the tops are 7 inches (18 cm.) high. Consequently, early spring grazing must be terminated in time to permit additional growth and storage of food reserves in the roots. Utilization may be as much as 50 or 60 percent removal, or even greater, if grazed

after Agropyron spicatum has cured in late summer or fall. McIlvanie (1942) found that maximum carbohydrates were stored as root reserves about two months after appearance of the flower stalks. Late season grazing, therefore, should not seriously harm the potential for overwintering and growth initiation the following year. If an Agropyron spicatum dominated range is in poor condition, grazing should be deferred until fall or early winter to permit the plants to regain vigor.

Various studies have shown a number of flower stalks to be a sensitive indicator of vigor in Agropyron spicatum (Blaisdell and Pechanec, 1949; Mueggler, 1972a). However, further studies (Mueggler, 1975) revealed that maximum lengths of flower stalks may actually be a more reliable indicator of initial vigor loss than numbers. Evaluation of vigor requires comparison with protected plants of normal vigor such as those in exclosures because both numbers and lengths of flower stalks vary greatly between years because of weather. Once the vigor of Agropyron spicatum is lowered, recovery can be very slow. Mueggler (1975) concluded that moderately low vigor Agropyron spicatum in a Festuca idahoensis/Agropyron spicatum habitat type may require at least six years of protection to recover fully; complete recovery of very low vigor plants can take more than eight years of protection. Recovery of low vigor plants could, however, be accelerated through reduction in competition from other plants, especially forbs and shrubs. Complete protection or rest may not be as advantageous to recovery of low vigor Agropyron spicatum plants as treatments to reduce shrubs and/or forb cover, or use by grazers which prefer forbs and shrubs equally to or more than grasses.

The following listing of species and their response to overgrazing in the Agropyron spicatum series was developed from Mueggler and Stewart's (1980) comparison of differentially grazed stands and from reviewing appropriate literature:

Decreasers	Increasers	Invaders
Agropyron spicatum	Antennaria spp.	Bromus tectorum
Eurotia lanata	Artemisia frigida	Cirsium vulgare
Oryzopsos hymendoides	Artemisia tridentata	Psoralea lanceolata
Potenilla sp.	Bouteloua gracilis	Taraxicum officinale
Stipa viridula	Carex sp. (dryland)	Tragopogon dubius
	Chrysopsis villosa	
	Chrysothamnus nauseosus	
	Chrysothamnus viscidiflorus	
	Erigeron filifolius	
	Galium boreale	
	Grindelia squarrosa	
	Gutierrezia sarothrae	
	Lesquerella alpina	
	Lupinus sp.	
	Poa sandbergii	
	Sphaeralcea coccinea	
	Stipa comata	

Agropyron smithii, Agropyron dasystachyum, Koeleria cristata, Poa fendleriana, and Phlox hoodii are often prominent species in the Agropyron series. However, Mueggler and Stewart (1980) did not generalize on their response to grazing because of extreme inconsistency.

Agropyron spicatum/Poa sandergii h.t.

(AGSP/POSA h.t.)

Distribution and Environment.--The AGSP/POSA habitat type is a major one on the arid, low elevation rangelands of the Clarks Fork and Wapiti Ranger Districts. Usually it occurs at elevations between 3,000 and 6,000 feet (900 and 1800 m). It can be found on any exposure and on gentle to very steep slopes. The type occurs on loamy soils derived from a wide variety of parent materials. It is considered a moderately arid type, falling within the 14 to 20 inch (36 to 56 cm) precipitation zone. The STCO phase is also frequently encountered in the lower elevational ranges of the Shoshone National Forest. This habitat type represents the most xeric sites both in the AGSP series, and the grassland habitat types as a whole, on the Shoshone National Forest.

Large areas of the AGSP/POSA habitat type alone are rarely found on the Shoshone National Forest. It generally occurs as units (or patches) in mosaics with various other habitat types,both non-forest and forest. At lower elevations on both the Clarks Fork and Wapiti Ranger Districts this habitat type is most often found associated with shrubland habitat types of the Artemisia series with the AGSP/POSA habitat types representing the sites with shallower soils and harsher environmental conditions. In the forested zone it is usually associated with the more xeric habitat types of the Pinus flexilis series of the Pseudotsuga menziesii series on the south and west exposures of ridgetops.

Vegetative Composition.--This grassland habitat type is clearly dominated by Agropyron spicatum. Poa sandbergii and Koeleria cristata are constant

species of secondary importance. Neither rhizomatous Agropyrons nor Bouteloua gracilis are important. The Stipa comata phase is delineated where Stipa comata shares dominance with Agropyron spicatum. The habitat type has a wide variety of forbs which sometimes comprise 30 to 40 percent canopy cover, yet no one forb constantly shares dominance with Agropyron spicatum. As with the other habitat types within the Agropyron spicatum series, Artemisia frigida and Gutierrezia sarothrae are the most prevalent low shrubs. Medium shrubs such as Chrysothamnus nauseosus, C. viscidiflorus, and Artemisia tridentata ssp. wyomingensis are sometimes present but do not form a major part of the undisturbed community. In disturbed communities such as on the Shoshone National Forest, these species form a more important part of the community.

Mueggler and Stewart (1980) propose that in western Montana good condition range in the AGSP/POSA habitat type will probably produce between 300 and 500 lbs/a (336 to 672 kg/ha) total air-dry vegetation. This correlates with AGSP/POSA habitat type sites on the Shoshone National Forest. Approximately 70 to 80 percent of this will consist of graminoids intermediate to desirable in palatability. However, if Stipa comata is abundant, value for mid-season grazing will be reduced because the desirability of this species decreases as it cures.

Changes with Grazing.--General reactions of species to overgrazing in the Agropyron spicatum series are discussed in the introduction to the Agropyron spicatum series. Under heavy cattle or horse grazing, Agropyron spicatum is the principal forage species to decrease; while Koeleria cristata, Poa fendleriana, and P. sandbergii are the principal forage species to increase. Artemisia frigida, A. tridentata ssp.

wyomingensis, Chrysothamnus nauseous, C. viscidiflorus, and Guitierrezia sarothrae will increase with continuing overuse. These shrubs may eventually dominate overused ranges of this grassland habitat type.

Stipa comata will increase initially with a decline in the more palatable species, but it too may decline with continued heavy use. Psoralea lanceolata is often a conspicuous invader in the AGSP/POSA habitat type. Houston (1976) shows that grasslands similar to the AGSP/POSA habitat type may change character completely under prolonged heavy spring-summer grazing pressure, becoming Artemisia tridentata ssp. wyomingensis shrublands. Under fall-winter wildlife use only, these habitat types recovered their original species composition, due to heavy browse use of A. tridentata ssp. wyomingensis.

Range Management.--Livestock and wildlife management in the AGSP/POSA habitat type should be keyed primarily to the grazing sensitivity of Agropyron spicatum, as discussed in the Agropyron spicatum series introduction.

Agropyron spicatum/Agropyron smithii h.t.

(AGSP/AGSM h.t.)

Distribution and Environment. --On the northern Districts of the Shoshone National Forest this habitat type is found at elevations between 4,000 and 6,500 feet (1200 and 1950 m), on flat to gently sloping landforms. The AGSP/AGSM habitat type is moderately arid, occurring within the 12 to 18 inch (30 to 45 cm) precipitation zone.

This habitat type, though not a commonly occurring one, is widely distributed, found on four of the five Ranger Districts. On the Clarks Fork Ranger District, it occurs solely on the nearly flat glacial deposits of Riddle Flat and adjacent lower gulches in Sunlight Basin. Minor areas of the Wapiti Ranger District represent this type including localities with shallow soils on limestone outcrops of Logan Mountain and low elevation sites in the arid rangelands of the South Fork Valley. On both the Wind River and Lander Ranger Districts shallow soils on exposed limestone formations and windswept sites characterize the AGSP/AGSM habitat type.

Vegetative Composition. --A definite grassland aspect, the dominance of Agropyron spicatum and the abundance of rhizomatous wheatgrasses (Agropyron smithii and/or Agropyron dasystachyum), characterize the AGSP/AGSM habitat type. Other important grasses include Koeleria cristata, Stipa comata, either Poa sandbergii or Poa cusickii, and Hesperochloa kingii. The low shrubs Artemisia frigida and Gutierrezia sarothrae are usually present and may be abundant. Taller shrubs are only occasional in the climax community except Tetradymia canescens. However, the Chrysothamnus spp. may dominate following prolonged severe disturbance. Chrysopsis villosa, Phlox hoodii, Sphaeralcea coccinea and Tragopogon dubius are the most constant and conspicuous forbs.

Productivity. --According to Mueggler and Stewart's (1980) work in Montana, productivity in this habitat type varies more between years than between stands. Differences in total biomass between stands averaged about 20 percent over a 3-year period. Differences between years attributable to weather amounted to 54 percent in one stand and 67 percent in another. Typical productivity values for extreme stands are:

Average Production in Air-Dry Lbs/A[1/]

	Least Productive Stand	Most Productive Stand
	Stand A	Stand B
Graminoids	488	742
Forbs	191	60
Shrubs	2	1
Total	681	803

1/ Multiply by 1.12 for kg/ha

More than two-thirds of the biomass consists of grasses and sedges. Agropyron spicatum is the major forage producer. Other important forage species include Stipa comata, Agropyron smithii and/or Agropyron dasystachyum, Koeleria cristata, and Poa cusickii.

Although numerous species of forbs may be present, they do not contribute very much to forage production because they usually are neither abundant nor palatable. Artemisia frigida is often abundant, but is only fairly palatable.

Though this habitat type represents arid sites, it is more productive than the AGSP/POSA habitat type.

Changes With Grazing. --Expected reactions of plant species to abusive grazing within the Agropyron spicatum series are covered in the introduction to the Series. Generally, Agropyron spicatum is the principal decreaser within the AGSP/AGSM habitat type. Agropyron smithii and Agropyron dasystachyum--two rhizomatous wheatgrasses--and Stipa comata usually increase as Agropyron spicatum decreases with heavy grazing. They too, however, will decrease with continued heavy grazing. Artemisia frigida, Gutierrezia sarothrae, and Chrysopsis villosa are the principal species that increase with overgrazing. Seemingly, Phlox hoodii should increase also because of its low, matty growth form and lack of palatability, but it responds erratically. Mueggler and Stewart (1980) expect a substantial increase in Opuntia polyacantha, Artemisia tridentata ssp. wyomingensis, and Chrysothamnus spp. in this type if overgrazing persists.

Range Management. --The AGSP/AGSM habitat type is more suitable for use by cattle and horses than it is for sheep. Palatable grasses are abundant, while palatable forbs are scarce.

Season of use is important as continuing spring and early summer grazing will damage Agropyron spicatum, one of the primary forage producers. The other two primary forage producers, A. smithii and A. dasystachyum, are better able to withstand both early season grazing and heavy use, because of their rhizomatous growth form.

If Agropyron spicatum declines, the rhizomatous wheatgrasses usually increase. Forage production thus tends to be maintained. However, if abusive grazing

continues, the rhizomatous wheatgrasses also will suffer, along with total forage production. Everson (1966) suggests that utilization of Agropyron smithii should not exceed a 4 inch (10 cm) stubble height to maintain good vigor. In one case, moderate continuous grazing over a 34-year period did not appreciably harm Agropyron smithii (Rogler, 1951). Buwai and Trlica (1977), however, propose a rest-rotation grazing system for such semiarid ranges to insure that grazed plants such as Agropyron smithii receive rest following grazing during critical growth periods.

Festuca idahoensis Series

The Festuca idahoensis series is composed of those grassland habitat types dominated by F. idahoensis and (at higher elevations) F. ovina. These habitat types comprise most of the acreage of grasslands in the montane zone of the Shoshone National Forest.

Four habitat types in the Festuca idahoensis series are found on the Shoshone National Forest: the F. idahoensis/Agropyron spicatum habitat type, the F. idahoensis/A. smithii habitat type, the F. idahoensis/A. caninum habitat type, and the F. idahoensis/Deschampsia caespitosa habitat type. All of these habitat types occur in the montane or forested zone and characterize sites where trees cannot survive due to limiting environmental conditions. Two habitat types are widely distributed across the Forest while the other two are uncommon with limited distributions.

The FEID/AGSM habitat type is restricted to limestone substrates at middle elevations. As such it is found only where resistant limestone formations are exposed on the Clarks Fork, Wind River, and Lander Ranger Districts.

The FEID/DECA habitat type is a subalpine habitat type representing meadow sites with gentle topography. Although it is a minor habitat type over much of the Forest, it comprises the major portion of an extensive mosaic of subalpine rangeland habitat types in the Union Pass area of the Wind River Ranger District.

The remaining two Festuca idahoensis habitat types are two of the more important rangeland habitat types occurring on the Forest. Its frequency

and pattern of occurrence makes the FEID/AGSP habitat type important while the high productivity of the FEID/AGCA habitat type makes this habitat type a key one. The FEID/AGSP habitat type is widely distributed, characterizing the montane bald-type grasslands common in the Absaroka and Wind River Mountains. These dry grasslands are scattered throughout the forested zone on south and west-facing slopes, ridgetops, and other sites too arid for tree reproduction. The FEID/AGCA habitat type in contrast represents mountain meadow sites on gentle topography where environmental conditions preclude shrub and/or tree dominance.

Range Management.-- Grazing relationships for the species in the series have been developed by Mueggler and Stewart (1980) from their research and extensive literature surveys. Festuca idahoensis, Agropyron spicatum, and A. caninum are the principal species which decrease under grazing pressure in this series. Although the literature suggests that Carex obtusata, Antennaria rosea, Astragalus miser and Phlox multiflora increase with grazing in this series, Mueggler and Stewart's data indicated the opposite, so they did not assign these four species to either category. Astragalus miser, Antennaria spp., and Phlox multiflora, however, appear to increase under heavy grazing in the Festuca idahoensis habitat types on the Shoshone National Forest. Some forbs, such as Lupinus spp., may increase under cattle use but decrease under sheep or summer wildlife use. Summarized below is a listing of species in the Festuca idahoensis series according to general response to grazing. This list was developed from Mueggler and Stewart's (1980) data on differentially grazed paired stands and from information contained in the literature.

Decreasers	Increasers	Invaders
Agoseris glauca	Achillea millefolium	Bromus tectorum
Agropyron caninum	Artemisia frigida	Cirsium spp.
Agropyron spicatum	Artemisia tridentata (ssp. vaseyana)	Poa pratensis
Aster integrifolius	Campanula rotundifolia	Taraxicum officinale
Bromus anamolis	Carex spp. (dryland)	Tragopogon dubius
B. ciliatus	Cerastium arvense	
Crepis spp.	Chrysopsis villosa	
Erigeron caespitosus	Chrysothamnus nauseosus	
Festuca idahoensis	Danthonia intermedia	
Geranium viscosissimum	Danthonia unispicata	
Hesperochloa kingii	Erigeron compositus	
Poa ampla	Erigeron filifolius	
Potentilla gracilis	Gaura coccinea	
Stipa virdidula	Geum triflorum	
Vicia americana	Gutierrezia sarothrae	
	Koeleria cristata	
	Phlox hoodii	
	Poa cusickii	
	Poa sandbergii	
	Potentilla diversifolia	
	Solidago missouriensis	
	Stipa comata	
	Stipa occidentialis	

Festuca idahoensis/Agropyron spicatum h.t.

(FEID/AGSP h.t.)

Distribution and Environment.-- This is perhaps the most frequently encountered mountain grassland habitat type on the Shoshone National Forest, comprising a large portion of the total rangeland acreage. Most of the dry montane meadows, balds, and ridgetops on the Wapiti and Clarks Fork Districts are the FEID/AGSP h.t. The type can be found at elevations ranging from 5,000 to 8,500 feet (1540 to 2644 m). It tends to occur more on northerly exposures at the lower elevations and on southerly exposures at the upper elevations. The Stipa occidentalis phase is a minor one, usually found at the higher elevations. Percent slope is not restrictive. This is a moderately mesic grassland habitat type that occurs primarily within the 13 to 20 inch (35 to 50 cm) precipitation zone.

This habitat type is so common and widely distributed across the Forest that it is hard to characterize its distribution on each Ranger District. No single site is particularily extensive but its cumulative acreage makes this an important rangeland habitat type. Its location on landforms that are snowfree for long periods of the winter makes the type important for big game use but causes the xeric site conditions and consequent low potential forage productivity of the habitat type.

Vegetative Composition.-- Agropyron spicatum is almost always present and usually is an obvious codominant with Festuca idahoensis. Although a wide variety of other graminoids can occur in this type, dryland Carex spp., Koeleria cristata, Poa sandbergii, and either Stipa comata or Stipa occidentalis are the only ones that are usually present and form substantial

canopy cover. The amount of forbs is highly variable, ranging from 10 to 60 percent canopy cover. Achillea millifolium, Antennaria rosea, Arenaria congesta and possibly Phlox hoodii are the forbs that occur most consistently. Lupinus sericeus, if present, can form a major part of the plant community. Medium shrubs such as Chrysothamnus viscidiflorus and Artemisia tridentata may occasionally be present, but they are never abundant unless the type has been severely disturbed.

Over the southern part of its range on the Shoshone National Forest (Greybull Ranger District and south) the vegetative composition of this habitat type shifts somewhat. Agropyron spicatum is either partly or wholly replaced as co-dominant by various dryland Carex spp. such as C. filofolia and C. stenophylla. Festuca idahoensis in this portion of the habitat type is often less robust than in other areas, resembling F.ovina. Lower average productivity and less percent desirable forage produced accompany these floristic changes. Otherwise not much variation in environmental parameters and/or vegetation composition occurs across the wide distribution of this habitat type.

The more moist Stipa occidentalis phase is characterized by conditions where Stipa occidentalis is more frequent and abundant than Stipa comata. Such species as Agropyron caninum, Danthonia intermedia, Geum triflorum, Agoseris glauca, Campanula rotundifolia, Cerastium arvense, Gaillardia aristata, and Galium boreale are more likely to be a prominent part of the vegetation here than in the other portion of the habitat type. This phase is transitional to the more mesic FEID/AGCA habitat type.

Productivity.-- Mueggler and Stewart (1980) selected stands for productivity sampling to span the range in site potential within the type. The best site produced almost twice as much as the poorest site. Production appeared to be greater on the northerly exposures, suggesting that lower insolation and greater moisture availability may be partly responsible for differences in site potential. Production of a stand varied as much as 56 percent over the 3-year period because of yearly weather differences. The extremes in production between the stands Mueggler and Stewart (1980) sampled in this type and between years are:

Average Production in Air-Dry Lbs/A[1/]

	Least Productive Stand A	Most Productive Stand B
Graminoids	271	465
Forbs	385	827
Shrubs	1	0
Total	657	1292

1/ Multiply by 1.12 for kg/ha.

In other studies in southwestern Montana, Mueggler (1972b) found that a stand at the drier end of the FEID/AGSP h.t. produced between 605 and 818 lbs/a (678 and 916 kg/ha) over a five year period; about 60 percent of this production consisted of graminoids. A stand on a more mesic northerly exposure (STOC phase) within this habitat type produced from 724 to 1599 lbs/a (810 to 1790 kg/ha) over a five year period, of which only 26 percent was graminoids. Herbage production fluctuated considerably more between years on the more productive northerly aspects than on the southerly aspects.

The proportion of forbs to graminoids differs appreciably between stands within this habitat type. Overall, however, forbs form a greater proportion of the vegetation in the FEID/AGSP h.t. than in any of the previously described types. They are especially abundant within the relatively mesic Stipa occidentalis phase.

Graminoid production in Mueggler and Stewart's stands in Montana ranged between 35 and 70 percent of the vegetation. Most of these grasses are considered good forage species. Between 30 and 65 percent of the total production consisted of forbs, most of which are fairly low in palatability. The proportion of grasses to forbs in a stand did not change more than about 25 percent because of yearly weather differences. In none of the four stands Mueggler and Stewart (1980) sampled did shrub production exceed 5 percent of the total biomass.

Festuca idahoensis and Agropyron spicatum are the two species which produce the most forage within this habitat type except where dryland Carex spp. replace A. spicatum. Together they usually comprise between 30 and 65 percent of the total air-dry production. Other important forage producers in the Stipa occidentalis phase are Carex petasata and Stipa occidentalis. The most abundant forbs, Achillea millifolium, Phlox hoodii, Cerastium arvense, Lupinus sericeus, Geum triflorum, and Antennaria rosea; are generally poor forage species.

Changes With Grazing.-- Agropyron spicatum and Festuca idahoensis are the principal species that decrease with heavy grazing in this plant association. In some instances, Festuca idahoensis may increase with the reduction of

Agropyron spicatum, but it will eventually decrease with continued heavy use. The principal species that usually increase are Artemisia frigida, dryland Carex spp., Poa sandbergii, Cerastium arvense, and Phlox hoodii. The responses of Lupinus spp. and Koeleria cristata to grazing in this type are variable and defy general categorization.

Where present, Chrysothamnus viscidiflorus and Tetradymia canescens will decrease under elk and deer winter browsing, but will increase under summer grazing by livestock. Prolonged heavy use of the FEID/AGSP habitat type may also encourage a great increase in the abundance of Artemisia tridentata ssp. vaseyana, which under normal conditions does not compete well on this site.

Range Management.-- Although the FEID/AGSP habitat type is perhaps best suited for cattle production, the abundance of forbs, particularly in the Stipa occidentalis phase, makes it acceptable sheep range. At lower elevations the type can be used by livestock in the spring, summer, and fall. Use is usually not possible at mid-elevations until early summer and can continue well into the fall. Use at the highest elevations is generally confined to mid-summer and early fall because of the lag in plant development and likelihood of late spring and early fall snows.

The FEID/AGSP habitat type is widely used by big game animals. Consequently, the resource manager should be alert to potential conflicts between wildlife and livestock. The type is used by elk and deer at the lower elevations as winter range, and by antelope year-round. For example, elk in the Elkhorn Mountains of Montana apparently spend all of their time from January through March in this type, subsisting on a diet of 3/4 dried grasses and

1/4 forbs (Stevens, 1966). At intermediate elevations, the type is important spring-fall range, and at the highest elevations summer range for elk and deer. Big game commonly migrate upward in the spring through this habitat type following the melting snow line to graze on fresh green herbage. Fall snow storms reverse the migration to lower elevations where they winter. Stevens (1966) therefore concluded that two potential conflicts exist in this type: one between summer and fall use by cattle and fall-winter-spring use by elk; and one in summer use of the type by both elk and sheep because of the high proportion of forbs in the summer diets of both. Certain sites at moderately high elevations are utilized by Bighorn sheep (such as the Whiskey Mountain herd) and Rocky Mountain goats as winter range.

Festuca idahoensis/*Agropyron smithii* h.t.

(FEID/AGSM h.t.)

Distribution and Environment.-- On the Shoshone National Forest, this habitat type is found in the montane zone on exposed limestone formations flanking mountain ranges of the Clarks Fork, Wind River, and Lander Ranger Districts. It usually occurs on relatively gentle slopes (less than 15 percent) between 5,000 and 8,000 feet (1500 and 2400 m). Soils are fairly deep and derived from the underlying calcareous substrate. The soil is usually well covered by vegetation. In stands sampled the amount of bare soil ranged from 1 to 8 percent and the amount of soil covered by rock ranged from 1 to 18 percent.

This habitat type is not a common one due to the infrequent occurrence on the Shoshone National Forest of gently to moderately dipping limestone substrates in the montane zone. Where it does occur however, extensive acreages are represented, such as Bald Ridge on the Clarks Fork Ranger District, Spring Mountain on the Wind River Ranger District, and on uptilted limestone blocks flanking the Wind River Range on both the Wind River and Lander Ranger Districts.

Vegetative Composition.-- All habitat types within the *Festuca idahoensis* series are characterized as grasslands where *Festuca idahoensis* is one of the dominant graminoids. The FEID/AGSM h.t. is differentiated from the other habitat types in the series by the presence and often abundance of rhizomatous wheatgrasses (*Agropyron smithii* and/or *Agropyron dasystachyum*), and the absence or scarcity (less than 5 percent canopy cover)

of Agropyron spicatum. Grasses are usually more abundant than either forbs or shrubs. Poa cusickii is often conspicuous and is associated with or replaces Poa sandbergii. Koeleria cristata and Hesperochloa kingii are also prominent grasses in this habitat type. Phlox hoodii, Gaillardia aristata, Antennaria rosea, and Achillea millefolium are usually the most prominent forbs. Shrubs, if present, are usually scattered; Artemisia frigida is the only shrub with high constancy.

Productivity.-- Mueggler and Stewart (1980) found that stands selected to span the range of site potential within the FEID/AGSM h.t. exhibited an 80 percent difference in total production. Even greater variation in annual production can be caused by yearly weather differences. Over a period of three consecutive years, one stand produced 110 percent more herbage in the high year than in the low year. The extremes in production between the stands they sampled in Montana and a measure of the variation between years are:

	Average Production in Air-Dry Lbs/A[1/]	
	Least Productive Stand	Most Productive Stand
Graminoids	354	1118
Forbs	344	168
Shrubs	21	6
Total	719	1292

1/ Multiply by 1.12 for kg/ha

Grasses usually comprise about 80 percent of the total production in this type. However, as shown in the above data for the less productive stand,

forbs can be abundant, but this is an exception. Shrubs are only a minor component. Festuca idahoensis and Agropyron smithii and/or Agropyron dasystachyum are the primary forage producers. Usually Festuca idahoensis makes up 30 to 60 percent of the total biomass and the rhizomatous wheatgrasses make up from 10 to 60 percent. Koeleria cristata, Poa cusickii, and Poa sandbergii, also desirable forage species, occur in lesser quantities. Forbs and shrubs usually consist of such low value forage species as Phlox hoodii, Gaillardia aristata, Achillea millifolium, and Artemisia frigida.

Changes with Grazing.-- Festuca idahoensis is the principal forage species that declines with overgrazing in this habitat type. Although Agropyron smithii is very palatable, neither it nor Agropyron dasystachyum apparently respond consistently to grazing-- in some cases they decrease and in others increase. The ability to reproduce vegetatively allowed by their rhizomatous growth habit causes this inconsistent response. The principal species that increase are Artemisia frigida, Poa sandbergii, Poa cusickii, and possibly Koeleria cristata. A generalized listing of the response of species in the Festuca idahoensis series is given in the introduction to the Series.

Range Management.-- The occurrence of much of this habitat type at lower elevations makes it suitable for grazing in either the spring, summer, or fall. The type is best suited for use by cattle and horses because of the predominantly graminoid vegetation.

Unfortunately, management information that can be correlated specifically

to the less common habitat types such as the FEID/AGSP habitat type is lacking in the literature. Consequently, management guides must be inferred from the known requirements and reactions of the major species as they occur in other better understood habitat types. Festuca idahoensis, the rhizomatious wheatgrasses (Agropyron smithii and Agropyron dasystachyum), and the Poa spp. are the major forage producers in the FEID/AGSM habitat type. Information discussed in the FEID/AGSP habitat type and AGSP/AGSM habitat type sections regarding management of these species is applicable in this habitat type as well.

Festuca idahoensis/*Agropyron caninum* h.t.

(FEID/AGCA h.t.)

Distribution and Environment.-- The FEID/AGCA habitat type is found at moderate to high elevations throughout the montane zone of the Shoshone National Forest. It commonly occurs on rather gentle slopes at elevations ranging from 6,500 to 8,600 feet (2,000 to 2,600 m), most frequently at the higher elevations. The FEID/AGCA habitat type is of intermediate importance as far as acreages are concerned, but is a very productive habitat type because it characterizes mesic sites. It falls within the 18 to 30 inch (45 to 75 cm) precipitation zone; however, the relatively high elevations create low potential evapotranspiration and a short growing season. The *Geranium viscossissimum* phase of this habitat type tends to occur on easterly and northerly exposures. This is not a major habitat type on the Shoshone National Forest but is important due to its high forage productivity.

The FEID/AGCA habitat type represents sites traditionally identified as grassland mountain meadows. These meadows are often a mosaic of drier sites, represented by the FEID/AGSP habitat type; and mesic sites, represented by the FEID/AGCA habitat type.

Although this habitat type usually occurs as part of a mosaic with other rangeland habitat types and rarely covers large contiguous areas, the only two occurrences of the *Festuca scabrella* phase on the Shoshone National Forest are exceptional. Both the grasslands at the south end of Bald Ridge on the Clarks Fork Ranger District and the Monument Hill grasslands on the Wapiti Ranger District represent extensive areas dominated solely by FEID/AGCA habitat type grasslands.

The Festuca scabrella phase identified from two locations on the Clarks Fork and Wapiti Ranger Districts is delineated by the occurrence and co-dominance of Festuca scabrella with F. idahoensis. This phase is not a major one on the Clarks Fork and Wapiti Ranger Districts, occupying less than 3 percent of the rangeland area. The FESC phase is found on a variety of aspects on rather gentle slopes (0 to 15 percent) at elevations ranging from 7,250 to 8,600 feet (2210 to 2620 m). This phase appears to be restricted to till soils derived mainly from limestone substrates.

Festuca scabrella was first collected in northwest Wyoming in the summer of 1978 and appears to occupy a substantially different niche than that occupied by Festuca scabrella in Montana. These locations probably represent an outlier or relict population of Festuca scabrella.

Vegetation Composition.-- Although the FEID/AGCA habitat type has a predominantly grassland aspect it contains a high proportion of forbs. Festuca idahoensis is usually the dominant grass. Agropyron caninum is consistently present and is the dominant wheatgrass. Other important graminoids in this type include Stipa occidentalis, Koeleria cristata, Danthonia intermedia, Carex petasata, Bromus anamolis, and B. ciliatus. Usually abundant forbs include Geum triflorum, Potentilla gracilis, Achillea millefolium, Agoseris glauca, Campanula rotundifolia, and Arenaria congesta. Delphinium bicolor (little larkspur) is a common spring forb at lower elevations which should be considered in range management. Shrubs are very scarce except for an occasional Artemisia tridentata ssp. vaseyana. At higher altitudes (above 8,000 feet) this type usually contains such succulent grasses and forbs as Melica bulbosa, M. spectabilis, Claytonia lanceolata, and C. megarhiza, which provide important grizzly bear food (Mealey, 1975).

The more mesic Geranium viscosissimum phase is characterized by the abundance of Geranium viscosissimum and Potentilla gracilis, and the presence of either Bromus carinatus or Bromus anomalis, and Poa juncifolia. This phase also usually contains Delphinium occidentale (tall Larkspur) which should be considered in management for domestic stock.

The Festuca scabrella phase is dominated by Festuca scabrella with canopy cover ranging from 5 to 25 percent. Festuca idahoensis is the co-dominant with coverages sometimes exceeding that of Festuca scabrella. Total graminoid cover ranges from 25 to 60 percent, forb cover ranges from 20 to 50 percent. Forb coverages are not as high as in the Geranium viscosissimum phase.

Productivity.-- This is one of the most productive grassland habitat types encountered on the Forest. Only the DECA/CAREX meadows are likely to produce more. Three stands in Montana which Mueggler and Stewart selected to span the range in productivity within the type differed as much as 30 percent in total production. During a three-year period, however, one stand produced over twice as much herbage in the high year than in the low year because of yearly weather difference. Generally, the Geranium viscosissimum phase produces more total plant biomass than the rest of the plant association. Extremes in production are:

Average Production in Air-Dry Lbs/A[1/]

	Least Productive Stand	Most Productive Stand
Graminoids	368	907
Forbs	825	765
Shrubs	0	0
Total	1193	1672

1/ Multiply by 1.12 for kg/ha

Mueggler and Stewart's production figures are somewhat lower than those obtained in other studies of this type of vegetation in Montana and Wyoming. For example, Branson and Lommasson (1958) recorded total air-dry weights of 2100 and 2300 lbs/a (2350 and 2575 kg/ha) on two sites in Montana, while Mueggler (1967) obtained total production varying from 1615 to 2622 lbs/a (1809 to 2937 kg/ha) over a 3-year period (1963-1965) on a luxuriant FEID/AGCA grassland. In the Big Horn Mountains, Hurd (1961) obtained total production figures ranging from 1120 to 3311 lbs/a (1254 to 3708 kg/ha) in vegetation similar to that of this habitat type.

The proportion of graminoids in the stands Mueggler and Stewart (1980) measured for production ranged from 30 to 60 percent. Generally, forbs formed a greater proportion of the total in those years when overall production was high than when it was low, or forbs appeared more responsive than the grasses to a good growing season. Shrubs are rare. A wide variety of grasses and sedges, most of which are relatively good forage species, occur in this type. Seldom does a single species predominate. Ordinarily, Festuca idahoensis is the most abundant grass, but it seldom constitutes more than 20 percent of the total production. Other important forage species may be Bromus carinatus, Agropyron caninum, Koeleria cristata, and possibly Stipa occidentalis and Danthonia intermedia. A wide variety of forbs usually occur in this type. Most of these are considered lower in palatability than the grasses. Because of this, their contribution to usable forage is probably less than suggested by their total biomass.

Changes With Grazing.-- Heavy grazing of the FEID/AGCA habitat type will result in a pronounced decrease of such forage producers as Agropyron

caninum, Bromus carinatus, Bromus anomalis, and Festuca idahoensis. Not enough information is available on Festuca scabrella to predict how it will react in this part of its range. Possibly Geranium viscosissimum, Lupinus spp. and Potentilla gracilis will also decrease if heavily grazed by sheep. The species most likely to increase under cattle and horse use are Danthonia intermedia, Frasera speciosa, Geum triflorum, Lupinus sp. Solidago missouriensis, Polygonum bistortoides, and Achillea millefolium. The Carices; Carex petasata, Carex stenophylla, and Carex obtusata, also will increase. Substantial increases in Artemisia tridentata ssp. vaseyana may occur in this habitat type if it is continually abused. The principal invading species are Cirsium species. A general listing of the reaction of species to grazing in the Festuca idahoensis series is given in the Series introduction and discussion for the FEID/AGSP habitat type.

Range Management.-- The abundance and variety of forbs in the FEID/AGCA habitat type, particularly in the Geranium viscosissimum phase, make it one of the better types for summer grazing by sheep. It is also suitable as summer cattle range because of the abundance of graminoids. Use is generally limited to mid-summer because of the late development of the vegetation at these higher elevations and the probability of late spring and early fall storms. Elk, deer, and even moose frequent the type summer long. Consequently, local conflicts may exist in coordinating livestock and wildlife use.

Management of the type as cattle range sould be keyed to the reaction of the major perennial forage grasses, Agropyron caninum, Bromus spp., and Festuca idahoensis. When used as sheep range, the manager should consider

the reaction of the major forbs as well. Mueggler (1967) determined that the three major forage grasses and two frequently abundant forbs (Aster integrifolius and Potentilla gracilis) are most sensitive to herbage removal. Usually these plants are most harmed when grazed during the period from early flowering to seed ripening. Julander (1968) found that Geranium viscosissimum was unable to withstand repeated removal of 50 percent of its herbage during late flowering. This sensitive stage of growth is just prior to and during the early part of the period when plants store carbohydrates in roots and crowns (McCarty and Price, 1942). Repeated heavy use at this time can be detrimental.

However, the relatively short summer period when these areas are accessible to livestock severely limits grazing alternatives on this very productive type. A rotation system of grazing should be considered to help achieve proper use given the short season of use for this habitat type.

Additional information on management of the Festuca idahoensis series that is applicable to this habitat type is discussed in the FEID/AGSP habitat type section.

Festuca idahoensis/Deschampsia caespitosa h.t.

(FEID/DECA h.t.)

Distribution and Environment.-- This is a subalpine meadow type found on relatively gentle slopes at elevations between about 8,000 and 10,000 feet (2500 and 3000 m). It represents intermediate sites between the true alpine habitat types and the more widespread FEID/AGCA habitat types. The loamy soils are derived from a wide variety of parent materials. The soil surface is usually well protected by vegetation and litter.

The FEID/DECA habitat type is not a major grassland habitat type, but does occur on three of the Ranger Districts. Minor areas are present at upper timberline-alpine interfaces of the Beartooth Plateau on the Clarks Fork Ranger District and the north facing slopes of Carter Mountain on the Wapiti Ranger District. The Union Pass area of the Wind River Ranger District supports the largest areas of the FEID/DECA habitat type, where it forms the dominant part of the grassland/shrubland habitat type mosaic.

Vegetation Composition.-- Deschampsia caespitosa and Festuca idahoensis are the only constant and generally the most productive graminoids in this high elevation grassland. Other graminoids commonly present in lesser quantities are Agropyron caninum, Phelum alpinum, Luzula spicata, Danthonia intermedia, and Carex scirpoidea. Forbs as a class are generally abundant, averaging 50 percent canopy cover. Polygonum bistortoides, Potentilla diversifolia, and Trifolium spp. are the most constant forbs although Lupinus argenteus and Achillea millefolium are sometimes abundant. Shrubby species are usually absent. At the highest elevations, Festuca idahoensis may be associated with or replaced by Festuca ovina.

Productivity.-- Productivity data are not available for this habitat type. However, the vegetation appears structurally similar to that in the FEID/AGCA habitat type, with a somewhat lower and denser cover. Total production probably ranges between 1,200 and 1,500 lbs/a (1344 and 1680 kg/ha), equally divided between graminoids and forbs. Carex spp. of only fair palatability may be common forage producers. Festuca idahoensis and Deschampsia caespitosa are the most consistently important forage producers. Agropyron caninum, Stipa occidentalis, and Danthonia intermedia may be productive in some locations. A wide variety of forbs exist, most of which are, at best, only moderately palatable. Shrubs are seldom encountered.

Changes With Grazing.-- The principal species that are likely to decrease with overgrazing in this habitat type are Deschampsia caespitosa, Agropyron caninum, Phleum alpinum, and Festuca idahoensis. Principal species that will probably increase are Danthonia intermedia, Potentilla diversifolia, Geum triflorum, and Polygonum bistortoides. The response of other species to overgrazing in the FEID/DECA habitat type is covered in the discussion of the Festuca idahoensis series.

Range Management.-- Since this habitat type occurs only at high elevations livestock use is restricted to a relatively short summer grazing season. The type appears equally suited for use by cattle and sheep. Usually the type is restricted by topo-edaphic conditions at these high elevations and does not cover very large areas.

Deschampsia caespitosa/Carex spp. h.t.

(DECA/CAR h.t.)

Distribution and Environment.-- The DECA/CAR habitat type represents wet meadows found on poorly-drained, high elevation valley bottoms and other flat areas commonly flooded by late spring and early summer snow melt. This type is usually found at elevations between 6,000 and 9,000 feet (1800 and 2700 m). The soils are deep and poorly aerated, with water standing on the surface at least during the early part of the growing season. The soil surface is ordinarily completely covered by vegetation and litter. This is the most moist montane grassland habitat type found on the Shoshone National Forest. It is widely distributed across the Forest, occurring on every Ranger District. Although this type occurs in patches of very few acres apiece and does not cover large total acreages, its high productivity and riparian nature make it very important.

Good examples of this habitat type include the Muddy Creek Meadows, Clarks Fork Ranger District; the spring/seep area of Sawmill Park, Wapiti Ranger District; the wet meadows of Upper Salt Creek, Wind River Ranger District; and wet area of Snow Creek on the Lander Ranger District.

Vegetation Composition.-- Deschampsia caespitosa is always abundant in this type. No other single species is consistently present; however, members of the Carex genera are always present. Danthonia intermedia and Phleum alpinum as well as species of Agrostis and Juncus are usually present. Agropyron and Festuca species are conspicuously absent. The most commonly occurring forbs are Potentilla gracilis, Antennaria spp., and Polygonum bistortoides.

for meadows on the Shoshone National Forest. They indicate that good to excellent condition is typified by a dense stand of Deschampsia caespitosa. Condition is only fair when this dominant grass becomes patchy and interspersed with areas of such showy forbs as Senecio spp., Erigeron speciosus, and Potentilla spp.. The drier, better-drained portions of the meadows decline most rapidly. On moderately dry sites, Poa pratensis and Agrostis spp. begin to increase as conditions decline. Koeleria cristata, Danthonia intermedia, and Bromus spp. increase on the driest sites. On poor condition meadows, Deschampsia caespitosa will be found only as small patches. The wet areas are dominated by Carex spp. and Juncus spp. and the drier sites by a cover of such forbs as Antennaria spp., Potentilla diversifolia, Agoseris glauca, and Gentiana affinis. This latter condition is representative of many DECA/CAR meadows at lower elevations on the Shoshone National Forest.

Most often, range habitat types in mountainous topography are not large enough to be managed as single units. The use of any one type, therefore, must be coordinated with requirements of adjacent types included within the allotment pasture. The DECA/CAR habitat type can be both a management problem as well as a useful grazing indicator in such situations. Cattle tend to concentrate on and graze these meadows heavily before moving out to drier types. Consequently, the meadow bottoms are usually heavily grazed before the adjacent slopes are grazed appreciably. Usually this habitat type does not occur as large enough areas to manage as separate units. Herding or riding stock would help to ensure proper utilization of the habitat type. Overuse and trampling of the meadows may cause stream erosion

At higher elevations Salix spp. may comprise up to 40 percent cover in this habitat type.

Productivity.-- The DECA/CAR meadows are potentially the most productive grasslands on the Shoshone National Forest. Ample soil moisture available during a good part of the growing season and relatively deep soils contribute to lush growth. Mueggler and Stewart (1980) measured production on only one stand in this type and obtained 2595 lbs/a (2906 kg/ha) dry matter. Ninety-one percent of this consisted of graminoids, of which 26 percent was Deschampsia caespitosa and 56 percent of various species of Carex. Judging from these data, about 50 percent of the production will usually consist of palatable grasses, about 30 percent of moderately palatable sedges and rushes, and about 20 percent of a mixture of forbs generally low in palatability.

Changes With Grazing.-- Although paired stand data is not available, species reaction to grazing in the DECA/CAR habitat type can be predicted from field observation. The principal species that probably decrease with heavy grazing are Deschampsia caespitosa, Phleum alpinum, and Agrostis spp.. Those that will probably increase are Juncus spp., Danthonia intermedia, Poa juncifolia, Antennaria spp., Achillea millefolium, Polygonum bistortoides, and Potentilla diversifolia. Both Poa pratensis and Taraxicum officinale are potential invaders. The various species of Carex very likely will tend to increase. Lower elevation areas of DECA/CAR habitat type on the Shoshone National Forest have high coverages of Poa pratense and Taraxicum officinale, indicating overuse.

Range Management.-- These meadows although usually small are among the best summer range for cattle in this area. Suitability for sheep is not as great because of the predominantly graminoid vegetation. Although the meadows may be accessible to livestock fairly early in the summer, use should be discouraged until the soils are no longer saturated with water. Pickford and Reid (1942) indicate that use of such meadows before the soils are firm enough to withstand trampling can be very damaging. Since elk and deer and other wildlife commonly frequent these lush mountain meadows, care must be taken to avoid use conflicts between livestock and wildlife. The prevalence of succulent vegetation in this type makes it especially important in providing feed for wildlife, including grizzly bears (Mealey, 1975). In dry years, wildlife--domestic stock use conflicts could be heightened as both wildlife and livestock will tend to concentrate late season use on these areas of lush vegetation.

From studies of similar meadows in eastern Oregon and Washington, Reid and Pickford (1946) concluded that proper use of Deschampsia caespitosa can be as high as 55 percent, and the associated forage species can be utilized to about 50 percent. Pond (1961) observed that clipping similar mountain meadows in northern Wyoming to a 3 inch (7.6 cm) height every two weeks harmed production but not plant density. More intensive clipping reduced density as well. However, he observed that clipping to a 1 inch (2.5 cm) height at the end of a growing season had little effect on the native meadow plants.

The condition classes of Deschampsia caespitosa meadows in eastern Oregon and Washington described by Reid and Pickford (1946) are generally appropriate

and channeling. This in turn may lower water tables, altering soil moisture relations and reducing productivity.

At higher elevations on the Shoshone National Forest (above 8,000 feet), extensive degradation of this type (hummocking and sod breaking) appears to allow invasion of coniferous forest types through lowering of surface water tables. Where serious degradation of this important type occurs, fencing of these wet areas might be considered.

Alpine Series

Although this project does not include classification of alpine vegetation due to the complexity in environments, a rough classification system for these sites can be devised using the literature and field observations. Johnson and Billings (1962) paper on the alpine vegetation of the Beartooth Plateau forms the basis for this classification system. These sites are described as community types rather than as habitat types in order to indicate that site potentials may not be constant over time because soils may be slowly modified by the vegetation produced on the site. Although these units do not fit the standard definition of habitat types many of the same types of information on site condition and responses to management can be developed from these community types as from habitat types.

Alpine areas are unique because of the severity and complexity of their environmental conditions. Constantly windswept sites with thin soils, high evapotranspiration, and severe temperature fluctuations exist adjacent to sites representing entirely different conditions; boggy sites sheltered by winter snow accumulation with saturated soils. In between these extremes of drought versus saturation, several intermediate environments may or may not exist all within a few yards (meters) of each other in any particular area, depending on topography, substrate, and climate.

Five community types can be identified in the Alpine series, although some are more widespread than others. Detailed description of the distributions of these community types are not available since mapping and describing these sites is not an objective of this project. Fieldwork was done in a few alpine areas, however, consequently these areas will be

emphasized. The five community types in order from most xeric to most hydric are: the Cushion Plant, the Geum rossii Turf, the Festuca idahoensis/Trisetum spicatum, the Deschampsia caespitosa Meadow, and the Carex spp. Bog.

The Beartooth Plateau (Clarks Fork Ranger District) is not only the largest contiguous area of alpine vegetation on the Forest, but also the most complex and diverse. It is the only area where all five community types are found. An excellent description of the vegetation and environments of the Beartooth Plateau is found in Johnson and Billings (1962).

Extensive areas of alpine vegetation representing the largest total acres of alpine rangeland on any one Ranger District occur on the Greybull Ranger District from Carter Mountain southward. These alpine rangelands appear to be more xeric and consequently less diverse than those of the Beartooth Plateau. The three drier community types dominate the alpine areas of the Greybull Ranger District, the Cushion Plant, the Geum rossii Turf, and the FEID/TRSP.

Alpine vegetation in the remainder of the Absaroka Mountains is similar in character but not extent to that of the Greybull Ranger District. Alpine areas in the Wind River Mountains were not studied.

A few small but important alpine areas on the Forest do not fit the general pattern of the five community types described. Although these areas are small relative to the total alpine acreage, their importance stems from

their potential to support rare plant species. Wherever calcareous substrates such as limestones, dolomites, or limey shales occur in the alpine, plant species must develop unusual adaptations in order to survive and compete successfully in such unique environments.

These sites are represented by Beartooth and Clay Buttes on the Clarks Fork Ranger District, and by Whiskey Mountain and adjacent high limestone peaks on the Wind River Ranger District. Rare plant species (including three species originally proposed for inclusion into the Federal Register of Threatened and Endangered Species) have been identified on all of these sites and further study will undoubtedly yield more rare species.

Distribution and Environment.-- This community type is one of the three major alpine community types on the Shoshone National Forest. It is found on every Ranger District and is probably represented on every alpine area of the Forest. It occurs on gentle to steep slopes and ridgetops, usually on the most windswept sites. Soils are poorly developed, rocky to almost nonexistent.

Vegetation Composition and Management Implications.-- This community type is characterized by the predominance of one form of plants rather than any one species. Mat and cushion forming forbs such as Eritrichum elongatum, Phlox caespitosa, Potentilla diversifolia, Silene acaulis, Trifolium nanum, T. haydeni, and T. parryi dominate. Scattered graminoids such as Trisetum spicatum and Festuca idahoensis (ovina) may be present but do not form an important part of the community. Plant spacing is widespread with bare rock or soil in between plants. The generally low, ground-hugging stature of the plants reflects the extremely harsh windswept nature of this site. Productivity on these sites has not been measured, but is obviously quite low. Recovery time after disturbance is undoubtedly the longest of any of the alpine community types due to the severity of the site conditions.

Geum rossii Turf c.t.

(Geum turf c.t.)

Distribution and Environment.-- The Geum rossii turf community type is another one of the three major alpine community types on the Shoshone National Forest, occurring on every Ranger District. Although specific site data is not available, sites are less harsh than those of the Cushion Plant community type.

Vegetation Composition and Management Implications.-- A predominance of Geum rossii characterizes this community type. Other forbs such as those listed for the Cushion Plant community type are also important in the Geum turf community type as well as: Mertensia alpina, Polemonium viscosissimum and Polygonum bistortoides. Although graminoids comprise a greater portion of this community than in the Cushion Plant community type, forbs still dominate. Important graminoids include: Carex drummondiana, Festuca idahoensis (ovina), Kobresia bellardi, Luzula spicata, Poa sp., and Trisetum spicatum.

Because this community type represents less harsh site conditions than that of the Cushion Plant community type, it is more productive and therefore better suited to grazing use. The season of use will be short however, due to climatic conditions. Sheep use would be more desirable than cattle use due to the predominance of forbs in this community.

Festuca idahoensis (ovina)/Trisetum spicatum c.t.

(FEID/TRSP c.t.)

Distribution and Environment.-- The FEID/TRSP community type is the most widespread alpine community type on the Forest, with the largest aerial extent of the alpine community types. It occurs on gentle to moderate slopes on all exposures. Sites may be sheltered enough to be snow covered for long periods in winter. Soil development is better than that of either the Cushion Plant community type or the Geum Turf community type.

Vegetation Composition and Management Implications.-- Graminoids and forbs comprise equal portions in this varied community unlike either the Cushion Plant community type or the Geum Turf community type. Festuca idahoensis (ovina) and Trisetum spicatum are the dominant graminoids, with Carex scopulorum, Calamagrostis purpurescens, Kobresia bellardi, Luzula spicata, and Poa spp. constant associates. Forbs such as Artemisia scopulorum, Erigeron simplex, Geum rossii, Mertensia alpina, Polemonium viscosisimum, and Polygonum bistortoides are common, but no single forb dominates, unlike the Geum Turf community type.

This community type is the most important of the Alpine series because of its frequency and large aerial extent. The balanced composition of a variety of graminoids and forbs qualifies this community type for a variety of grazing management schemes. Use is limited, however, by the short snow-free season and low potential productivity.

Recovery of this community type from disturbance is relatively slow as

with all of the Alpine series, necessitating careful management. Severe disturbance of any of the community types in the Alpine series may result in wind erosion of the soils, drastically reducing both productivity and recovery potentials.

Deschampsia caespitosa Meadow c.t.

(DECA Meadow c.t.)

Distribution and Environment.-- This minor alpine community type has only been noted from the Beartooth Plateau, Clarks Fork Ranger District although small patches may occur in other alpine areas on the Forest. Well drained soils of gentle lower slopes, basins, and other sheltered sites develop this community type. Due to its topographic position, this community type is protected from the severest alpine conditions by winter snow cover. Vegetative and litter cover is high reflecting the fairly high productivity of this type.

Although small areas of the DECA Meadow community type may occur in other alpine areas of the Forest, its best development is on the diverse alpine environment of the Beartooth Plateau.

Vegetation Composition and Management Implications.-- This is a true alpine grassland, dominated by Carex scopulorum, Deschampsia caespitosa, and to a lesser extent, Festuca idahoensis (ovina) and Poa sp. No forbs are particularly representative of this community type although Artemisia scopulorum, Caltha leptosepala, Geum rossii, and Polygonum bistortoides usually occur.

Recovery rates following severe disturbance of this community type are probably the fastest of any of the alpine community types but wind-caused soil erosion can result in drastically reduced site potential. Because this cover type is not widespread, it is not an important one on the

Forest as a whole. It contributes greatly to the rangeland resource where it does occur however, due to its high productivity and high proportion of graminoids.

Carex scopulorum Bog c.t.

(*Carex* Bog c.t.)

Distribution and Environment.-- The *Carex* bog community type is a minor one, noted only from the diverse alpine environment of the Beartooth Plateau, Clarks Fork Ranger District, although small areas of this community type may occur in other alpine areas on the Shoshone National Forest. Shallow basins with sources of summer meltwater support the development of this marshy community type. Soils are high in organic matter and often remain saturated throughout the growing season.

Vegetation Composition and Management Implications.-- As the name implies, this community type is dominated by *Carex scopulorum* along with other *Carex* spp.. Forbs and graminoids other than *Carices* are infrequent in this community type except on small islands or hummocks with well-drained soils representing drier alpine community types.

The fragility of the saturated organic soils in the *Carex* Bog community type make it an undesirable one for grazing use. Damage to the soils through trampling and hummocking could cause erosion, severely reducing production potential, and changing vegetation composition.

SHRUBLAND INTRODUCTION

Approximately half of the rangelands on the Shoshone National Forest are dominated by shrubland habitat types, from the extensive sagelands below lower timberline and in the montane zone, to the occasional dwarf willow communities in the alpine. Artemisia spp. dominate most of these habitat types. Where shrubland and grassland habitat types occur in the same elevational zone, shrubland habitat types represent intermediate sites between grassland and forest habitat types. Shrubland habitat types generally occur on deeper and/or more well developed soils than grassland habitat types. In the montane zone, shrubland habitat types often represent the deeper alluvial soils of valleys and other gentle topography. The Grassland Introduction contains a short discussion on the ecological relations of potential grasslands versus shrublands.

Riparian shrublands are not included in the scope of this project and therefore are not described in this classification. They are, however, extremely important for their values in providing wildlife and fisheries habitat, stream stabilization, and high forage productivity.

Diverse substrates and climatic regimes found on the Shoshone National Forest cause varying distributions of shrubland habitat types over the Forest as a whole. Brief descriptions of shrubland distributions follow.

Clarks Fork Ranger District

The majority of the shrubland habitat types on the Clarks Fork Ranger District are found in the montane zone, either as part of extensive

forest/shrubland/grassland habitat type mosaics of the lower portions of the Beartooth Plateau on granite substrates, or representing smaller areas on alluvial soils in the Absarokas. These shrubland habitat types dominated by Artemisia tridentata ssp. vaseyana are far more extensive on the moderately rolling topography and till soils of the glaciated granitics of the lower Beartooths than on the steeper, dissected topography of the Absaroka Mountains. Arid shrublands found below lower treeline on the Clarks Fork Ranger District are most extensive on the eastern and southern edges of the Beartooth Uplift.

Calcareous soils in the lower elevations of the Clarks Fork Ranger District generally support dwarf sage shrublands dominated by Artemisia nova whereas non-calcareous alluvial soils support A. tridentata habitat types. Minor shrublands occurring on the Clarks Fork Ranger District include the Potentilla fruticosa/Festuca idahoensis habitat type, and a dwarf Salix community type in the alpine of the Beartooth Plateau.

Wapiti Ranger District

Shrubland habitat types of the Wapiti Ranger District are generally dominated by Artemisia species. Arid lower elevation shrublands are best represented in the South Fork and North Fork Valleys on unique landslip/slump-type landforms. These constitute the most extensive areas of low elevation shrublands on the Shoshone National Forest. Alluvial fans in these valleys are dominated by Artemisia tridentata shrublands while calcareous substrates produce A. nova habitat types. Montane zone shrublands dominated by A. tridentata ssp. vaseyana are scattered throughout

the Absaroka Mountains on alluvial deposits or deeper soils of south and west facing slopes. Minor areas of the montane Potentilla fruticosa habitat type occur on subirrigated soils in the Trout Peak area.

Greybull Ranger District

The mid to high elevation position of the Greybull Ranger District precludes development of a great variety of shrublands, therefore a single shrubland habitat type dominated this Ranger District. The Artemisia tridentata ssp. vaseyana/Festuca idahoensis habitat type is found on intermediate sites between grasslands and shrublands throughout the District, often representing sites on alluvial soils of valleys or other depositional areas. A xeric, high elevational phase of the habitat type occurs on south and west facing slopes up to 10,500 feet (3230 m) just below the high plateau surfaces of Carter Mountain, Phelps Mountain, and the Upper Greybull River.

Wind River Ranger District

Shrublands of the Wind River Ranger District are not particularly diverse; the majority representing the Artemisia tridentata ssp. vaseyana/Festuca idahoensis habitat type which dominates montane shrublands throughout the Absaroka Mountains. Distribution of this habitat type in the Absaroka portion of the District follows that described for the more northerly Ranger Districts. Where younger sediments and non-volcanic substrates are found, however, two unique shrublands with very limited ranges occur. Although these two dwarf sage habitat types cover relatively minor areas, they represent unique management situations. Shallow rocky soils and

exposed sites at middle elevations in the East Fork - Button Draw areas support Artemisia arbuscula shrublands. These provide important big game winter range because they remain snowfree for much of the winter. Despite the inherent low productivity and limited aerial extent of this habitat type, these sites receive heavy wildlife browse use. A contrasting set of environmental conditions support A. longiloba shrubland habitat type on shale substrates of the lower Horse and Long Creek areas. Soils under these shrublands have a fine textured layer which interrupts drainage, causing saturation for part of the growing season. This renders these sites subject to extreme degradation from trampling when soils are saturated. The A. longiloba shrublands occur as small patches, part of a mosaic pattern of distribution of shrubland/scattered forest habitat types, making management difficult.

Shrublands on the Lander Ranger District are quite different from those on the remainder of the Forest because of the occurrence of shrub species more common to Utah and the Great Basin area. These species form mixed shrub communities occupying basins and lower slopes on sedimentary formations flanking the southern Wind River Mountains. These communities are dominated by Artemisia tridentata ssp. vaseyana and one or more other shrubs including Purshia tridentata and Symphoricarpos orephilus. Mid and upper slope portions, and steep south and west exposures on the sedimentaries support dwarf sage habitat types dominated by Artemisia tripartata. The southwest corner of the Lander Ranger District (Pine-Willow Allotment area) contains xeric shrublands dominated by Artemisia tridentata subspecies which are similar to the less productive shrublands of the Absaroka Mountains.

Artemisia Series

This series is composed of shrubland habitat types dominated solely by Artemisia species. Mixed shrub communities are in a separate series. This report follows Hironaka and Fosberg's (1978) concept of separating the Artemisia tridentata complex into subspecies and using the subspecies as the basis for habitat types. Seven major species and subspecies of the genus Artemisia have been recognized as indicator shrubs for habitat types on the Shoshone National Forest. Three are subspecies of Artemisia tridentata (Big Sage); A. tridentata ssp. wyomingensis (Wyoming Big Sage), A. tridentata ssp. tridentata (Basin Big Sage), and A. tridentata ssp. vaseyana (Mountain Big Sage). The others are dwarf sages; A. nova (Black Sage), A. arbuscula (Low Sage), A. longiloba, and A. tripartata (Three-tip Sage). One other species. A. cana (Silver Sage), has been recognized on several Districts but does not delineate a distinct habitat type.

Most of the shrublands on the four northern Ranger Districts are dominated solely by Artemisia species. Shrub rangelands on the Lander Ranger District, however, are partially comprised of mixed shrub communities which are discussed in the Mixed Shrub series.

Dwarf sages dominate the harshest shrubland sites--those with soils which impose limitations on plant growth: thin or poorly developed soils which cause droughty conditions, calcareous soils, or soils with claypan layers which impede drainage and root growth. Often these sites occur at lower elevations, but may be found up into the montane zone.

The three subspecies of A. tridentata (Big Sage) cover the majority of

shrubland sites between 4,000 and 9,000 feet (1400 to 2770 m). A. tridentata ssp. wyomingensis (Wyoming Big Sage) occurs at the lower end of this elevation range and as such is only important on the Clarks Fork and Wapiti Ranger Districts although it is found in small amounts on the Lander Ranger District also. A. tridentata ssp. tridentata (Basin Big Sage) is not found in appreciable amounts anywhere on the Forest but does occur on deep alluvial soils at the lowest elevations of the Clarks Fork and Wapiti Ranger Districts. By far the most important shrublands on the Forest are those dominated by A. tridentata ssp. vaseyana (Mountain Big Sage), by virtue of their aerial extent and wide distribution throughout the montane zone above 6,000 feet (1850 m) on all five Ranger Districts.

Percent coverage of Artemisia, especially in less disturbed situations, reflects the amount of available moisture. When moisture is the limiting factor in plant communities, plants will space themselves accordingly, since their root systems compete for available soil water and nutrients. This directly affects the possible density or percent cover. On the Shoshone National Forest the percent cover of dwarf sages will usually range from 5 percent to 20 percent while percent cover of Artemisia tridentata ssp. vaseyana may range from 15 percent to 70 percent, reflecting a great deal more available moisture. The basic relationship between available moisture and plant density also affects the density of understory plants with less potential density, and therefore, less forage production and less management options possible in the drier types.

Artemisia nova/Agropyron spicatum h.t.

(ARNO/AGSP h.t.)

Distribution and Environment.-- The distribution of this habitat type on the Shoshone National Forest is limited to sites on the Wapiti and Clarks Fork Ranger Districts at lower elevations (below 7,000 feet) where soils are shallow and derived from calcareous or granitic substrates. Precipitation is generally below 15 inches annually. On deeper soils, A. tridentata ssp. wyomingensis and/or A. tridentata ssp. tridentata replace Artemisia nova. This habitat type is of intermediate importance in terms of acreage on the Clarks Fork Ranger District and a minor one on the Wapiti Ranger District.

Two areas of the Clarks Fork Ranger District contain the ARNO/AGSP habitat type: the alluvial fans along the Beartooth Face, and the glaciated surface between lower Dead Indian and Sunlight Creeks. In these mosaic site patterns the ARNO/AGSP habitat type occupies intermediate sites between grassland and other shrubland or forest habitat types.

Limestone formations on the lower slopes of Logan Mountain and isolated limestone remnants in the Absaroka Volcanics (such as the lower Horse Creek area of the North Fork) support the ARNO/AGSP habitat type on the Wapiti Ranger District. This habitat type reflects well-drained colluvial soils on these sites with adjacent deeper alluvial soils supporting Artemisia tridentata.

Vegetation Composition.-- Artemisia nova is the dominant shrub species in this habitat type although Artemisia tridentata ssp. wyomingensis is

sometimes present. Agropyron spicatum and Poa sandbergii are the dominant graminoids, with Stipa comata and Oryzopsis hymenoides present in varying amounts. Due to preferential grazing Stipa normally increases while Oryzopsis decreases. Phlox sp. and Oxytropis sp. are constant forbs in this habitat type. Opuntia polycantha occurs on the most xeric sites.

Changes With Grazing.-- A study on winter big game range on the North Fork of the Shoshone River (Horse Creek Big Game Enclosure) indicates that under intense big game winter browse use Artemisia nova cover will decrease. Agropyron spicatum and Oryzopsis hymenoides will also decrease while Stipa comata and Koeleria cristata will increase substantially until grazing pressure becomes so abusive that they too decrease. Forbs such as Chrysopsis villosa and Antennaria microphylla are increasers in this habitat type.

Range Management.-- Due to the shallow soils and harshness of these sites, recovery of depleted range can be slow if Artemisia nova density is so excessive that the community is temporarily closed to the reestablishment of desirable plant species. In such situations, the Artemisia nova overstory must be treated to open up the community for establishment of grass seedlings. However, care must be taken to insure that the vigor of desirable species can be regained. If this step is not taken, desirable forage may remain at low coverage levels due to inherent harsh site conditions.

Although productivity figures are not available for this habitat type,

potential production for the graminoid and forb layers should be similar to that of the AGSP/POSA habitat type. Browse production has not been measured.

Browse shrub availability--due to snowfree periods in winter--and desirability make this an important habitat type for big game use where the ARNO/AGSP habitat type occurs in winter range.

Artemisia longiloba/Agropyron smithii h.t.

(ARLO/AGSM h.t.)

Distribution and Environment.-- This dwarf shrub habitat type covers minor acreages below 8,000 feet (2460 m) on the lower Horse and Long Creek drainages of the Wind River Ranger District. Its distribution in this area is restricted to soils which have a strongly developed claypan layer in the B horizon at depths averaging eight inches (20 cm). The ARLO/AGSM habitat type forms the lesser portion of a shrubland mosaic with the ARTR-V/FEID habitat type in which the ARTR-V/FEID habitat type is associated with more well-drained soils.

Vegetative Composition.-- Artemisia longiloba is the dominant shrub species in this habitat type with coverages of 15 - 30 percent. Agropyron smithii and/or A. dasystachyum are the most common graminoids, with Festuca idahoensis, Koeleria cristata, Poa cusickii, P. fendleriana, and P. sandbergii present in varying amounts. Antennaria sp., Commandra umbellata, Eriogenum umbellatum and Phlox hoodii are consistently present in a rather depauperate forb layer.

Changes with Grazing.-- Agropyron smithii and A. dasystachyum will eventually decrease with heavy grazing pressure, while Koeleria cristata and the Poa spp. will tend to increase. As graminoids decrease, Artemisia longiloba and Guitterizia sarothrae will increase, as will the forbs.

Management Implications.-- The shallow claypan present in the soils of this habitat type restricts drainage and root growth, resulting in low

potential vegetative productivity and limiting use. According to Hironaka and Fosberg (1978) severe trampling damage to the supersaturated soils may occur if these sites are used in the early part of the growing season when snowmelt moisture is abundant. Frost heaving due to the saturated condition of the soils is a potential problem to seedling establishment during the same period.

According to field observations Artemisia longiloba is not an important wildlife browse species although it may be slightly to moderately browsed.

Where soils in this type have been mechanically churned Artemisia tridentata ssp. vaseyana quickly becomes established, outcompeting A. longiloba. Disturbance of the shallow claypan could therefore temporarily improve productivity of these sites.

Artemisia arbuscula/Festuca idahoensis h.t.

(ARAR/FEID h.t.)

Distribution and Environment.-- This dwarf shrub habitat type is restricted to the East Fork and Button Draw areas of the Wind River Ranger District below 8,500 feet (2620 m). Shallow coarse-textured soils developed in place on moderately sloping granite-type substrates along with exposed topographic positions create the xeric conditions which this habitat type represents.

Vegetative Composition.-- Artemisia arbuscula dominates this habitat type although its low stature makes it difficult to recognize on some sites. The graminoid layer is dominated by Festuca idahoensis, and to a lesser extent, Agropyron spicatum. Dryland Carex spp., Koeleria cristata and Poa spp. are also present. Forbs tend to be of the xeric mat plant type including Antennaria spp., Eriogonum ovalifolium, and Phlox hoodii. Total plant coverage is low on these sites due to the harsh conditions. Potential shrub coverage does not exceed 5 - 10 percent, potential graminoid and forb coverages may each reach 15 - 20 percent. Vegetative production is therefore considered to be low, although data are not available for this habitat type.

Changes with Grazing.-- Festuca idahoensis and Agropyron spicatum will undoubtedly be the principal decreasers under heavy summer grazing by cattle or elk, whereas the other graminoids and forbs, especially mat and cushion-type plants, can be expected to function as increasers. Heavy winter use by elk combined with summer grazing use, however, causes

Artemisia arbuscula to act as a decreaser also. Its desirability and availability on these windswept sites cause heavy winter browsy use. A combination of heavy winter use with heavy summer use could have cause the situation which exists around the Button Draw Exclosures, where total vegetative cover has decreased markedly from about 40 percent inside to approximately 10 percent outside the exclosures.

Management Implications.-- Exposed site position makes this habitat type desireable for winter wildlife range due to snowfree winter conditions, even though potential vegetative productivity is low. This site position, however, when combined with the shallow coarse-textured soils causes harsh conditions making recovery after disturbance slow.

Artemisia tripartata/Festuca idahoensis h.t.

(ARTA/FEID h.t.)

Distribution and Environment.-- The Artemisia tripartata/Festuca idahoensis habitat type is restricted to the Lander Ranger District, occurring mainly on steep upper and/or south and west exposures on the sedimentary strata flanking the Wind River Ranger District. Soils are developed from shales and colluvial limestone material from overlying limestone formations. A distinct pattern of horizontal vegetation zones often occurs on these shale slopes with the ARTA/FEID habitat type representing the steep upper slope position. Below on the convex lower slopes, the PUTR/FEID habitat type and the ARTR-V/FEID habitat type occupy more favorable sites. The back slopes of Limestone Mountain, Ed Young Mountain, and the other upthrust limestone blocks flanking the Wind River Range all represent this pattern.

Vegetative Composition.-- Artemisia tripartata constitutes the shrub layer of the ARTA/FEID habitat type. Festuca idahoensis dominates the graminoid layer, but is accompanied by Agropyron spicatum, dryland Carex spp. (including elynoides) and Poa fendleriana. Other graminoids are present but species vary somewhat from site to site. Common forbs from the diverse forb layer include: Antennaria microphylla, Astragalus spp., Cerastium arvense, Lupinus spp. and Phlox hoodii.

Percent vegetative coverages and production figures are not available for this habitat type, but are probably similar to those of the graminoid and forb components of the FEID/AGSP habitat type for the graminoid and forb components. Potential percent coverage for Artemisia tripartata is limited

by available moisture and soil depth and will therefore probably not exceed 5 - 15 percent.

Changes With Grazing.-- Grazing relationships for the graminoid and forb species are undoubtably similar to those discussed for the FEID/AGSP habitat type. Festuca idahoensis and Agropyron spicatum will be the primary decreasers under summer cattle grazing. Artemisia tripartata appears to be slightly to moderately browsed. Combined sheep and wildlife use, however, could cause this dwarf shrub to decrease.

Management Implications.-- Due to the occurrence of the ARTA/FEID habitat type primarily on steep and/or upper slopes, it is not primary cattle range. These site factors combined with its palatable shrub component and relatively diverse forb layer make sheep and/or wildlife use more desirable for the ARTA/FEID habitat type. Topographic position also makes this habitat type useful for winter and/or early season use due to increased solar insulation warming the microclimate of these south and west facing slopes.

Artemisia tridentata ssp. wyomingensis/Agropyron spicatum h.t.

(ARTR-W/AGSP h.t.)

Distribution and Environment.-- Lower elevations from 4,000 to 6,000 feet (1200 - 1800 m) on the Clarks Fork and Wapiti Ranger Districts support the ARTR-W/AGSP habitat type. Minor areas also occur at the southwest edge of the Lander Ranger District. This habitat type is found on gentle to steep slopes with shallow to moderately deep soils formed from a variety of parent materials. Even under good range conditions considerable rock (average 32 percent) and bare soil (average 11 percent) are present on the soil surface. This moderately arid type is restricted primarily to the 12 to 18 inch (30 to 46 cm) precipitation zone.

Alluvial sediments along the Beartooth Face support the ARTR-W/AGSP habitat type in combination with either the AGSP/POSA habitat type or other Artemisia series habitat types. Lower south and west facing slopes of the winter big game range around Sunlight Basin support the only other substantial areas of the ARTR-W/AGSP habitat type on the Clarks Fork Ranger District.

This habitat type comprises part of grassland/shrubland habitat type complexes at lower elevations of the South Fork and North Fork on the Wapiti Ranger District. It is a major one on the low elevation range allotments and the North Fork Big Game Winter Range. Landslip formations and alluvial fans develop mosaics of sites in these areas. Where the ARTR-W/AGSP habitat type occurs with grassland or dwarf sage habitat types, it characterizes sites with deeper soils. In complexes with the ARTR-T/AGSP habitat

type, however, the ARTR-T/AGSP habitat type occupies the deepest soils.

Vegetation Composition.-- Artemisia tridentata ssp. wyomingensis is the obvious dominant shrub in this type, with a canopy cover averaging 15 percent. A. tridentata ssp. tridentata may also be present. Low shrubs, particularly Artemisia frigida and Gutierrezia sarothrae, are usually present. The herbaceous understory is dominated by Agropyron spicatum; other usually conspicuous grasses are Koeleria cristata, Poa sandbergii, and Stipa comata. Though a variety of forbs may be present, they generally are not abundant (1 to 18 percent canopy cover). No single forb species occurs consistently, although Antennaria spp., and Phlox sp. are usually present.

Percent cover of sagebrush in the ARTR-W/AGSP habitat type on pristine sites in Idaho was found by Winward (1977) to range from 14 to 22 percent with a mean of 19 percent. Data collected from non-pristine sites of this habitat type on the Clarks Fork and Wapiti Ranger Districts shows a mean of 20 percent. This indicates that A. tridentata ssp. wyomingensis cover on these Districts does not differ much from that on pristine sites in Idaho. Desirable grass cover in these communities ranged from a trace (less than 1 percent) to 5 percent with a mean of 3 percent indicating both low productivity and generally poor condition of the understory of the sites studied.

Productivity.-- Mueggler and Stewart (1980) measured production over a 3-year period on three relatively undisturbed sites within this habitat type. The sites were selected to span the range in site potential.

Differences in total annual production between sites did not exceed 15 percent, and differences between years attributable to weather did not exceed 25 percent. However, differences between sites and between years for vegetation classes were considerably greater. Half again as much total grass and over four times as much total forbs were produced in one stand than in another. Shrub production was highest where either grass or forb production was low. Over the 3-year period, almost twice as much grass was produced in the high year than in the low year. The extremes in total production between stands and a measure of variability between years are:

Average Production in Air-Dry Lbs/A[1/]

	Least Productive Stand	Most Productive Stand
Graminoids	278	427
Forbs	133	231
Shrubs	328	206
Total	739	864

1/ Multiply by 1.12 for kg/ha.

In the near-pristine stands that Mueggler and Stewart (1980) measured in western Montana, between 40 and 50 percent of the total production was grasses, 7 to 27 percent forbs, and the remainder shrubs. Sites on the Shoshone National Forest show higher percent total forb production and lower percent graminoid production. Agropyron spicatum was the most important forage species, accounting for between 20 and 45 percent of the total vegetation production. Although many species of forbs may be present, they do not contribute much to overall forage production because of low palatability. Artemisia tridentata ssp. wyomingensis accounts for most of the shrub production.

Changes With Grazing.-- According to Mueggler and Stewart (1980), heavy grazing in this habitat type results primarily in a decrease of Agropyron spicatum. Substantial increases can be expected in grazing resistant grasses such as Poa sandbergii, and such unpalatable low shrubs and forbs as Artemisia frigida, Gutierrezia sarothrae, Psoralea lanceolata, and Opuntia polyacantha. Stipa comata will increase initially in this type with excessive grazing. A. tridentata ssp. wyomingensis will only increase substantially in the absence of browse use.

With the original understory depleted or destroyed by abusive domestic stock grazing, the density of sagebrush increases and increaser species dominate the understory. Bromus tectorum is usually the principal invader although according to Hironaka and Fosberg (1978) Bromus will not dominate the understory unless the shrub cover is weakened or destroyed. Hironaka and Fosberg also conclude that even after an area is released from grazing stress, Agropyron spicatum will be slow in reestablishing its former cover because of low viable seed production, low seeding vigor, and slow development.

Range Management.-- The ARTR-W/AGSP habitat type is best suited as early spring and late fall cattle range. Artemisia tridentata ssp. wyomingensis is of low palatability for domestic stock although it may receive light to moderate use, depending upon the amount of understory herbage available. In big game winter range, however, it receives moderate to heavy browse use. Where feasible, a good cover of Agropyron spicatum in amongst the shrubs should be a management goal. Where closed communities occur, grazing management alone will not bring change or noticeable improvement.

The shrub cover will need to be reduced to permit understory species to increase. Drastic reduction of the shrub cover will probably permit weedy annuals such as Salsola kali (Russian thistle), Sisymbrium altissimum (tumble mustard), Descurania pinnata (mustard), and/or Bromus tectorum to fill the vacuum. More gradual reduction in shrub cover would permit the resident perennials to regain vigor and reestablish, particularly Agropyron spicatum and Poa sandbergii. Once established, Artemisia tridentata ssp. wyomingensis competes severely with the herbaceous understory and tends to suppress establishment of new grass plants (Blaisdell, 1949). Dense stands of A. tridentata ssp. wyomingensis may become established even under moderate browse use if grazing pressure on the understory is severe. Total removal of the shrub cover may be required in some cases to reduce competition from this shrub if improvement of overall forage production only is desired.

This habitat type is also important winter range for big game and sage grouse (Hironaka and Fosberg, 1978; Mueggler and Stewart, 1977). A. tridentata ssp. wyomingensis is readily browsed by big game and is an important part of their winter diet. According to studies in Yellowstone National Park (Houston, 1976) and Forest Service studies on the North Fork of the Shoshone River, A. tridentata ssp. wyomingensis may actually decrease under heavy winter browse use by big game in the absence of summer grazing use (Houston, 1976 and Despain, 1978).

Artemisia tridentata ssp. tridentata/Agropyron spicatum h.t.

(ARTR-T/AGSP h.t.)

Distribution and Environment.-- The Artemisia tridentata ssp. tridentata/Agropyron spicatum habitat type occupies areas with deep alluvial soils between 4,000 and 6,000 feet (1200 to 1800 m) on the Wapiti and Clarks Fork Ranger Districts. This includes alluvial fans, swale areas, and many riparian areas. Although the aerial extent of this habitat type is not great, it occurs on the North Fork and South Fork valleys of the Wapiti Ranger District and the Face of the Mountain Allotment on the Clarks Fork Ranger District.

Vegetation Composition.-- Undisturbed ARTR-T/AGSP communities are more productive but otherwise quite similar to the ARTR-W/AGSP habitat type, except that the overstory is dominated by tall (4+ feet) stands of A. tridentata ssp. tridentata. In most stands of this habitat type on the two Ranger Districts, increasers such as Chrysothamnus viscidiflorus and/or C. nauseousus form a sizable portion of the community, as well as invaders such as Bromus tectorum. In some riparian transition zones, Juniperus scopulorum may form a sizable portion of the overstory. Percent cover of sagebrush in ARTR-T/AGSP habitat type on the Shoshone National Forest shows a mean of 23 percent, ranging from 15 percent to 35 percent. Since the sites inhabited by this subspecies have more favorable environmental conditions than those occupied by A. tridentata ssp. wyomingensis, A. tridentata ssp. tridentata sites have the potential for somewhat greater shrub density. Percent cover figures are not available for similar pristine sites in this plant association since it is rarely undisturbed.

Desirable grass cover in the disturbed sites studied ranged from 5 percent to 10 percent with a mean of 8 percent indicating somewhat higher productivity than that of the ARTR-W/AGSP habitat type.

Vegetative production data were not collected for this habitat type. Its productivity should be higher than that of the ARTR-W/AGSP habitat type due to less arid site conditions.

Range Management.-- The management of this habitat type is made difficult because its distribution is often restricted to swales, draws, and narrow riparian areas where animals congregate. Moreover, this type often makes up small areas (especially in swales) spread throughout other types. Since the principal shrub, A. tridentata ssp. tridentata, is relatively unpalatable, it usually increases readily as competition from the more palatable grass species is reduced (Mueggler and Stewart, 1980). One difficulty according to Hironaka and Fosberg (1978) in improving the understory is the widespread occurrence of Bromus tectorum in this habitat type. In such disturbed sites intermediate species such as Poa and/or Stipa are probably the major native grasses able to penetrate before Agropyron spicatum can become fully reestablished. Before the perennial grasses would be able to reestablish in many areas, the A. tridentata ssp. tridentata overstory will need to be reduced.

In some cases, neither partial or total removal of the tall A. tridentata ssp. tridentata is wise if protective cover for livestock and wildlife is desired. The shade and wind protection provided by this Artemisia sub-

species in riparian margins may more than offset the benefits obtained by converting to a perennial grass type by artificial seeding, particularly where the A. tridentata ssp. tridentata is restricted to small areas of draws and swales.

Artemisia tridentata ssp. *vaseyana*/*Festuca idahoensis* h.t.

(ARTR-V/FEID h.t.)

Distribution and Environment.-- The ARTR-V/FEID habitat type occurs throughout the Shoshone National Forest at elevations ranging from 6,000 to 9,500 feet (1800 to 2920 m) on mountain slopes with less than 40 percent slope. This is a moderately mesic shrubland type that occurs within the 16 to 30 inch (40 to 75 cm) precipitation zone. The *Geranium viscosissimum* phase of the type represents sites at the upper end of the precipitation range, often on northerly and easterly exposures above 7,000 feet (2100 m). Normally, the soil surface of these sites is well covered with vegetation and litter. According to Mueggler and Stewart (1980), the *Geranium viscosissimum* phase generally occupies the deeper soils with higher moisture-holding capacities.

The ARTR-V/FEID habitat type and *Geranium viscosissimum* phase are best expressed at higher elevations on the Shoshone National Forest although they may interfinger into drier, low elevation habitat types on north and east facing slopes. This habitat type is less extensive and often less productive on the soils developed from Absaroka volcanic substrates. It is a major one on the Clarks Fork, Greybull, and Wind River Ranger Districts, comprising a great deal of the rangeland in the montane zone.

The ARTR-V/FEID habitat type is one of the major habitat types occurring on the Shoshone National Forest, representing a large part of the rangeland in the montane zone on the Clarks Fork, Wapiti, Greybull, and Wind River Ranger Districts. It is present on the Lander Ranger District but

does not cover a large proportion of the rangelands. Because of its frequency within a wide distribution range, it is difficult to detail its distribution over the Forest as a whole. Therefore only major areas are discussed.

Clarks Fork Ranger District.-- A mosaic of grassland, shrubland and forest habitat types covers the lower portion of the Beartooth Plateau on gently to moderately rolling topography developed on glaciated granitic-type substrates. The ARTR-V/FEID habitat type represents the shrubland portion of this mosaic, sometimes occurring in small patches, and other times comprising large contiguous areas of some of the most productive rangeland on the District.

Alluvial soils in mid elevation valleys throughout the Clarks Fork Ranger District often contain productive sites for the ARTR-V/FEID habitat type, such as the gulches to the southeast of Sunlight Basin. These productive sites represent the GEVI phase.

Wapiti Ranger District.-- Distribution of the ARTR-V/FEID habitat type on the Wapiti Ranger District is scattered, because it often comprises small sites in a dry grassland, shrubland and forest habitat type complex on the dissected topography of the Absaroka Mountains.

The most productive areas of this habitat type on the Wapiti District--the GEVI phase--occur on the younger sedimentary formations on the lower slopes of Carter Mountain and on alluvial soils in the Trout Peak area. Vegetative production and composition of these sites implies more

favorable local climates than those characterized by most of the ARTR-V/FEID sites in the Absaroka Mountains of the Wapiti Ranger District.

An arid upper elevation phase with Artemisia tridentata ssp. vaseyana shrubs stunted to 12 inches (30 cm) or less occurs on the Wapiti District on ridgetops and upper slope positions above 8,500 feet (1800 m). Harsh site conditions somewhat similar to drier alpine environments limit productivity and diversity of this phase.

Greybull Ranger District.-- The ARTR-V/FEID habitat type is the only shrubland habitat type recognized to date on the Greybull Ranger District, representing the majority of all rangelands below the alpine zone. Alluvial soils and south and west facing slopes characterize the ARTR-V/FEID sites on Absaroka volcanics in the montane zone. Below lower timberline this habitat type may be restricted to generally north and west facing landforms. The productive GEVI phase represents the majority of the sites on the District with the exception of those sites occurring around upper treeline, which fall into the high elevation phase discussed for the Wapiti District.

Wind River Ranger District.-- The major areas of the ARTR-V/FEID habitat type on the Wind River Ranger District include: the Alkali Basin area, lower Horse and Long Creeks, and the Warm Spring-Salt Creek-Union Pass areas. Close to half of the rangelands on this District are represented by the ARTR-V/FEID habitat type.

Basin and valley landforms with alluvial soils in the Alkali Basin area

support large acreages of the GEVI phase. These constitute the most productive rangeland on the northeastern portion of the District.

Substantial acreages at lower treeline in the Horse and Long Creek areas are also covered by the ARTR-V/FEID habitat type, mainly the GEVI phase. ARTR-V/FEID sites occur as the major portion of a mosaic with the ARLO/FEID dwarf sage habitat type over a portion of this area.

Lower slopes of valley-side landforms along the Warm Springs Creek drainage represent large contiguous areas of the ARTR-V/FEID habitat type.

Till soils at high elevations around the Salt Creek-Union Pass area support a mosaic of sites. The ARTR-V/FEID habitat type comprises an important part of this grassland/shrubland/forest habitat type complex. These sites are unique because they support a possible Artemisia cana phase where A. cana and A. tridentata ssp. vaseyana co-dominate. High frequency and severity of pocket gopher disturbance appears to be correlated with this particular phase of the ARTR-V/FEID habitat type.

Lander Ranger District.-- Although the ARTR-V/FEID habitat type occurs on the Lander Ranger District, it does not represent a major portion of the shrubland acreages or production. It occurs most extensively with the ARTA/FEID habitat type and a mixed shrub habitat type at lower elevations on sedimentary substrates along the flanks of the Wind River Range. Marginal, unproductive sites of the ARTR-V/FEID habitat type are found on well-drained soils scattered throughout the forested zone at middle to high elevations on the Lander Ranger District.

Vegetation Composition.-- Both Artemisia tridentata ssp. wyomingensis and ssp. vaseyana can be found within this habitat type; however, the latter is the dominant shrub. The type is characterized by the presence of Festuca idahoensis as the dominant understory species to Artemisia tridentata ssp. vaseyana. Agropyron spicatum and Koeleria cristata are constantly associated with Festuca idahoensis. Forbs, especially Geum triflorum, are fairly abundant. The drier portion of this habitat type is likely to contain such shrubs as Chrysothamnus spp. and Artemisia frigida as minor associates.

The more mesic portion of the type, the Geranium viscosissimum phase, is differentiated compositionally by a greater variety of graminoids and abundance of forbs as understory to the Artemisia tridentata ssp. vaseyana overstory. The abundance of such graminoids as Danthonia intermedia, Bromus carinatus, Agropyron caninum, Stipa occidentialis, Stipa richardsoni, and Carex raynoldsii, as well as such forbs as Geranium viscosissimum, Potentilla arguta, P. gracilis, Helianthella uniflora, and Eriogronum umbellatum characterize this phase.

Succulent forbs and grasses including Clatonia lanceolata, C. megarhiza, Melica bulbosa, and M. spectabilis are also present in the GEVI phase. These and other succulent, ephemeral forbs provide important grizzly bear food (Mealey, 1975).

Delphinium occidentale (tall Larkspur) and D. bicolor (low Larkspur) are also usually present in this phase at higher elevations. These should be considered in range management for domestic stock.

Percent cover of sagebrush in the ARTR-V/FEID habitat type on pristine sites in Nevada are found by Winward (1977) to range from 14 to 40 percent with a mean of 27 percent. Data collected from non-pristine sites in this project shows a mean of 36 percent with a range of 15 to 50 percent. This indicates an increase in the sage cover, probably due to grazing use on the sites sampled in this project. Desirable grass cover ranged from 3 to 30 percent with a mean of 15 percent. Sites in the GEVI phase on the Shoshone National Forest showed sagebrush cover from 30 to 60 percent with a mean of 50 percent. Desirable grass cover ranged from 4 to 16 percent with a mean of 10 percent in the stands sampled. The GEVI phase represents the most favorable conditions of the habitat type, allowing a potentially greater cover of sage. Desirable grasses show a lower cover in the GEVI phase due to increased forb cover.

Productivity.-- Mueggler and Stewart (1980) found this type produces considerable more vegetation than the ARTR-T/AGSP habitat type or the ARTR-W/AGSP habitat type. The range in productivity, however, is fairly wide--almost a two-fold difference in yield was found between strands selected to span the range in site potential. They found that total production on the better sites (Geranium viscosissimum phase) comparable to that in the FEID/AGCA habitat type whereas the less productive sites are more comparable to production in the FEID/AGSP habitat type. A 50 percent difference in annual production occurred over a 3-year period because of weather differences. Extremes in production between stands and a measure of variability over a 3-year period are:

	Average Production in Air-Dry Lbs/A[1/]	
	Least Productive Stand	Most Productive Stand
Graminoids	201	609
Forbs	423	691
Shrubs	139	144
Total	763	1444

1/ Multiply by 1.12 for kg/ha

In the Montana stands that Mueggler and Stewart (1980) sampled for production, graminoids constituted 21 to 42 percent, forbs 38 to 56 percent, and shrubs 10 to 41 percent of the biomass. Most of the graminoid production consisted of palatable grasses; only in the Geranium viscosissimum phase did an appreciable amount of sedges occur. Most of the forbs are rather poor forage, with the possible exception of Helianthella uniflora, Geranium viscosissimum and Potentialla arguta, which are found primarily in the Geranium viscosissimum phase. 88 to 98 percent of the shrub production in their Montana stands was Artemisia tridentata ssp. vaseyana. This correlates well with production figures for the Shoshone National Forest, with the exception of the percent contributed by ARTR-V. This probably averages 25 to 50 percent, higher than Mueggler and Stewart's pristine sites.

Changes with Grazing.-- Overgrazing of the type will cause a reduction of such palatable species as Agropyron spicatum and Festuca idahoensis. The unpalatable shrubs Artemisia tridentata ssp. vaseyana and Chrysothamnus viscidiflorus will tend to increase, as will the unpalatable forbs Geum

triflorum, Arenaria congesta, and Archillea millefolium. In the Geranium viscosissimum phase of the type, Agropyron caninum, Bromus carinatus, Carex raynoldsii, and possibly Stipa occidentalis also may decrease appreciably with heavy cattle use. Continued heavy sheep use of this phase may cause a decrease in Helianthella uniflora, Potentilla arguta, Geranium viscosissimum, and possibly Potentialla gracilis. The reaction of other species to overuse will parallel the responses discussed for the Festuca idahoensis series.

Range Management.-- The ARTR-V/FEID habitat type is well suited as late spring to early fall range for all classes of livestock. Use at the higher elevations, however, may be restricted to just the summer season because of late plant development and early fall snows. The Geranium viscosissimum phase is particularly well suited for sheep use because of the rich array of forbs. The type frequently is important wildlife habitat, especially for mule deer and sage grouse.

At higher elevations on the Shoshone National Forest (above 8,000 feet) some sites which appear to represent the ARTR-V/FEID habitat type and its GEVI phase may actually be fire-maintained. At the present time, in the absence of periodic fires, these shrublands appear to be succeeding to forest habitat types. Fire can be used as a management tool in maintaining these seral communities as productive shrublands and grasslands. These communities are successional to the less productive habitat types of the Pseudotsuga menziesii and Abies lasiocarpa series. Potential forage production of these habitat types is only significant in the grassland/shrubland seral stages.

A rest-rotation system of grazing is often preferred for the ARTR-V/FEID type because of the mountainous topography in which drainage bottoms usually receive heavy use while adjacent slopes are under-utilized. The heavy, short-term stocking of a rest-rotation system combined with proper water development and fencing usually improves livestock distribution. Where topography is not a handicap, deferred rotation and season-long systems may suffice.

Many of the management considerations discussed in the FEID/AGSP and FEID/AGCA habitat type sections are also applicable to the ARTR-V/FEID habitat type. The abundance of Artemisia tridentata ssp. vaseyana however, requires that consideration be given to control of this competitive shrub to improve forage production. The treatment of the more mesic sites representing this habitat type, especially those in the GEVI phase, will cause the best response in improved forage production. Returns for amount of time and money invested will be better for these sites than the less productive sites in this habitat type. Recovery of herbaceous layers is necessarily slower where site conditions are less favorable.

Mixed Shrub Series

These shrublands, co-dominated by either Purshia tridentata or Symphoricarpos oreophilus, and Artemisia tridentata ssp. vaseyana, are unique to the Lander Ranger District. This series, though comprised of only two types, the PUTR/FEID habitat type and the ARTR-V/SYOR community type, represents the majority of the browse shrub range on this District.

The PUTR/FEID habitat type is widespread over basins and lower slopes of limestone and shale formations along the eastern edge of the Ranger District. An arid phase occurs intermixed with dry forest habitat types on the Pine-Willow Allotment.

South and west exposures at lower elevations in the vicinity of Sinks Canyon represent the ARTR-V/SYOR community type. Although this type is not widespread the diversity of its browse shrub component makes this community type an important one for wildlife. The ARTR-V/SYOR community type is a shrubland community type rather than a habitat type, representing a broad transition zone between shrubland and forest habitat types. It is discussed here because of its similar management implications to the PUTR/FEID habitat type.

Artemisia tridentata ssp. vaseyana/Symphoricarpos oreophilus c.t.

(ARTR-V/SYOR c.t.)

Distribution and Environment.-- South and west facing lower to mid slopes at lower elevations on the Lander Ranger District support this community type. These communities represent a broad transitional zone between the Pinus flexilis and/or Pseudotsuga menziesii series and shrubland habitat types below lower treeline in the 12 to 18 inch (32 to 46 cm) precipitation zone. This community type occurs in the vicinity of Sinks Canyon on glacial till soils on sedimentary formations.

Vegetation Composition.-- A diverse shrub layer is dominated by Artemisia tridentata ssp. vaseyana and Symphoricarpos oreophilus. Other constant shrubs include Amelanchier alnifolia, Chrysothamnus viscidiflorus, Guitterezia sarothrae, Purshia tridentata and Rosa spp. Principal understory species include Agropyron spicatum, Balsamorhiza sagittata, Festuca idahoensis, Hesperochloa kingii, and Stipa comata.

No productivity information is available for this community type. Productivity should be comparable to that of the less productive sites in the ARTR-V/FEID habitat type. Some of the shrub productivity is contributed by desirable shrub species including Amelanchier alnifolia and Purshia tridentata.

Management Implications.-- Changes with grazing and management implications discussed for the PUTR/FEID habitat type are generally applicable to this community type.

Purshia tridentata/Festuca idahoensis h.t.

(PUTR/FEID h.t.)

Distribution and Environment.-- The PUTR/FEID habitat type occurs on gentle to moderate mountain slopes at elevations between 6,000 and 8,500 feet (1800 - 2400 m) on the Lander Ranger District. Soils derived from limestones and shales on mid to lower slope positions of south and west facing exposures, basins, and alluvial areas support this habitat type. These sites fall within the 15 to 25 inch (38 to 64 cm) precipitation zone. A xeric, less-productive phase is found in the southwest corner of the Lander Ranger District on coarse-textured soils developed from crystalline rocks.

This habitat type represents a large portion of the productive rangeland of the Lander Ranger District, both for domestic livestock and wildlife use. Good examples of this habitat type include most of the shrublands in Ed Young Basin, and shrublands on the lower south and west facing slopes of the Freak Mountains and Fairfield Hill.

Vegetation Composition.-- Purshia tridentata and Artemisia tridentata ssp. vaseyana dominate the shrub layer of this habitat type. Other shrubs are common, including Amelanchier alnifolia, Rosa spp. and Symphoricarpos oreophilus. A variety of graminoids are important in the herbaceous layer such as: Bromus spp., Festuca idahoensis, Hesperochloa kingii, Koeleria cristata, Poa spp., and Stipa occidentalis. Balsamhoriza sagittata and B. incana are the most conspicuous species of a diverse forb component. The diversity of shrub, graminoid and forb species constantly present in this habitat type is an important character-

istic of the type.

The xeric phase of the PUTR/FEID habitat type is considerably less diverse. Artemisia tridentata ssp. vaseyana and Purshia tridentata dominate the shrub layer while other shrub species occur occasionally. Dominant graminoids and forbs are those common to the type which are best adapted to drier conditions of this phase: Antenneria sp., Agropyron spicatum, Eriogonum sp., Festuca idahoensis, Hesperochloa kingii, Koeleria cristata and Poa spp..

Percent canopy coverage of the shrub layer of the PUTR/FEID habitat type from about 20 to 40 percent. Artemisia tridentata ssp. vaseyana contributes much of this with Purshia tridentata varying from 1 percent to 10 percent and other shrubs about 5 percent. Purshia tridentata coverages apparently vary partly due to differential wildlife browse use.

Productivity.-- Productivity data were not collected for the PUTR/FEID habitat type during this project. It is expected to be similar to the lower end of the productivity range of the ARTR-V/FEID habitat type.

Changes with Grazing.-- Purshia tridentata vigor apparently declines under combine domestic stock and wildlife browse use. Vigor of such less common desirable browse species as Amelanchier alnifolia will also decline. Reactions of other species to grazing are discussed in the ARTR-V/FEID habitat type and the Festuca idahoensis series.

Management Implications.-- Range management considerations for domestic stock use are basically similar to those discussed for the ARTR-V/FEID

habitat type and the FEID series, except for possible domestic stock-big game conflicts in browse use of Purshia tridentata and other desirable browse species.

Purshia tridentata is key browse for deer and elk, making proper range management of this habitat type crucial in maintaining important winter range. Mueggler and Stewart (1980) suggest that use during spring and early summer is the most detrimental to P. tridentata vigor as its carbohydrate reserves have been shown by various studies to be at a low from May through mid-July. Thus late summer and/or fall use is preferable in areas where it is desirable to maintain good productivity and reproduction of this species for winter wildlife use.

Browse utilization percentages from several studies cited in Mueggler and Stewart (1980) range from 50 - 65 percent. Moderate browse use may stimulate twig production but continued heavy use will cause a decline in shrub vigor and eventually Purshia tridentata cover will decrease through mortality.

Although past studies have concluded that burning is detrimental to Purshia tridentata vigor (Blaisdell, 1953, and Wright 1971), several burns on the Lander Ranger District do not support this. These projects suggest that controlled burning to reduce Artemisia tridentata ssp. vaseyana coverage may actually increase Purshia tridentata coverage. Apparently if sufficient soil moisture is present at the time of burning, vigorous post-burn sprouting will occur, resulting in increased P. tridentata vigor. Guest (1979) suggests that soil moisture should be greater than 60 percent of field capacity at the time of burning. This

will also protect grass root crowns, ensuring post-burn recovery of desirable graminoids. Burns in Ed Young Basin and Sinks Canyon demonstrate greatly increased Purshia tridentata and desirable grass production resulting in improved range condition.

Other Shrubland Habitat Types

Several minor shrubland habitat types have been encountered on the Forest. The Potentilla fruticosa/Festuca idahoensis habitat type is a semi-riparian habitat type while the other two; the Sarcobatus vermiculatus/Elymus cinereus habitat type and the Rhus trilobata/Agropyron spicatum habitat type, are arid shrublands. None of these habitat types cover extensive areas.

Potentilla fruticosa/Festuca idahoensis h.t.

(POFR/FEID h.t.)

Distribution and Environment.-- This is an uncommon habitat type noted occasionally only on the Clarks Fork and Wapiti Ranger Districts at elevations between 6,500 and 8,600 feet (2000 and 2600 m). It occurs primarily on gentle slopes with moderately deep to very deep soils, associated with abundant subsurface moisture. It is a semi-riparian, mesic montane meadow type; often occurring as a narrow-transition zone between the DECA/CAR and the ARTR-V/FEID habitat types. Normally the soil surface is well covered with vegetation and litter. The type falls within the 20 to 30 inch (50 to 75 cm) precipitation zone.

Vegetation Composition.-- Usually Potentilla fruticosa is the only shrubby species present. In some cases, however, Artemisia tridentata ssp. vaseyana is part of the community. Festuca idahoensis and Danthonia intermedia are the dominant graminoids; Carex obtusata may also be abundant. Achillea millefolium, Arenaria congesta, Campanula rotundifolia, and Potentilla gracilis are the most common forbs. Geum triflorum is sometimes abundant.

Productivity.-- Productivity data is not available for this habitat type. Mueggler and Stewart (1980) suggest that due to the overall similarity between this type and FEID/AGCA habitat type in species composition (with the exception of Potentilla fruticosa) and environment, total production probably is between 1,200 and 1,500 lbs/a (1344 and 1680 kg/ha). The unpalatable Potentilla fruticosa averages less than 10 percent of the vegetation. Approximately 35 percent of the total consists of a mixture

of forbs of generally low palatability. About 60 percent of the total vegetation usually consists of palatable grasses and sedges, the most productive of which are Festuca idahoensis and Danthonia intermedia.

Changes With Grazing.-- The primary species that decrease with overgrazing in the POFR/FEID habitat type are Agropyron caninum, Festuca idahoensis and possibly Carex obtusata. Although the grasses Koeleria cristata and Danthonia intermedia may increase initially, they tend to decrease with continued heavy use. Potentilla fruticosa, the only shrub of consequence, generally increases appreciably as do such forbs as Geum triflorum and Potentilla gracilis. Other species within this type probably respond to grazing as they do in the Festuca idahoensis series.

Range Management.-- Grazing in this type is generally confined to summer months since it usually occurs above 6,500 feet (1981 m) elevation. The type is about as well suited for cattle as it is for sheep. The herbaceous vegetation is expected to respond to grazing much as it does in the FEID/AGCA habitat type. However, the presence of Potentilla fruticosa may complicate management. This shrub fills a role somewhat similar to that of Artemisia tridentata ssp. vaseyana in the ARTR-V/FEID habitat type; it is a relatively unpalatable woody plant that tends to increase with overgrazing. Although it does not appear to compete as aggressively as Artemisia tridentata ssp. vaseyana, it is more difficult to control because of its ability to sprout following burning or spraying.

Sarcobatus vermiculatus/Elymus cinereus h.t.

(SAVE/ELCI h.t.)

Distribution and Environment.-- This habitat type normally occurs at low elevations (between 3,000 and 5,500 feet) on heavily textured, poorly drained saline soils. It is a common habitat type outside the Shoshone National Forest in the Bighorn and Wind River Basins. Isolated patches occasionally extend up onto the Forest. It has been noted on the Wapiti Ranger District in the South Fork Valley.

Vegetation Composition.-- The presence of large clumps of Elymus cinereus characterizes the SAVE/ELCI habitat type. Agropyron smithii is usually abundant beneath the Sarcobatus vermiculatus overstory; such graminoids as Agropyron spicatum, Koeleria cristata and Carex filifolia may also be present. Forbs such as Aster chilensis, Iva axillaris, and Sphaeralcea coccinea, are common. Atriplex canescens may be an important component of this plant association.

Productivity.-- Production data is not available for this habitat type on the Shoshone National Forest. Canopy cover data suggest that at least one-half of the production consists of such palatable grasses as Agropyron smithii and Agropyron spicatum. Neither the shrubs nor forbs are desirable forage, with the exception of Atriplex canescens.

Changes With Grazing.-- Overgrazing of this type commonly causes Agropyron spicatum and Agropyron smithii to decline. If heavy use persists, Koeleria cristata, Elymus cinereus, Atriplex canescens, and possibly Chrysothamnus

viscidiflorus will probably decrease as well. The principal species that increase are Sarcobatus vermiculatus, Gutierrezia sarothrae, and Opuntia polyacantha.

Range Management.-- Sarcobatus vermiculatus is used somewhat by cattle, deer, and antelope in the winter but is poisonous to sheep. Best use of this low elevation type probably is as late fall, winter, and early spring cattle range. Atriplex canescens is considered a good browse species for wildlife. Agropyron smithii and Agropyron spicatum are principal forage producers. Management considerations for these two grasses are discussed in the Agropyron series. Elymus cinereus may also be an important forage producer. Brall, et al (1971) found that early spring grazing is very harmful to this grass. He suggests that no more than 50 percent of the herbage of Elymus cinereus be grazed prior to its boot stage of development, and that spring grazing not take place every year.

Rhus trilobata/Agropyron spicatum h.t.

(RHTR/AGSP h.t.)

Distribution and Environment.-- This minor habitat type occurs in small amounts along the North Fork and South Fork on the Wapiti Ranger District and may also occur in the lower Clarks Fork Canyon. It occurs around 5,500 feet (1650 m) as patches on the convex shoulders and slopes that descend from sedimentary benchlands above the rivers and streams. The soils are typically shallow, rocky and have considerable amounts of rock and bare soil on the surface. This is an arid habitat type, representative of lower elevations.

Productivity.-- Vegetative production data is not available for the RHTR/AGSP habitat type. However, it will probably produce about as much as either the AGSP/POSA habitat type or the AGSP/AGSM habitat type--between 400 and 700 lbs/a (450 and 780 kg/ha). Approximately half of this production will consist of forage grasses, about a third will be shrubs, and the remainder will be forbs. The forbs and shrubs are of little forage value.

Changes With Grazing.-- Heavy summer use of the type by livestock usually causes a decrease in the amount of Agropyron spicatum and Oryzopsis hymenoides, and an increase in Chrysothamnus nauseosus, Opuntia polyacantha, Chrysopsis villosa, and possibly Rhus trilobata.

Range Management.-- The major shrub, Rhus trilobata, is low in palatability for livestock but may receive considerable use by deer in the winter, especially if other browse is limited. The greatest value for livestock

would be for early spring or late fall grazing. Agropyron spicatum is the key forage species for livestock. Management considerations for this grass are discussed in the Agropyron series.

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APPENDICES

APPENDIX 1

Key to

SCIENTIFIC NAMES, COMMON NAMES AND

ABBREVIATIONS

KEY TO

SCIENTIFIC AND COMMON NAMES AND ABBREVIATIONS

GRAMINOIDS-GRASSLIKE

SCIENTIFIC NAMES	COMMON NAMES	ABBREVIATIONS
Agropyron	Wheatgrass	AGR
caninum	Bearded W.	AGCA
dasystachum	Thickspicke W.	AGDA
smithii	Western W.	AGSM
spicatum	Bluebunch W.	AGSP
Agrostis	Bentgrass	AGR[2]
Bouteloua		
gracilus	Blue Grama	BOGR
Bromus	Brome	BRO
anamolis	Nodding B.	BRAN
carinatus	Mountain B.	BRCA
ciliatus	Fringe B.	BRCI
tectorum	Cheatgrass	BRTE
Calamagrostis	Reedgrass	CAL
purpurescens	Purple R.	CAPU
Carex	Sedge	CAR
drummondiana	Drummond's S.	CADR
elynoides	Kobresia-like S.	CAEL
filifolia	Threadleaf S.	CAFI
obtusata		CAOB
petasta	Liddon S.	CAPE
raynoldsii	Raynold S.	CARA
scirpoidea	Beaked S.	CASC$_2$
scopulorum	Rocky Mountain S.	CASC[2]
stenophylla	Thin-leaved S.	CAST
Danthonia	Danthonia	DAN
intermedia	Timber Oatgrass	DAIN
unispicata	Onespike D.	DAUN
Deschampsia		
caespitosa	Tufted Hairgrass	DECA
Elymus		
cinereus	Giant Wildrye	ELCI
Festuca	Fescue	FES
idahoensis	Idaho F.	FEID
ovina	Sheep F.	FEOV
scabrella	Rough F.	FESC

SCIENTIFIC NAMES	COMMON NAMES	ABBREVIATIONS
Hesperochloa		
kingii	Spike Fescue	HEKI
Juncus	Rush	JUN
balticus	Baltic R.	JUBA
drummondii	Drummond's R.	JUDR
Kobresia	Kobresia	
bellardi		KOBE
Koeleria		
cristata	Junegrass	KOCR
Luzula		
spicata	Alpine Woodrush	LUSP
Melica	Melic, Oniongrass	MEL
bulbosa	Oniongrass	MEBU
spectabilis	Purple O.	MESP
Oryzopsis	Ricegrass	ORY
hymenoides	Indian R.	ORHY
Phleum		
alpinum	Alpine T.	PHAL
Poa	Bluegrass	POA
alpina	Alpine B.	POAL
ampla	Big B.	POAM
compressa	Canada B.	POCO
cusickii	Cusick	POCU
fendleriana	Muttongrass	POFE
juncifolia	Alkali B.	POJU
pratensis	Kentucky B.	POPR
sandbergii	Sandberg B.	POSA
Stipa	Needlegrass	STI
comata	Needle and Thread	STCO
occidentalis	Western N.	STOC
richardsonii	Richardson N.	STRI
viridula	Green N.	STVI
Trisetum		
spicatum	Spike T.	TRSP

FORBS

SCIENTIFIC NAMES	COMMON NAMES	ABBREVIATIONS
Achillea millefolium	Yarrow	ACMI
Agoseris glauca	Pale Agoseris	AGGL
Antenneria	Pussy-toes	ANT
dimorpha	Low P.	ANDI
microphylla	Rosy P.	ANMI
parvifolia	Nuttalls P.	ANPA
rosea	Pink P.	ANRO
Areneria congesta	Capitate Sandwort	ARCO
Aster	Aster	AST
chilensis		ASCH
intergrifolius	Thickstemmed A.	ASIN
Astragalus miser	Weedy Milkvetch	ASMI
Balsamahiza		
incana	Hoary Balsamroot	BAIN
sagittata	Arrow-leaf B.	BASA
Caltha leptosepala	Marsh Marigold	CALE
Campanula rotudifolia	Harebell	CARO
Cerastium arvense	Field Chickweed	CEAR
Chrysopsis villosa	Hairy Golden-Aster	CHVI[2]
Cirsium		
scariosum	Elk Thistle	CISC
vulgare	Common T.	CIVU
Claytonia		
lanceolata	Lanceleaf Springbeauty	CLLA
megarhiza	Alpine S.	CLME
Crepis	Hawksbeard	CRE
Delphinium		
bicolor	Low Larkspur	DEBI
occidentale	Tall L.	DEOC
Erigeron	Daisy, Fleabane	ERI
caespitosus	Tufted F.	ERCA
compositus	Cut-leaved D.	ERCO
filifolius	Thread-leaved F.	ERFI
speciosus	Showy F.	ERSP

SCIENTIFIC NAMES	COMMON NAMES	ABBREVIATIONS
Eriogenum umbellatum	Sulfur-Buckwheat	ERUM
Eritrichum nanum	Alpine Forget-me-not	ERNA
Frasera speciosa	Monument Plant	FRSP
Fritillaria atropurpurea	Checker Lily	FRAT
Gaillardia aristata	Gaillardia	GAAR
Galium boreale	Northern Bedstraw	GABO
Gaura coccinea	Scarlet Gaura	GACO
Geranium viscosissimum	Sticky Geranium	GEVI
Geum triflorum	Prairie Smoke	GETR
Grindelia squarrosa	Curleycup Gumweed	GRSQ
Helianthella uniflora	Helanthella	HEUN
Iva axilaris	Poverty-weed	IVAX
Lesquerella alpina	Alpine Bladderpod	LEAL
Lupinus	Lupine	LUP
sericeus	Silky L.	LUSE
Mertensia alpina	Alpine Bluebells	MEAL
Oxytropus	Crazyweed	OXY
bessyi	Bessey's C.	OXBE
lagopus	Rabbitfoot C.	OXLA
sericea	Silky C.	OXSE
Phlox	Phlox	PHL
caespitosa	Mat P.	PHCA
hoodii	Hood's P.	PHHO
multiflora	Many-flowered P.	PHMU
Polemonium viscosissimum	Sky Pilot, Skunkweed	POVI
Polygonum bistortoides	American Bistort	POBI
Potentilla	Cinquefoil	POT
arguta	Glandular C.	POAR
diversifolia	Diverse-leaved C.	PODI
gracilis	Cinquefoil	POGR

SCIENTIFIC NAMES	COMMON NAMES	ABBREVIATIONS
Psoralea lanceolata	Lance-leaf Scruf-pea	PSLA
Salsola kali	Tumbleweed	SAKA
Silene acaulis	Moss Campion	SIAL
Solidago missouriensis	Missouri Goldenrod	SOMI
Sphaeralcea coccinea	Red Globe-mallow	SPCO
Taraxacum officinale	Dandelion	TAOF
Tragopagon dubius	Goatsbeard	TRDU
Trifolium	Clover	TRI
haydeni	Hayden's C.	TRHA
nanum	Dwarf C.	TRNA
parryi	Parry's C.	TRPA

SHRUBS AND TREES

SCIENTIFIC NAMES	COMMON NAMES	ABBREVIATIONS
Abies		
lasiocarpa	Subalpine Fir	ABLA
Amelanchier	Serviceberry	AME
alnifolia	Saskatoon S.	AMAL
Artemisia	Sagebrush	ART
arbuscula	Low S.	ARAR
cana	Silver S.	ARCA
frigida	Fringed S.	ARFR
longiloba	Longleaf S.	ARLO
nova	Black S.	ARNO
tridentata	Big S.	ARTR
tridentata	Basin Big S.	ARTR-T
vaseyana	Mountain Big S.	ARTR-V
wyomingensis	Wyoming Big S.	ARTR-W
triparta	Three-tip S.	ARTR
Atriplex		
canescens	Fourwing S.	ARCA
Chrysothamnus	Rabbitbrush	CHR
nauseosus	Rubber R.	CHNA
viscidiflorus	Douglas R.	CHVI
Eurotia		
lanata	Winterfat	EULA
Guitterezia		
sarothrae	Broom Snakeweed	GUSA
Juniperus	Juniper	JUN
communis	Common J.	JUCO
scopulorum	Rocky Mountain J.	JUSC
Opuntia	Prickleypear	OPU
polycantha	Plains P.	OPPU
Potentilla		
fruticosa	Shrubby Cinquefoil	POFR
Pseudotsuga		
menziesii	Douglas-fir	PSME
Purshia		
tridentata	Bitterbrush	PUTR
Rhus		
trilobata	Skunkbrush	RHTR

SCIENTIFIC NAMES	COMMON NAMES	ABBREVIATIONS
Rosa	Rose	ROS
Salix	Willow	SAL
Sarcobatus vermiculatus	Greasewood	SAVE
Symphoricarpus oreophilus	Mountain Snowberry	SYOR
Yucca glauca	Small Soapweed	YUGL

APPENDIX 2

KEY TO *ARTEMISIA* SPECIES

Key to *Artemisia* Species

Eight species and subspecies of sagebrush occur on the Shoshone National Forest. Three of these are subspecies of *Artemisia tridentata* (Big Sage) and the other five are separate species; *A. nova* (Black Sage), *A. arbuscula* (Low Sage), *A. longiloba* (Longleaf Sage), *A. tripartata* (Three-tip Sage:, and *A. cana* (Silver Sage). The three subspecies of *A. tridentata* are ssp. *wyomingensis* (Wyoming Big Sage), ssp. *tridentata* (Basin Big Sage) and ssp. *vaseyana* (Mountain Big Sage). All of these species and subspecies are indicators for shrubland habitat types except for *A. cana*. A taxonomic key and description of the species and subspecies excerpted from Winward and Tisdale (1977), and Winward (1980), follows.

Key to *Artemisia* Species

Identification of Big Sagebrush.

From Winward and Tisdale (1977) and Winward (1980)

Three important features of the big sagebrush group must be recognized for identification purposes:

1. Leaves from the flowering branches are not always reliable for taxonomic separation.

2. Leaves of the vegetative shoots are of two types; ephemeral or persistent. Ephemeral leaves are larger, often irregularly lobed, and found on outer clusters. They are among the earliest to develop and are shed as the season advances. Persistent leaves are typically three-lobed and overwinter on all big sagebrush taxa.

3. Leaf and growth form characteristics are most easily distinguished during the flowering through seed stages.

Key to *Artemisia* (Section *tridentatae*)

The key is based on persistent (overwintering) leaves.

1. Leaves entire 2

    2. Leaves silver-grey, plants from lower to mid elevations along drainages of Wapiti and Clarks Fork Ranger Districts . . . . . *A. cana* ssp. *bolanderi* (p.137)

    2. Leaves green-grey, plants along stream bottoms at meadow edges at mid to high elevations, Wind River Ranger District. . . . . *A. cana* ssp. *viscidula* (p.137)

1. Leaves divided or lobed 3

    2. Mature shrubs less than 6 dm (2 feet) tall. . 4

        4. Leaves divided (lobe length less than 3 times lob width). 5

            5. Mature shrubs less than 4 dm, plants on shallow, well drained soils, East Fork - Button Draw area, Wind River Ranger District . . . . . *A. arbuscula* (p.136)

5. Mature shrubs to 6 dm, plants on arid sites mid to high elevations, Lander Ranger District. . . . . A. tripartata (p.143)

4. Leaves lobed (lobe length greater than 3 times lobe width)*. 6

6. Leaves sticky, dotted with whitish or brown glands, plants of lower to mid elevations on calcareous substrates, Wapiti and Clarks Fork Ranger Districts. . . . . A. nova (p.139)

6. Not as above, plats of pure dwarf shrublands intermixed with pure Mountain Big Sage shrublands, mid elevations, Wind River Ranger District . . A. longiloba (p.138)

3. Mature shrubs taller than 6 dm (2 ft.). . . . 7

7. Uneven topped shrubs, flower stalks arise throughout crown. 8

8. Mature plants greater than 10 dm (40 in.) in height, leaves strap-like, plants

*For plants above 2615 m (8500 feet) in the Absaroka Mountains, see A. tridentata ssp. vaseyana. These plants may be wind-shrubbed to less than 3 dm (12 inches) in height at high elevations.

at lower elevations, Clarks Fork and Wapiti Ranger Districts . . . . . A. tridentata spp. tridentata (p.140)

8. Mature plants less than 10 dm (40 in.) in height, leaves bell-shaped, plants at lower - mid elevations, Clarks Fork, Wapiti, and Lander Ranger Districts. . . . . A. tridentata ssp. wyomingensis (p.142)

7. Even-topped shrubs, flower stalks arise from upper crown and extend above foliage, leaf margins straight, plants of mid - high elevations, all Ranger Districts . . . . . A. tridentata ssp. vaseyana (p.141)

Artemisia arbuscula Nuttall (Low Sagebrush).

Low Sagebrush is a dwarf shrub which grows from 1-4 dm (4 - 16 inches) tall. Its leaves are small, ranging from 5-15 mm long with three and sometimes up to five lobes. Unlike black sage, low sage does not have black glands on the leaf and twig surfaces.

Low Sage grows on shallow, well-drained soils. On the Shoshone National Forest, it is found on the East Fork - Button Draw area of the Wind River Ranger District.

Low Sage is heavily browsed where it occurs on the Shoshone National Forest. It may provide important winter browse for elk.

Artemisia cana Pursh (Silver Sage).

Silver Sage is a medium shrub from 6 to 10 dm (24 - 40 inches) tall. It is easily distinguished from other sage species by its entire silver-grey leaves. Two subspecies occur on the Shoshone National Forest and although neither are indicator species for shrubland habitats, they have distinct characteristics important to sage management.

Bolander Silver Sage (ssp. bolanderi), a subspecies characteristic of arid lower elevations, extends up onto the Wapiti and Clarks Fork Ranger Districts. This subspecies is found on alluvial soils along drainages up to 2150 m (7,000 feet). It is not common but where it occurs it is intermixed with Wyoming Big Sage and Mountain Big Sage. This subspecies is a vigorous sprouter, a characteristic which makes mechanical or chemical reduction of shrub cover difficult. It is, however, a desirable browse shrub for both domestic sheep and mule deer. Control of Bolander Silver Sage by browse use is therefore a management alternative.

The other subspecies, Mountain Silver Sage (ssp. viscidula), occurs in mixed communities with Mountain Big Sage. It has been identified on the Wind River Ranger District, on till soils in the Salt Creek-Union Pass area, and alluvial soils in the lower Horse and Long Creek areas. This subspecies is also a vigorous sprouter, but does not appear to provide palatable browse for wildlife. Its value as domestic sheep browse is unknown. The sprouting ability of this species will cause it to increase in canopy cover after chemical or mechanical treatment unless the root crown is tilled. This subspecies presents a management problem where it occurs in dense stands with Mountain Big Sage.

Artemisia longiloba (Longleaf Sage).

Longleaf Sage is a dwarf shrub up to 6 dm (two feet) tall. Its three-lobed leaves are rather short and bell-shaped, up to 15 mm long. Inflorescences extend above the rounded shrub tops.

This dwarf sage is found in the Horse Creek Basin and the lower Long Creek area of the Wind River Ranger District. It characterizes sites with very specific environmental conditions. Soils are fine textured with a clay layer in the B horizon at depths averaging eight inches. This claypan interrupts drainage and root penetration, causing long periods of saturation, and consequent lowered productivity.

Artemisia nova Nuttall (Black Sagebrush).

Black Sage is very similar morphologically to low sage and is sometimes considered a subspecies of low sage (Hitchcock and Cronquist, 1973). Black Sage is distinguished from low sage by the presence of small glands on the leaves which are whitish early in the growing season and turn dark by mid-summer. This gives the species its characteristic dark color. The glands make the leaves of the Black Sage sticky.

Black Sage is found mostly on shallow well-drained soils developed from limestone or dolomitic parent material. It occurs at lower elevations of the Clarks Fork and Wapiti Ranger Districts. Black Sage provides fair to good browse for wildlife, especially in the winter (Kinney and Sugihara, 1943).

Artemisia tridentata subspecies tridentata Nuttall (Basin Big Sagebrush). This subspecies represents the tallest form of big sagebrush. Mature plants are commonly 120-180 cm (4 - 6 feet) in height, and individuals may reach 240 cm or more. The main stem normally forms a single trunk. Flower stalks arise throughout the crown of the plant, causing a rounded irregular top. The leaves are relatively long and narrow and the persistent leaves are shallow-lobed. Leaf margins are straight, providing a narrow wedge-shaped leaf which is widest at the lobe tips.

This subspecies grows in deep, well-drained soils of low elevation valley bottoms and foothill regions on the Clarks Fork and Wapiti Ranger Districts. It shows only moderate increases in density with disturbances of the associated vegetation, but may increase greatly in foliage due to enlargement of crowns.

Basin Big Sagebrush in the least palatable form of big sagebrush and is normally only lightly browsed. However, observations on the South and North Fork winter ranges, Wapiti Ranger District, showed moderate winter browse use by mule deer.

Artemisia tridentata subspecies vaseyana (Rydberg) Beetle (Mountain Big Sagebrush).

Mountain Big Sagebrush is distinguished from the other two subspecies by its characteristic flat topped appearance and early seed maturity. Flower stalks arise only at the upper crown portions of the plant and extend above the foliage. Leaves tend to be wider in relation to their length than those of Basin Big Sagebrush, and are usually widest just below the leaf lobes. Vegetation shoots in the upper crown are less than half as long as the nearest flower stalks.

This subspecies is found throughout the upper foothills and mountain areas of the Shoshone National Forest, at elevations ranging from 1690 to 2920 m (5,500 to 9,500 feet) above sea level. Mountain Big Sage has the most potential of any sagebrush species or subspecies for increasing its canopy cover. The habitat types that it represents, however, have the most potential for improved herbaceous production after shrub treatment of any of the sagebrush habitats. Dense stands in some areas may be used as cover by wildlife during the animals' reproduction periods. Maintenance of dense shrub cover is desirable in these areas.

Artemisia tridentata subspecies wyomingensis Beetle (Wyoming Big Sage). Wyoming Big Sagebrush is a relatively low-growing subspecies, 5 - 10 dm (20-40 in.) in height. Flower stalks arise throughout the crown of the plant, causing a rounded, irregular top. Its leaves are relatively short and wide, more deeply lobed than those of other big sagebrush subspecies. The leaf margins curve outward from the base, forming bell-shaped leaves. The main stem is separated into two to three twisted portions at ground level.

Wyoming Big Sage is most adapted to the xeric conditions of all the subspecies of big sage. It grows in relatively shallow soils in the warmer and drier portions of the sagebrush region, and is common on the lower elevations of the Wapiti and Clarks Fork Ranger Districts. The subspecies shows a moderate tendency to increase in density with disturbances of the associated vegetation. It tends to produce more lateral roots in the upper soil horizons than other big sagebrush taxa and consequently, may compete more with associated herbaceous species. In his studies in Idaho, Winward (1970) found that Wyoming Big Sagebrush was the most palatable form of big sagebrush. Studies in other states also report the high palatability of this subspecies. Wyoming Big Sagebrush canopy coverage does not increase as much as the other big sage subspecies with excessive livestock grazing. The species normally grows in relatively open stands and crown canopy coverage seldom exceeds 20 percent.

Artemisia tripartata Rydb (Three-tip sage).

Three-tip Sage is a dwarf shrub, growing up to 6 dm (two feet) tall. It is restricted to the Lander Ranger District where it is the only dwarf sage species. The linear leaves are deeply cleft into three lobes. Sites with shallow or otherwise arid soils support this sage. Density and potential canopy coverages of this species are low, limited to available moisture. Palatability of this species is not known.

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