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SAGEBRUSH-GRASS HABITAT TYPES OF SOUTHERN IDAHO

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PREFACE

This publication is the product of a cooperative agreement between the University of Idaho and the USDA, Forest Service Intermountain Forest and Range Experiment Station, Ogden, Utah, on a project entitled "Habitat Type Classification for Grasslands and Shrublands of Southern Idaho."

The authors are grateful to many range professionals and soil scientists of the U.S. Forest Service, U.S. Soil Conservation Service and the U.S. Bureau of Land Management for their help and interest in the project. Without their support this report would be much less than it is. Special thanks go to Dr. E. W. Tisdale (Emeritus) of the University of Idaho for providing the initial stimulus to study the ecology of the sagebrush-grass ecosystem and for providing background material that made this project possible. In addition, the support and interest of Mr. Hallie Cox, Dr. Edward F. Schlatterer and Dr. Walter F. Mueggler of the U.S. Forest Service and the Intermountain Forest and Experiment Station deserve special recognition for their support and encouragement of and patience with the researchers.

The interpretations and viewpoints presented in this report are solely those of the authors.

M. Hironaka
M. A. Fosberg
A. H. Winward
December 23, 1982.

Cover photo: *Artemisia wyomingensis/Stipa thurberiana* habitat type near Paul, Idaho.

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Sagebrush-Grass Habitat Types Of Southern Idaho

M. Hironaka, M. A. Fosberg, and A. H. Winward

INTRODUCTION

During the past decade land management agencies have expressed renewed interest in vegetation classification. Many ecologists in the United States championed classifications based on potential or climax vegetation when the discipline of plant ecology was a relatively young science (Clements 1916, Korstian 1919, Shantz and Zon 1924, Hanson and Whitman 1938). In more recent years the classification cause has been quietly carried on by Dyksterhuis (1949), Braun (1950), Daubenmire (1952, 1970), Poulton and Tisdale (1961) and Kuchler (1964) among others.

For range management purposes, classification of land based on the current vegetation prevailed until Dyksterhuis (1949) introduced the range site concept. His classification scheme, based on the climax vegetation, was used exclusively by the Soil Conservation Service (Shiflet 1973) for many years before it was adopted by the Bureau of Land Management. The habitat type classification, also based on the climax vegetation, is a more recent system. This classification is presently being used by the Forest Service (Pfister et al. 1977).

Classification based on the habitat type concept was initially developed with forest vegetation (Daubenmire 1952, Daubenmire and Daubenmire 1968) and later extended to shrub vegetation (Poulton and Tisdale 1961, Daubenmire 1970, Mueggler and Stewart 1980). The habitat type system is a land classification, defined as the aggregate area of land that supports, or until recent times supported, and presumably is capable of again supporting, a particular climax plant community, regardless of the type or kind of disturbance plant community presently occupying the site.

The habitat type is named after the unique combination of dominants (in some instances a diagnostic species is used) of the climax vegetation associated with the habitat type. In most cases a binomial system of nomenclature is adequate, but at times a trinomial is necessary. This report identifies and describes many of the major nonforest habitat types of southern Idaho, with particular emphasis on those lands on which sagebrush-grass vegetation is or was climax.

Problems of Vegetation Classification

Many problems are associated with development of a habitat type classification. The amount of variability within a classified unit is of primary concern. It is also difficult to find examples of vegetation where disturbance is known to be inconsequential. Because of this uncertainty, this classification, which is based on the interpretation of available information, is tentative.

Uses of Habitat Type Classification

Many regard habitat type classification as another classification scheme of limited value because the land manager generally does not have climax vegetation as a management goal. And yet those who have attempted to manage with total disregard for the current vegetation have been frustrated and disappointed with results.

The habitat type classification provides a basis for classifying landscape areas possessing similar effective environment, expressed by their ability to produce the same

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climax vegetation. By itself this knowledge has limited value for management. It becomes important when the present vegetation is not an expression of the potential capability of the land.

Of greater importance, habitat type classification permits the development of an information storage and retrieval system for multiple use management. Information can be documented with a permanent land reference, which cannot be obtained using seral, temporary, vegetation.

Value of Soils Information

The relationship between soils and climax vegetation is close. Theoretically, a single soil body supports only a single climax community (Major 1951, Jenny 1958). However, because plants compensate for environmental differences and grow over a range of environmental conditions, the same climax vegetation may be supported on more than one soil. This soil-vegetation relationship provides a realistic base for interpreting the potential of secondary successional communities within habitat types without repeated, long-term monitoring of permanent plots.

Although several different soils occur in the same habitat type, i.e., support the same climax vegetation, from a management viewpoint they may vary in sensitivity to management practice and land treatment. In addition, soils may differ in productivity level, yet support the same basic climax plant community. The different levels of productivity within a habitat type would be identified as habitat type phases or range sites.

Habitat Type Versus Range Site

Although similar, the habitat type (ht) and range site are not synonymous. The habitat type is more inclusive and encompasses a greater amount of variability of soils and vegetation than the range site. Conceptually, range sites derived from the same climax vegetation are neatly and completely included within a single habitat type. A range site is likened to the habitat type phase, a subdivision of a habitat type (Pfister et al. 1977).

By simply expanding the present nomenclature of the range site to include the dominant species (or diagnostic species) of the climax vegetation, resource personnel can merge the habitat type and range site classification to form a hierarchical classification. The land management agencies, without additional field work, would have a uniform land classification system.

Seral Community Types

As stated earlier, the classification of seral communities is an important sequel to habitat type classification. Classification of landscape based on the climax vegetation is the beginning of a system that allows us to document our experiences with the land so that they can be meaningfully conveyed to subsequent land managers and applied to any specific piece of land. Classification of seral communities into community types (CT) within habitat types would enable us to study the relationship of seral communities to one another and would provide insight into probable successional pathways (Huschle and Hironaka 1980). Preliminary studies to develop procedures for classification and their probable successional sequence appear promising (Schott 1981, Hann 1982). The solid cone model proposed by Huschle and Hironaka (1980) can be incorporated nicely with vital attributes models of secondary succession used to predict the community resulting from a catastrophic impact such as prescribed burning or silvicultural cutting practices (Slatyer 1973, Cattelino et al. 1979, Kessel and Potter 1980).

REVIEW OF LITERATURE

Those interested in ecological literature of sagebrush-grass vegetation are encouraged to read a published review by Tisdale and Hironaka (1981). A comprehensive bibliography on ecology and management aspects for grazing, control, revegetation, wildlife and watershed of sagebrush ranges was produced by Harniss et al. (1981).

AREA OF APPLICATION

The habitat type classification in this report is applicable primarily to the sagebrush-grass region of southern Idaho. Use of this classification beyond the intended area is not recommended.

Physiography and Geology

The physical features of Idaho are well described by Ross and Savage (1967). The dominant physical feature of southern Idaho is the arc-shaped Snake River Plain, 360 miles long and 50 to 80 miles wide. It is predominately a basalt lava plain gradually rising from 2300 feet in elevation at the Idaho-Oregon border to 6600 feet at the Wyoming border. The plain is mantled with loessial deposits in the eastern section and sedimentary deposits in the western portion.

The Owyhee Plateau borders the plain on the southwest and rises 4000 to 6000 feet in elevation. The northern portion of this plateau is interrupted by a mountain mass of granitic origin rising to 800 feet. The rock formations of the plateau are predominately Idaho silicic volcanics intermixed with basalt flows.

On the east side of the Owyhee plateau is the northern extension of the Basin and Range Province, characterized by a series of parallel mountain ranges oriented in a north-south direction. Sediments from ancient Lake Bonneville cover the wide valley floors. The mountain ranges are composed of cretaceous sedimentary rocks.

Bordering the Snake River Plain on the east is the Middle Rocky Mountain Province. The northern portion of this province is formed of silicic rhyolites and welded tuffs. The southern portion consists of mountain ranges of Paleozoic and Mesozoic sedimentary rocks.

Much of the area that lies on the north side of the Snake River Plain is classified as the Northern Rocky Mountain Province. The southern portion of the province is composed of parallel mountain ranges of Paleozoic sedimentary rocks. The valleys contain extensive overlapping glacial outwash fans. The southwest portion of this physiographic province is composed primarily of the granitic rocks of the famed Idaho batholith. These rocks are predominately quartz monzonite, with lesser amounts of quartz diorite and granodiorite (Larsen and Schmidt 1958).

Climate

Precipitation occurs primarily during the winter period, particularly in the western half of the state. The sagebrush-grass region of southern Idaho receives between 7 to 20 inches of precipitation annually (Stevlingson 1959), whereas the forested region receives 20 to 60 inches, mostly in the form of snow. Summer thunderstorms also contribute significantly to the annual amount in the mountains. During summer, the eastern portion of the state is often in the path of moist upper air masses, and storms occur more frequently than in other areas. This portion of Idaho receives more than 50 percent of its annual precipitation during the April-September period, compared with less than 35 percent for the same period in western Idaho.

Temperature extremes are wide on the Snake River Plain, with the average being between 37 and 52 degrees F. In the mountainous areas, freezing temperatures may occur any night of the year.

Soils

The soils of southern Idaho are highly varied because of variations in kinds of parent material and the intensity and duration of the soil forming factors (Jenny 1958). Differences in topography result in different combinations of factors, which in turn produce different soils.

A generalized soils map of Idaho (USDA-SCS 1973) indicates that the soils of the Snake River Plain are predominately Camborthids, Calciorthids, Durorthids, Haplargids, with some Calcixerolls and Durixerolls. These soils reflect the warm and dry climate of the area.

The Owyhee Uplands has a cooler, more moist climate than the Snake River Plain, and the soils are predominately Argixerolls and Haplargids, derived from igneous parent materials.

The soils in the valleys of the Basin and Range Province are classified as Calcixerolls, Argixerolls and Calciorthids. These are developed on deep lake sediments and are neutral to moderately alkaline. The mountain ranges, which are for the most part shrub lands, have soils that are Calcixerolls, Argixerolls and Cryoborolls, indicating a relatively cool, but dry climate.

The Middle Rocky Mountain Province is dominated by soils that are Cryoborolls and Paleborolls, reflecting a temperature regime that is cryic or frigid and with sufficient precipitation to support forest vegetation.

The Idaho batholith portion of the Northern Rocky Mountain Province contains soils belonging primarily to the following Great Groups: Cryochrepts, Cryumbrepts, Cryoborolls, Cryopsamments and Xeropsamments. Where the mountain ranges are predominately of Paleozoic sedimentary rocks, Paleborolls, Cryoborolls, Haploxerolls and Argixerolls are the primary Soil Groups. The valleys that lie in the rain shadow of these mountain ranges have soils of the Torriorthents, Argixerolls, Calciorthids and Haplaquolls Great Groups.

FIELD PROCEDURE

The data used to develop the habitat type classification in this final report come from several sources. Collection of the basic data began nearly 25 years ago under an Idaho-Oregon-Washington regional project on shrub steppe vegetation. Oregon, under the leadership of Dr. C. E. Poulton, and Idaho used the same procedure (Poulton and Tisdale 1961), whereas Daubenmire (1970) of Washington used a smaller plot size for frequency and obtained estimates on foliage cover instead of on basal cover. The leader for Idaho was Dr. E. W. Tisdale.

Briefly, the basic sampling methods used in Idaho follow. A homogeneous, relatively undisturbed-appearing vegetation on a uniform terrain was selected for study and a macroplot of 50 x 100 ft was delineated, with the long side of the plot located parallel to the slope. A preliminary examination of the soil around the macroplot was made to verify that the macroplot was located on only a single soil body.

Four belt transects, 4 x 50 feet, were located within the macroplot, with the restriction that the starting end of two of the transects must be located in the first 0-25-foot zone along the 100-foot length of the macroplot. The 4-foot wide transects were located randomly across the 50-foot width of the macroplot, with the stipulation that there was no overlap of belts.

A 50-foot metal tape was used to define the boundary of one side of the 4-foot wide belt transect. Along each transect, ten 12 x 24-inch microplots were systematically placed to obtain data on the basal cover rooted frequency of herbaceous species. The basal cover of each species was estimated with the aid of guide rings of known areas. Estimates were also made for coverage of cryptograms, litter and bare ground. The microplot was designed so that one end was open to facilitate placement in shrub-grass vegetation.

Shrub data were obtained in 4 x 50-foot belt transects. A 50-foot metal tape was used to form one side of the belt transect and to measure shrub crown intercept, providing canopy data. Density data by species and height classes were obtained in a 4-foot wide belt by use of a 4-foot stick, placed perpendicular to the steel tape to determine whether a questionable shrub individual was inside or outside the belt. The number of dead individuals was also counted. The heights of 10 dominant shrub individuals were recorded and averaged. Species not encountered in sampling were recorded. Photographs were taken of each macroplot.

A soil pit was dug adjacent to the macroplot and genetic horizons were described according to standard soil survey procedures. Soil samples were collected by horizon and returned to the laboratory for analysis.

To provide a larger data base to better describe the variability, vegetation and soil data from other studies were incorporated. In some cases, the sampling intensity was reduced from 40 microplots to 20, plot size was reduced from 12 x 24 inches to 8 x 20 inches, and foliage rather than basal cover was estimated, retaining the basic procedure as previously described. In other situations, where the Forest Service, Bureau of Land Management and Soil Conservation Service collected data for inventory and trend studies their data were also utilized. In these instances the vegetation parameter estimated was yield or foliage cover. Soil data were generally lacking.

A rapid sampling procedure was also developed to determine which species in a stand were sufficiently conspicuous and abundant to aid in describing the vegetation variability of a habitat type. Briefly, the station presence method involved the random location of 10 stations within the bounds of a macroplot. Each station was an area of 50 sq ft (4.0 ft radius) circumscribed from its center. From the center, percentage foliage cover by species was estimated and recorded by cover class coverage (Table 1). A mental conversion that 1 sq ft of foliage cover was equal to 2 percent coverage was included in the estimation.

Table 1. Cover classes assigned in estimation of foliage coverage.

Range in Percent Cover	Cover Class	Average Percent Cover
<1%	1	0.5%
1-5%	2	3.0%
5-15%	3	10.0%
15-25%	4	20.0%
25-50%	5	37.5%
50-75%	6	62.5%
75-95%	7	85.0%
95-100%	8	97.5%

The soil was given a cursory examination. A soil hole was dug, the genetic horizons were briefly described, and microprofile samples were collected for later reference. The information was sufficient to classify the soil to the soil family, and to the series level if the soil had been previously studied and classified.

CLASSIFICATION PROCEDURE

Basic Premises

The habitat type classification is based on climax vegetation. Because much of the vegetation involved in this project was not climax, some adjustments were needed to allow use of the available data. The basic premise used in this study was that all stands had been disturbed in varying degrees. Because some stands had been disturbed less than others, we could assume that some were nearer to climax, if "climax" were defined as the endpoint of secondary succession. Utilizing the concept (Major 1951, and Jenny 1958) that a single soil body (and also highly similar soils) supports only a single climax vegetation, a means to distinguish between differences in vegetation due to site or to disturbance was made available.

Although the plant association (the climax plant community) has been defined by ecologists, the amount of variation in species and floristic composition within an association has never been specifically stated. Those who use the habitat type classification must appreciate that there is considerable variation within a habitat type. There is intraspecific variability (ecotypic variation) and spatial variability, which is a reflection of soil differences within the habitat type. Thus, the habitat type classification may incorporate more variation than some would desire. In such cases, further subdividing (habitat type phase or range site) is recommended.

Basic Strategy

A basic consideration in developing a habitat type classification is to use species that are long-lived, self-perpetuating, conspicuous, persistent and which reflect the nature of the habitat. For shrub-grass vegetation such as ours, woody species, particularly sagebrush species and subspecies, partially fulfill this requirement. Although the native bunchgrasses may not be as persistent as climax woody species, they too are long-lived and reflect the conditions of the habitat. Selected perennial grass species used in combination with woody species help delineate areas of environmental uniformity more effectively than would be the case where a woody species or a perennial bunchgrass species is used alone. The use of forb species has not been successful in indicating site differences because of their seemingly erratic and inconsistent spatial recurrence. Admittedly, we know very little about their ecology.

Because of their longevity, persistence and conspicuousness, the presence of the identifying climax species is often sufficient evidence to enable one to classify an area to its proper habitat type even though the vegetation has been somewhat disturbed. In situations where the vegetation has been drastically altered, greater dependence must be placed on soils and on other site information for proper and consistent identification of habitat type.

Data Analysis

Summarized stand data were computer processed. Because of the large number of stands involved, the stands were stratified by the dominant sagebrush species or subspecies. In those stands where sagebrush was lacking or was a very minor member of the community, shrubs related to the mountain shrub zones were used to determine the grouping. This data reduction process was necessary to remain within the capacity of the computer's memory. This process also biased the analysis, forcing the classification to be based on the sagebrush species. In some instances sagebrush may not have ranked in the top two or three species in terms of cover, frequency and/or yield.

Each group of stands was treated separately and further subdivided into habitat types. The subdividing process was aided by a polythetic-divisive classification strategy named MONIT developed in England by Lambert et al. (1973). Presence/absence data were used in the classification process. Estimates of the measured parameters were utilized in describing the variability of the attributes within classified units. The units formed by the MONIT program were examined, and if differences between some groupings appeared minor, they were merged. Some units were rejected because of known disturbance status; others were rejected because the grouping consisted of residual stands, with no affinity to other groups.

Because each stand is assigned to a habitat type, its associated soil is uniquely associated with the same habitat type. In cases where a single soil series or soil series phase is assigned to two habitat types, the classification of both the soil and vegetation is questioned and reexamined, as it is contrary to the basic premise of the classification.

HABITAT TYPE CLASSIFICATION

Identification of Sagebrush

The habitat type classification is dependent on the proper taxonomic identification of sagebrush species and subspecies. Because it is difficult to identify the subspecies in the *Artemisia tridentata* complex (Beetle 1960, Beetle and Young 1965), the taxonomic keys and fluorescence tests developed by Winward and Tisdale (1977) and Winward (1980) are partially reproduced in Figures 1 and 2, and Tables 2 and 3.

Table 2. Key to identification of big sagebrush. Excerpted from "Taxonomy of the *Artemisia tridentata* Complex in Idaho," by A. H. Winward and E. W. Tisdale, 1977.

TAXONOMIC KEY AND DESCRIPTIONS

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 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 3-lobed and over-winter on all big sagebrush taxa.**
3. **Leaf and growth form characteristics are most easily distinguished from flowering through seed stages.**

The following key is designed for separations based on persistent leaves only. Illustration of some characters used in the key are presented in Figure 2.

1. **Uneven topped shrubs, flower stalks arising throughout the crown.**
   2. **Mature plants usually more than 100 cm (40 inches) in height, leaf margins straight.**
      3. **Leaves relatively long-narrow, 1/w ratio 4.0 or greater, fluoresces reddish brown in alcohol. (Winward and Tisdale 1969).**
         A. tridentata ssp. *tridentata*
      3. **Leaves relatively long-broad, 1/w ratio less than 4.0, fluoresces bluish-cream in alcohol.**
         A. tridentata ssp. *vaseyana f. "xericensis"*
   2. **Mature plants less than 100 cm (40 inches) in height, ½ ratio less than 4.0, leaf margins curved outward, fluoresces reddish brown in alcohol.**
      A. tridentata ssp. *wyomingensis*
1. **Even topped shrubs, flower stalks arising from upper crown and extending above foliage.**
   4. **Flower heads less than 1.5 mm wide, 4-6 flowers per head, branches not layered, fluoresces bluish-cream in alcohol.**
      A. tridentata ssp. *vaseyana*
   4. **Flower heads more than 1.5 mm wide, more than 6 flowers per head, branches often layered, fluoresces bluish-cream in alcohol.**
      A. tridentata spp. *vaseyana f. "spiciformis"*

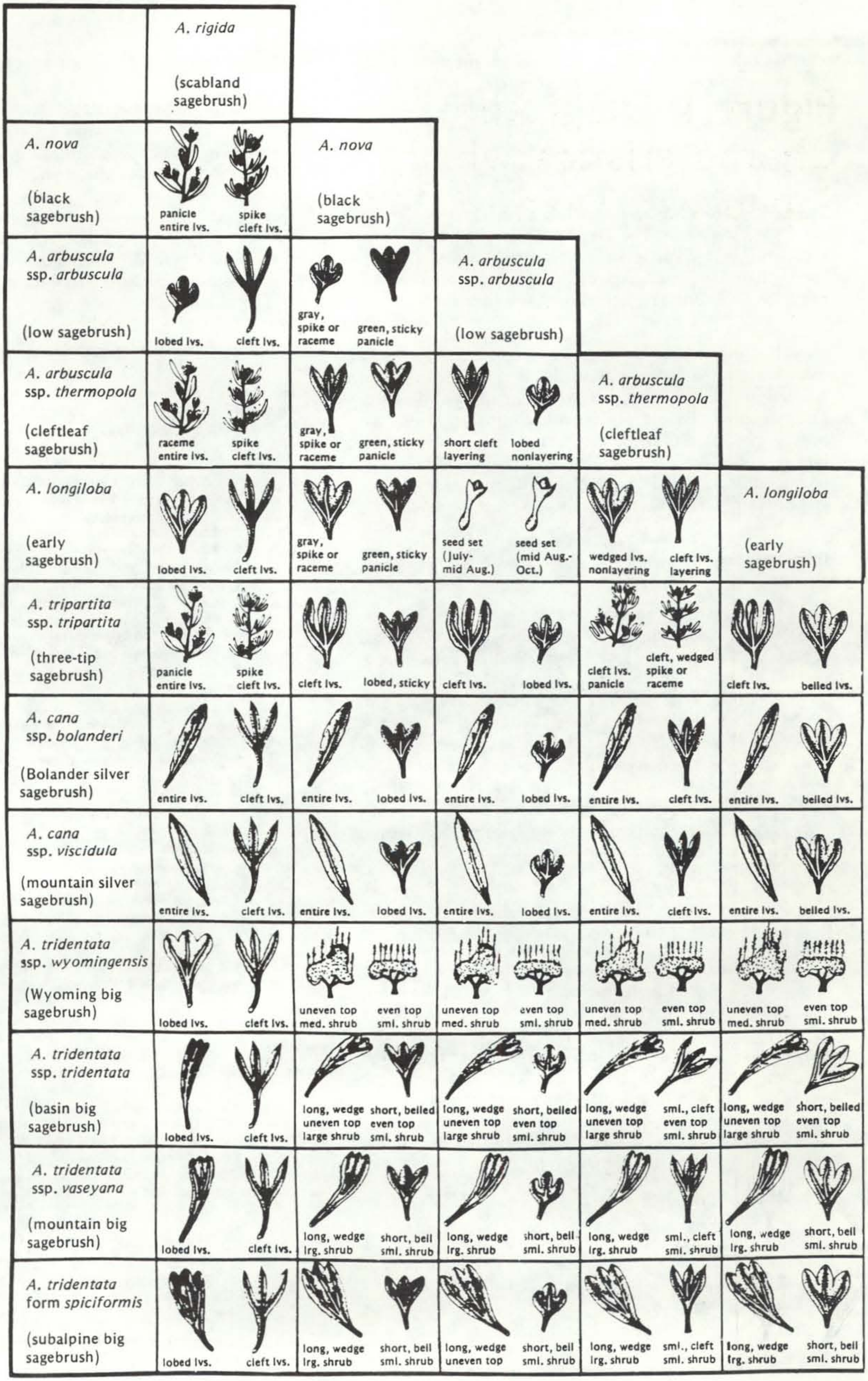
A. rigida
(scabland sagebrush)
A. nova
(black sagebrush)
panicle entire lvs.
spike cleft lvs.
A. nova
(black sagebrush)
A. arbuscula ssp. arbuscula
(low sagebrush)
lobed lvs.
cleft lvs.
gray, spike or raceme
green, sticky panicle
A. arbuscula ssp. arbuscula
(low sagebrush)
A. arbuscula ssp. thermopola
(cleftleaf sagebrush)
raceme entire lvs.
spike cleft lvs.
gray, spike or raceme
green, sticky panicle
short cleft layering
lobed nonlayering
A. arbuscula ssp. thermopola
(cleftleaf sagebrush)
A. longiloba
(early sagebrush)
lobed lvs.
cleft lvs.
gray, spike or raceme
green, sticky panicle
seed set (July-mid Aug.)
seed set (mid Aug.-Oct.)
wedged lvs. nonlayering
cleft lvs. layering
A. longiloba
(early sagebrush)
A. tripartita ssp. tripartita
(three-tip sagebrush)
panicle entire lvs.
spike cleft lvs.
cleft lvs.
lobed, sticky
cleft lvs.
lobed lvs.
cleft lvs. panicle
cleft, wedged spike or raceme
cleft lvs.
belled lvs.
A. cana ssp. bolanderi
(Bolander silver sagebrush)
entire lvs.
cleft lvs.
entire lvs.
lobed lvs.
entire lvs.
lobed lvs.
entire lvs.
cleft lvs.
entire lvs.
belled lvs.
A. cana ssp. viscidula
(mountain silver sagebrush)
entire lvs.
cleft lvs.
entire lvs.
lobed lvs.
entire lvs.
lobed lvs.
entire lvs.
cleft lvs.
entire lvs.
belled lvs.
A. tridentata ssp. wyomingensis
(Wyoming big sagebrush)
lobed lvs.
cleft lvs.
uneven top med. shrub
even top sml. shrub
uneven top med. shrub
even top sml. shrub
uneven top med. shrub
even top sml. shrub
uneven top med. shrub
even top sml. shrub
A. tridentata ssp. tridentata
(basin big sagebrush)
lobed lvs.
cleft lvs.
long, wedge uneven top large shrub
short, belled even top sml. shrub
long, wedge uneven top large shrub
short, belled even top sml. shrub
long, wedge uneven top large shrub
sml., cleft even top sml. shrub
long, wedge uneven top large shrub
short, belled even top sml. shrub
A. tridentata ssp. vaseyana
(mountain big sagebrush)
lobed lvs.
cleft lvs.
long, wedge lrg. shrub
short, bell sml. shrub
long, wedge lrg. shrub
short, bell sml. shrub
long, wedge lrg. shrub
sml., cleft sml. shrub
long, wedge lrg. shrub
short, bell sml. shrub
A. tridentata form spiciformis
(subalpine big sagebrush)
lobed lvs.
cleft lvs.
long, wedge lrg. shrub
short, bell sml. shrub
long, wedge uneven top
short, bell sml. shrub
long, wedge lrg. shrub
sml., cleft sml. shrub
long, wedge lrg. shrub
short, bell sml. shrub

Figure I. Diagrammatic Key Showing Characteristics which Separate Sagebrush Taxa

Characteristics at left of box refer to taxa on left.
Characteristics at right of box refer to taxa at top.
Leaf sizes are not drawn to scale.

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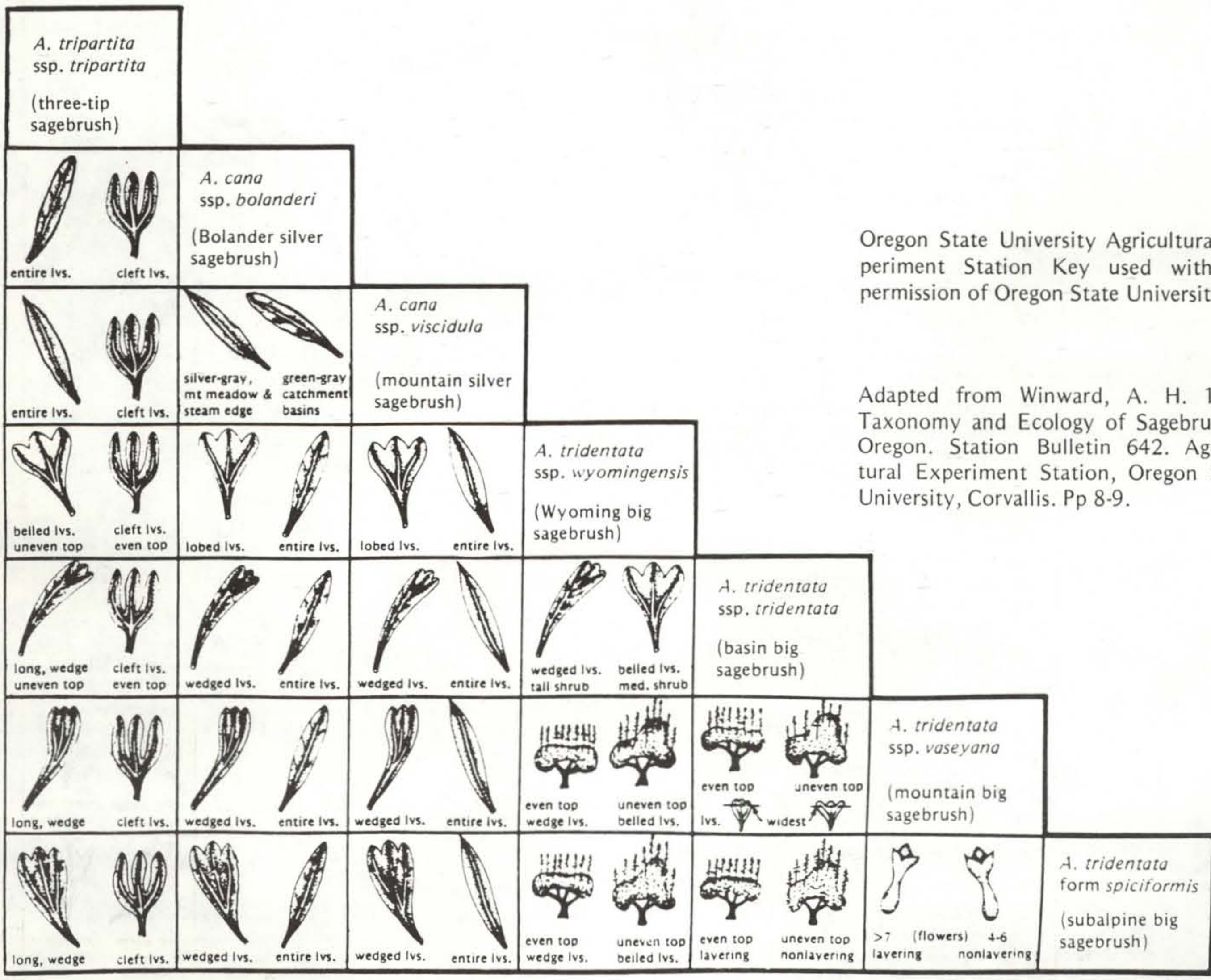


Oregon State University Agricultural Experiment Station Key used with the permission of Oregon State University.

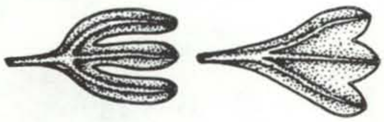
Adapted from Winward, A. H. 1980. Taxonomy and Ecology of Sagebrush in Oregon. Station Bulletin 642. Agricultural Experiment Station, Oregon State University, Corvallis. Pp 8-9.

Figure 2. Dichotomous Key to *Artemisia* (Section Tridentatae)

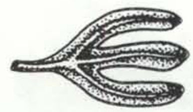
1a Leaves entire[1] 

2a Leaves silver-gray, plants from internally drained basins with seasonal flooding . . . . *A. cana* ssp. *bolanderi*

2b Leaves green-gray, plants along stream bottoms or meadow margins from mid to high elevations . . . . *A. cana* ssp. *viscidula*

1b Leaves divided or lobed 

3a Mature[2] shrubs less than 20" high

4a Leaves divided (lobe length $>$ 3 times width) 

5a Flower stalk leaves divided, inflorescence spicate, all leaves winter deciduous . . . .  . . . *A. rigida*

5b Flower stalk leaves entire 

6a Inflorescence paniculate, upper flower stalk leaves much longer than flower heads . . . . *A. tripartita* ssp. *tripartita*

6b Inflorescence spicate or racemose, flower stalk leaves equal or only slightly longer than flower head . . . . *A. arbuscula* ssp. *thermopola*

4b Leaves lobed (lobed length $<$ 3 times width) 

7a Inflorescence paniculate, seed stalks brownish and persist into following year . . . .  . . . . . . *A. nova*

7b Inflorescence spicate or racemose, seed stalks grayish and weakly persistent 

8a Seeds mature mid-July to mid-August. . . . . *A. longiloba*

8b Seeds mature late August to October . . . . *A. arbuscula* ssp. *arbuscula*

3b Mature shrubs taller than 20"

9a Uneven topped shrubs, flower stalks arise throughout crown

10a Mature plants > 40" in height, leaf margins straight . . . . *A. tridentata* ssp. *tridentata*

10b Mature plants < 40" in height, leaf margins belled outward. . . . . *A. tridentata* ssp. *wyomingensis*

9b Even topped shrubs, flower stalks arise from upper crown and extend above foliage

11a Leaf margins belled outward, inflorescence spicate or racemose . . . . *A. arbuscula* ssp. *arbuscula*

11b Leaf margins straight, inflorescence paniculate

12a Four to six flowers per head . . . . *A. tridentata* ssp. *vaseyana*

12b More than six flowers per head, plant often layering. . . . . *A. vaseyana* f. "*spiciformis*"

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[1] Key based on persistent (overwintering) leaves unless otherwise noted.

[2] Mature infers at least 20 years old (see xylem layers).

Adapted from Winward, A. H. 1980. Taxonomy and Ecology of Sagebrush in Oregon. Station Bulletin 642. Agricultural Experiment Station, Oregon State University, Corvallis.

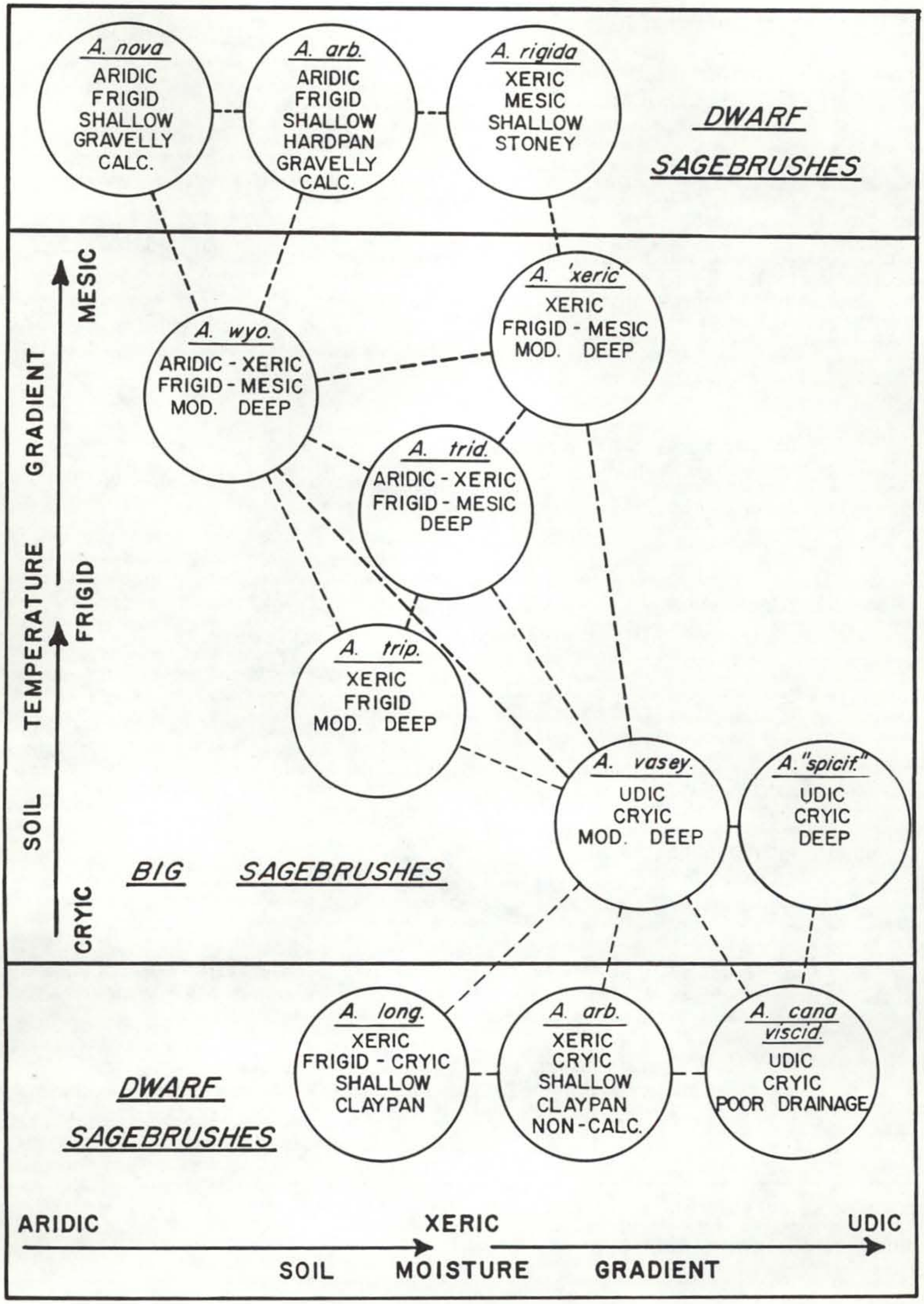

Figure 3. Conceptual relationship of sagebrush species and subspecies based on soil moisture, temperature and other soil characteristics.

Table 3. Fluorescent color of sagebrush–alcohol solution under long-wave, ultraviolet light.

Group I. Fluorescence of brownish-red.
- *Artemisia tridentata* ssp. *wyomingensis*
- *Artemisia tridentata* spp. *tridentata*
- *Artemisia nova*
- *Artemisia rigida*

Group II. Fluorescence of creamish-blue.
- *Artemisia arbuscula* ssp. *arbuscula*
- *Artemisia arbuscula* ssp. *thermopola*
- *Artemisia longiloba*
- *Artemisia tripartita* ssp. *tripartita*
- *Artemisia cana* ssp. *viscidula*
- *Artemisia cana* ssp. *bolanderi*
- *Artemisia tridentata* ssp. *vaseyana*
- *Artemisia tridentata vaseyana* f. *"spiciformis"*
- *Artemisia tridentata vaseyana* f. *"xericensis"*

Taxonomists have not formally recognized *Artemisia tridentata* ssp. *vaseyana* f. *"xericensis"* (Winward and Tisdale 1977) and *Artemisia tridentata* spp. *vaseyana* f. *"spiciformis"* (Beetle 1960). For sake of brevity, the two forms will be treated as subspecies in the *A. tridentata* complex.

Ecological Relationship of Sagebrush Taxa

Without the acceptance of the sagebrush subspecies the habitat type classification for the sagebrush zone would be difficult to develop. The subspecies of the *A. tridentata* complex are ecologically significant and their distribution is related primarily to moisture, temperature and soil development. The basic distributional relationship of the major sagebrush taxa to environment in Idaho is presented in Figure 3. The connecting dashed lines indicate those sagebrush communities commonly found in contact with one another.

As can be seen, the distribution of sagebrush is closely related to climate and to depth and degree of soil development. All of the dwarf sagebrush species occur in soils that are shallow, that have a restrictive layer if moderately deep, or are on wet sites.

Uniformity Within Habitat Types

The dominant perennial grasses such as *Agropyron spicatum, Festuca idahoensis, Stipa thurberiana,* and *Stipa comata* are also related to environment. Their distributional ranges differ from those of the sagebrush species, indicating that their requirements do not coincide. By observing shrub and dominant understory species, field personnel can classify landscape into fairly homogeneous units. Each dominant species occupies certain portions of the numerous environmental gradients. Thus, with each sagebrush-perennial grass combination, a more homogeneous environment is delineated.

The environment and thus the potential to produce a particular type of vegetation is different in the *A. tridentata/Agropyron spicatum* ht than in the *A. wyomingensis/ Agropyron spicatum* ht or *A. vaseyana/Agropyron spicatum* ht. The total effective environment is different, and each supports a different subspecies of sagebrush. It also holds that response to management probably would not be the same in all three habitat types.

Widely distributed species probably include considerable ecotypic variation. Although the same species may recur in many stands in a habitat type, it is not unusual for the abundance of those species to vary considerably from stand to stand, producing variation in species abundance within a habitat type. In classification, similarity in recurrence of dominant and influential species is important. The lesser species play little or no role in the classification scheme.

Soils in a Habitat Type

From a theoretical viewpoint, a particular soil is associated with a particular habitat type. In practice, this is generally the case. There are instances, however, when it appears that a particular soil is associated with more than a single habitat type. If one considers that the soil classification is also an arbitrary one, albeit one that has had more study, and that the amount of variability within a soil taxon is also arbitrarily defined, the lack of boundary coincidence is understandable. This apparent contradiction about soil-vegetation relationships appears to occur more frequently in arid zones or where soil is young, and the influence of the environmental factors is only weakly imprinted in the soil profile characteristics.

In most instances, areas supporting the same soil series or soil series phase belong to the same habitat type. Thus, the combined areal distribution of the soils that are known to be associated with a particular habitat type could be used to delineate the areal extent of the habitat type.

In those cases where only the soil family level of classification is available, the limits of the habitat type cannot be determined from the soil family because the soil family is not unique to a single habitat type. If the extent of the habitat type is delimited, the combined area within the habitat type belonging to the same soil family would likely be of similar productivity and respond to management in a similar manner.

One of the objectives of this study was to determine the soil series associated with each habitat type. Because many of the soils had not been previously described and accorded soil series names, the list of soil series associated with each habitat type in this report is far from complete. This is especially true of those soils that occur in the mountainous areas. They have not been classified due to their low value from an agricultural viewpoint.

The basic procedure used in this study involved classifying each stand as to its habitat type based on the climax vegetation. The soil series associated with the stand was identified wherever feasible. In this manner we are to determine those soil series associated with each habitat type encountered.

Although not carried out to the extent we had hoped, the productivity of each habitat type is correlated with soils. The variability in productivity that occurs within a habitat type is related to soil groups, and is equivalent to a range site. Hopefully, we will be able to correlate productivity with soils at the soil family level of classification within habitat type. More data are needed to test this idea, however. We are well aware of the effect of disturbance and weather on current production.

Shrubland Habitat Types

The major habitat types in the sagebrush and mountain brush zones of southern Idaho are listed in Table 4. It should be emphasized that it is not a complete listing.

The taxa of *Artemisia* to the subspecific and in some cases the forma level have ecological significance. For the purpose of brevity in this report, the nomenclature of the scientific name below the species level is abbreviated to a binomial.

Abbreviated	Complete
A. "spiciformis"	*A. tridentata* ssp. *vaseyana* f. *"spiciformis"*
A. thermopola	*A. arbuscula* ssp. *thermopola*
A. tridentata	*A. tridentata* ssp. *tridentata*
A. vaseyana	*A. tridentata* ssp. *vaseyana*
A. bolanderi	*A. cana* ssp. *bolanderi*
A. viscidula	*A. cana* ssp. *viscidula*
A. wyomingensis	*A. tridentata* ssp. *wyomingensis*
A. "xercensis"	*A. tridentata* ssp.*vaseyana* f. *"xericensis"*

A key to the habitat types is presented in Table 5, which is followed by a brief description and diagnostic features of each.

Table 4. List of shrubland habitat types in southern Idaho.

Low sagebrush series

1. *A. arbuscula/Agropyron spicatum* ht
2. *A. arbuscula/Festuca idahoensis* ht
3. *A. arbuscula/Poa sandbergii* ht
4. *A. bolanderi/Muhlenbergia richardsonis* ht
5. *A. viscidula/Festuca idahoensis* ht
6. *A. longiloba/Festuca idahoensis* ht
7. *A. nova/Agropyron spicatum* ht
8. *A. nova/Festuca idahoensis* ht
9. *A. nova/Stipa comata* ht
10. *A. rigida/Poa sandbergii* ht
11. *A. thermopola/Festuca idahoensis* ht

Big sagebrush series

1. **A. "spiciformis"/Bromus carinatus* ht
2. *A. tridentata/Agropyron spicatum* ht
3. *A. tridentata/Elymus cinereus* ht
4. *A. tridentata/Festuca idahoensis* ht
5. *A. tridentata/Stipa comata* ht
6. *A. tripartita/Agropyron spicatum* ht
7. *A. tripartita/Festuca idahoensis* ht
8. *A. tripartita/Stima comata* ht
9. *A. vaseyana/Agropyron spicatum* ht
10. *A. vaseyana/Elymus cinereus* ht
11. *A. vaseyana/Festuca idahoensis* ht
12. *A. vaseyana/Stipa comata* ht
13. *A. vaseyana/Stipa thurberiana* ht
14. *A. vaseyana/Symphoricarpos oreophilus/Agropyron spicatum* ht
15. *A. vaseyana/Symphoricarpos oreophilus/Festuca idahoensis* ht
16. *A. vaseyana/Symphoricarpos oreophilus/Carex geyeri* ht
17. *A. wyomingensis/Agropyron spicatum* ht
18. *A. wyomingensis/Poa sandbergii* ht
19. *A. wyomingensis/Sitanion hystrix* ht
20. *A. wyomingensis/Stipa thurberiana* ht
21. **A. "xericensis"/Agropyron spicatum* ht
22. **A. "xericensis"/Festuca idahoensis* ht

Other shrub series

1. *Purshia tridentata/Agropyron spicatum* ht
2. *Cercocarpus ledifolius/Agropyron spicatum* ht

*These "subspecies" of *A. tridentata vaseyana* are not true subspecies. These are often regarded as "forma" a subdivision of subspecies. Both *"xericensis"* and *"spiciformis"* are "forma" of subspecies *vaseyana*. The former occurs at the warm extreme and the latter at the cold and mesic extreme of *vaseyana's* distribution.

Table 5. Key to Shrub Vegetation of Southern Idaho

I. *Artemisia* species present, well represented and generally dominant or co-dominant shrub species.

1. Dwarf sagebrush species are the dominant sagebrush species on site. Soils are rocky, shallow to bedrock, shallow gravelly soils, soils with strongly developed clay B horizon within 10"-14" of surface, or shallow soils derived from limestone or dolomitic parent material.

2. *Artemisia rigida* (scabland sagebrush) is the dominant sagebrush species. This species is restricted to western Idaho and adjacent Oregon and Washington. It occurs on soils that are shallow to bedrock and derived from basalt. *Poa sandbergii* is the primary grass species. *Sitanion hystrix* may be poorly represented. *Agropyron spicatum* is absent or if present is restricted to pockets of deeper soils.

Artemisia rigida/Poa sandbergii ht
page 19

2. *Artemisia rigida* absent, or if present is a minor member of the shrub component. Site is dominated by other dwarf sagebrush species.

3. *Artemisia nova* (black sagebrush) is the dominant sagebrush species. This species occurs in south-central and eastern Idaho. It is associated with limestone or dolomite-like derived soils that are dry or shallow and generally highly calcareous. Soils are well drained.

4. *Agropyron spicatum* is conspicuously present. Some sites may also support *Stipa comata* in conspicuous amounts. *Festuca idahoensis* is absent, or present only in minute amounts.

A. nova/Agropyron spicatum ht
page 19

4. *Festuca idahoensis* is conspicuously present with *Agropyron spicatum.*

A. nova/Festuca idahoensis ht
page 20

3. *Artemisia nova* is absent, or if present, is a minor member of the shrub component. Site dominated by other dwarf sagebrush species. The soils are not necessarily calcareous.

5. *Artemisia arbuscula* (low sagebrush) is the dominant sagebrush species. This species is widely distributed in Idaho. It occurs on soils that are shallow to bedrock, shallow gravelly soils, thin skeletal soils, soils with strongly developed clay B horizon within 10"-14" of surface. It occurs on soils derived from a wide variety of parent material. Limestone derived soils may be calcareous to the surface. Nonlimestone soils are generally subjected to saturated conditions for a period of the year.

6. *Poa sandbergii* is the principal grass. The soils are shallow to bedrock. Deep-rooted perennials are lacking. Generally restricted to southwest Idaho.

A. arbuscula/Poa sandbergii ht
page 20

6. *Poa sandbergii* is present but not the principal grass. Deeper rooted perennial grass predominates. Soils are shallow to moderately deep, often with a strongly developed clay B horizon, or shallow limestone gravelly soils with a cemented pan.

7. *Agropyron spicatum* is the principal grass. *Sitanion hystrix* may be present in conspicuous amounts. In some areas *Koeleria cristata* is well represented. *Festuca idahoensis* absent, or present only in minute amount.

A. arbuscula/Agropyron spicatum ht
page 21

7. *Festuca idahoensis* is conspicuously present. *Argopyron spicatum* may or may not be present conspicuously. Some stands may contain a light scatter of *Purshia tridentata.*

A. arbuscula/Festuca idahoensis ht
page 22

5. *Artemisia arbuscula* absent or if present contributes little to the shrub component. Other dwarf sagebrush species dominate sites that are shallow and noncalcareous and are subjected to saturated conditions for a period of the year.

8. *Artemisia longiloba* (alkali sagebrush) is the principal shrub species. This species is restricted to soils derived from basalt. The principal understory grass is *Festuca idahoensis* with *Agropyron spicatum* occurring in varying amounts. *Stipa thurberiana* may replace *Agropyron spicatum* in some situations.

A. longiloba/Festuca idahoensis ht
page 22

8. *Artemisia thermopola* (thermopola low sagebrush) is the principal dwarf sagebrush species with *Festuca idahoensis* the principal grass.

A. thermopola/Festuca idahoensis ht
page 23

1. The shrub layer is predominately of the taller woody *Artemisia* species instead of members of the dwarf sagebrush group. (Soils are moderately deep to deep, soils with weak to strongly developed B horizon, or if strongly developed clay B horizon deeper than 10" of surface.)

10. *Artemisia wyomingensis* is the principal sagebrush species. Its distribution is primarily on the Snake River Plains and adjacent valleys that receive less than 12 inches of precipitation. It normally extends to about 6000 feet elevation on dry, steep, mountain slopes in eastern Idaho. The soils are shallow to moderately deep. Soils are warm and dry during the summer.

11. *Poa sandbergii* is the only perennial grass of significance in the understory. Precipitation is about 8 inches annually. Soil is fine-textured and calcareous to the surface. This type is restricted to western Idaho in the vicinity of Kuna, Idaho.

A. wyomingensis/Poa sandbergii ht
page 23

11. *Poa sandbergii* is present, but deep-rooted perennials dominate the understory. The soils are variable in texture, depth and development.

12. *Sitanion hystrix* is the principal understory species. Long-lived perennials such as *Agropyron spicatum* or *Stipa thurberiana* are lacking. This habitat type is difficult to verify. It may be a degraded condition at the dry end of other habitat types.

A. wyomingensis/Sitanion hystrix ht
page 24

12. *Sitanion hystrix* is not the principal climax understory species. Deep-rooted, long-lived perennial grasses are the dominant species of the understory. (3 alternatives)

13. *Stipa thurberiana* is the dominant understory species. *Agropyron spicatum* is absent, or present only in minute amounts. The distribution of the habitat type is restricted principally to a 10 to 15-mile band south of the Snake River from Hammett to Paul, Idaho. *Festuca idahoensis* absent.

A. wyomingensis/Stipa thurberiana ht
page 24

13. *Agropyron spicatum* is the principal understory species. *Stipa thurberiana* is present in varying amounts from conspicuous to none.

A. wyomingensis/Agropyron spicatum ht
page 25

13. *Stipa comata* is the dominant understory. *Stipa thurberiana* and/or *Agropyron spicatum* are absent, or if present, occur in small amounts. Soils are generally sandy loam to coarse sand or highly calcareous.

A. wyomingensis/Stipa comata ht
page 27

10. *Artemisia wyomingensis* is absent, replaced by sagebrush species that grow in more mesic and cooler conditions.

14. *Artemisia tridentata* is the principal sagebrush member. The differentiation of *A. tridentata* from other big sagebrush can often be based on shrub height. Average stand height of greater than four feet, with leaves that are narrowly strap-shaped, would almost assure that you are dealing with *A. tridentata.* The soils are deep with no restrictive layer. The distribution is restricted to swales, valley bottoms and roadsides where soils are deep and extra water is received. (3 alternatives)

15. *Agropyron spicatum* is the principal understory species. Where coarse-textured soil predominates, *Stipa comata* also occurs. Most *A. tridentata* stands have been drastically disturbed in the past; good examples of this habitat type were not observed.

A. tridentata/Agropyron spicatum ht
page 27

15. *Festuca idahoensis* is the principal understory species. *Agropyron spicatum* also occurs. Only one example of this habitat type was found.

A. tridentata/Festuca idahoensis ht
page 28

15. *Stipa comata* is the dominant understory species. *Agropyron spicatum* is lacking, or is present in small amounts. Soils are deep, coarse-textured, sandy loam to coarse sand in upper horizons.

A. tridentata/Stipa comata ht
page 29

14. *A. tridentata* is absent, or if present, not the dominant member of the shrub component.

16. *Artemisia vaseyana* (mountain sagebrush) is the principal sagebrush species. The distribution of this species is widespread from mid to high elevation with a lower elevation limit at 4500 to 5000 feet. Precipitation generally exceeds 16 inches annually. Soils are medium to deep and classed as frigid or cryic. *Purshia tridentata* occurs with *A. vaseyana* more often than with other sagebrush species.

17. *Symphoricarpos oreophilus* is absent. *Prunus* spp., *Ribes cereum* and other mountain brush species are lacking. (3 alternatives)

18. *Agropyron spicatum* is the principal understory species. *Balsamorhiza sagittata* is generally conspicuously abundant. *Purshia tridentata* is often a prominent member, varying from few to many. *Festuca idahoensis is lacking.*

A. vaseyana/Agropyron spicatum ht
page 29

18. *Festuca idahoensis* is present and generally the principal understory species. *Balsamorhiza* is generally conspicuously abundant. *Purshia tridentata* is often present.

A. vaseyana/Festuca idahoensis ht
page 30

18. *Stipa comata* is the principal understory species. *Festuca idahoensis* may be present in small amount. *Agropyron spicatum* is generally lacking. Soils are sandy loam to coarse sand.

A. vaseyana/Stipa comata ht
page 31

17. *Prunus* spp., *Ribes cereum* and/or other low mountain brush species present. *Symphoricarpos oreophilus* may be lacking but is generally present. These hts occur generally above 6,000 feet elevation. (3 alternatives)

19. *Agropyron spicatum* is the principal understory species. *Festuca idahoensis* is lacking, or present in minute amounts. *Melica bulbosa* often present.

A. vaseyana/Symphoricarpos oreophilus/Agropyron spicatum ht
page 32

19. *Festuca idahoensis* is present. *Agropyron spicatum* and *Melica bulbosa* present in varying amounts.

***A. vaseyana/Symphoricarpos oreophilus/Festuca idahoensis* ht**
page 32

19. *Carex geyeri* is present in varying amounts. *Festuca idahoensis* may be lacking, but generally present.

A. vaseyana/Symphoricarpos oreophilus/Carex geyeri ht
page 33

16. *Artemisia vaseyana* is absent, or if present, does not contribute significantly to the shrub component.

20. *Artemisia vaseyana f. "xericensis"* is the principal sagebrush species. The distribution of this sagebrush is western Idaho. It is not distinguishable in stature and growth from *A. tridentata*. Its stature ranges from 3 to 6 or more feet in height. Its leaf shape is not narrow strap-like but like that of *A. vaseyana*. In some areas it intergrades with *A. vaseyana*. Distribution of this sagebrush species is 3000-4500 feet, with precipitation between 12 and 20 inches annually.

21. *Agropyron spicatum* is the principal understory grass. *Balsamorhiza sagittata* is generally conspicuous. *Festuca idahoensis* is absent.

*A. "xericensis"/**Agropyron spicatum*** ht
page 33

21. *Festuca idahoensis* is present with *Agropyron spicatum*. This type has limited distribution, generally being replaced by *A. vaseyana.*

*A. "xericensis"/**Festuca idahoensis*** ht
page 34

20. *Artemisia "xericensis"* is not the principal sagebrush species.

22. *A. vaseyana f. "spiciformis"* is the principal sagebrush species. Its distribution is above the distribution level of *A. vaseyana,* often occurring at 8000 to 9000 feet elevation. It occurs on deep, well-drained, mesic sites. Morphologically, it differs from *A. vaseyana* in leaf size, *A. "spiciformis"* being generally several times larger than *A. vaseyana*.

23. Understory species generally with *Festuca idahoensis/Melica bulbosa/Bromus carinatus/Agropyron caninum*, etc.

*A. "spiciformis"/**Bromus carinatus*** ht
page 35

23. Understory includes conspicuous amounts of *Carex geyeri*.

*A. "spiciformis"/**Carex geyeri*** ht
page 35

22. *Artemisia "spiciformis"* is not the principal sagebrush species.

24. *Artemisia tripartita* is the principal shrub species. The distributional level of this species is from 4000 to 6000 feet in most areas. This species is not found in western Idaho. It sprouts after fire.

25. *Agropyron spicatum* is the primary understory species with *Koeleria cristata, Poa sandbergii* and *Poa nevadensis* frequently contributing. *Festuca idahoensis* is lacking. *Purshia tridentata* is generally lacking.

*A. tripartita/**Agropyron spicatum*** ht
page 36

25. *Festuca idahoensis* is present and *Agropyron spicatum* occurs in varying amounts. *Purshia tridentata* is often present.

*A. tripartita/**Festuca idahoensis*** ht
page 36

24. *Artemisia tripartita* is not the principal shrub species.

26. *Artemisia viscidula* is the dominant sagebrush species. The distribution of this species is restricted to bottomlands that have water tables near the soil surface during at least part of the year. *Potentilla fruticosa* may be present.

Artemisia viscidula/Festuca idahoensis ht
page 37

II. *Artemisia* species absent, poorly represented and/or subdominant to other shrub species.

1. *Symphoricarpos oreophilus* absent or is subdominant in the community.

4. *Purshia tridentata* is the primary shrub. *Artemisia* and mountain shrub species lacking. *Chrysothamnus* species may be present. *Agropyron spicatum* is the primary understory species.

Purshia tridentata/Agropyron spicatum ht
page 37

4. *Purshia tridentata* is the primary shrub. *Artemisia* and mountain shrub species are lacking. *Stipa comata* is the primary understory species.

Purshia tridentata/Stipa comata ht
page 38

4. *Cercocarpus ledifolius* is the dominant shrub. *Artemisia vaseyana* generally present. Mountain shrub species often present. *Agropyron spicatum* is the primary understory species. *Festuca idahoensis* lacking, or if present, in small amount only.

Cercocarpus ledifolius/Agropyron spicatum ht
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ARTEMISIA RIGIDA/POA SANDBERGII HT
(Arri/Posa)

The *Artemisia rigida/Poa sandbergii* ht is restricted to northern and west-central Idaho. This *Artemisia* species is deciduous, dropping all its leaves in the winter. It occurs on shallow, basalt derived soils in Adams and Washington counties. It is the primary woody *Artemisia* species found in the Palouse grasslands of northern Idaho and adjacent Oregon and Washington.

This habitat type supports a sparse cover of vegetation, with *Poa sandbergii* the principal understory species, and an occasional scatter of *Sitanion hystrix* and rarely *Agropyron spicatum.* The thin soil mantle, underlain by basalt bedrock, is supersaturated during winter and spring; surface overland flow is conspicuous during snow melt. Supersaturated soil conditions may not occur each year, but occur in sufficient frequency to preclude the establishment of other *Artemisia* species. Moisture stress is severe during summer because of the low water storage of the thin mantle. Other species associated with this ht are *Allium acuminatum, Lithophragma bulbifera, Eriogonum baileyii* and low growing *Lomatiums. Bromus tectorum* and/or *Taeniatherum asperum* occur sparsely in all stands, even where fully protected from grazing.

Soils: The soils of this ht are shallow to moderately deep, extremely stony or extremely rocky over basalt bedrock. Where subsoils occur, they are strongly developed of montmorillonitic clay, and the permeability is extremely low.

Management Implications: This ht forms a mosaic with other hts, making management recommendations in most situations academic. The saturated soil moisture conditions in winter and spring require a different management strategy from that used on the *Artemisia wyomingensis/ Poa sandbergii* ht, even though the *Poa sandbergii* is the principal understory species in both situations. Trampling damage in winter and spring is severe. The sparse ground cover affords little protection from surface runoff in this higher precipitation zone (12-20 inches annually). Frost heaving is natural and severe. Pedestaled and upheaved *Poa* plants are common even in protected areas.

Because the ht grows on extremely shallow, rocky soils, a control program probably would not be beneficial. The most commonly associated grass species, *Poa sandbergii,* is not able to make use of additional soil moisture that may result from removal of sagebrush. Reseeding with introduced species of *Agropyrons* would not be economical because of the nature of the soils. Sites supporting *A. rigida* are heavily browsed by big game animals in the winter, even though the protein content is relatively low. Increase in forage yields by restoration practices may not justify treatment costs, but severely disturbed areas cannot be left unattended. Programs geared to managing areas of *Artemisia rigida* should be designed to maintain an open stand of sagebrush with a scattered understory of native herbaceous species.

ARTEMISIA NOVA/AGROPYRON SPICATUM HT
(Arno/Agsp)

The distribution of *A. nova* is restricted to eastern Idaho and occurs on shallow, calcareous soils derived primarily from limestone. This species of sagebrush is at its extreme northern distribution in Idaho, being more prevalent in Utah and Nevada (Beetle 1960). Where *A. arbuscula* is present in the immediate vicinity, *A. nova* occupies the warmer, more xeric and more calcareous positions on the landscape. On adjacent deeper soils *A. wyomingensis* or *A. tridentata* replaces *A. nova*. On sites too xeric or saline for *A. nova, Atriplex confertifolia* and other salt desert shrub species occur.

The *A. nova/Agropyron spicatum* ht has a strong complement of perennial grasses in the understory. *Agropyron spicatum* is the dominant with *Poa sandbergii* constantly present. Although precipitation is scant, often less than 8 inches annually, *Agropyron spicatum* dominates the understory. More than 40 percent of the precipitation occurs during the April-August period. *Stipa comata* and *Oryzopis hymenoides* may occur in varying amounts. Due to the higher frequency of summer precipitation in eastern Idaho the forb population is richer in this ht than in areas of comparable total annual precipitation in western Idaho. *Phlox hoodii* and *Castilleja angustifolia* occur frequently in this ht with *Opuntia* species restricted to the warmer, xeric portions. A variety of other forbs occur but they do not consistently recur from stand to stand.

As is true with all dwarf sagebrush species, *A. nova* is restricted to shallow and moderately deep soils. In Idaho, *A. nova* is consistently associated with limestone derived soils in the lower rainfall zone. This is not to say that all calcareous soils support *A. nova,* however.

Soils: Soils of this ht are relatively uniform in characteristics. They occur at mid-elevation in the low precipitation zone (8-11 inches) on highly calcareous parent material derived from limestone or loess. The soils are shallow to moderately deep and occur on alluvial fans, fills and mountain slopes. The major portion of this ht occurs north of the Snake River Plain.

At the lower precipitation zone of its distribution, a typical soil would be one with a surface horizon that is light colored, gravelly silt loam and strongly calcareous. The B horizon is weakly developed, strongly calcareous, gravelly silt loam that overlies a highly calcareous, gravelly, indurated C horizon at approximately 13 inches.

On moderately deep soils, the surface layer is light colored, strongly calcareous, gravelly loam that overlies a strongly calcareous, weakly developed, loam B horizon. At about 27 inches, a gravelly, highly calcareous, indurated C horizon is encountered.

Soil families include: loamy-skeletal, mixed (calcareous), frigid, shallow Xerollic Durorthid; coarse-loamy, mixed (calcareous), frigid, Xerollic Durorthid.

Management Implications: The terrain included in this ht is generally flat to hilly and poses no great physical constraint to management. The soils are generally gravelly and well-drained internally. Adequate water is a problem, as open water courses are few due to low precipitation and high soil permeability. Wildlife, particularly antelope and sagegrouse, use this ht extensively. *Artemisia nova* is relatively low on the palatability scale to mule deer and only moderately selected by domestic sheep. Due to terrain and sparse vegetational cover, fire is not a normal feature of this vegetational type. Artificial revegetation is risky because of low precipitation and high variability from year to year. Some stands of this ht have been successfully seeded to *Agropyron desertorum,* but this appears to be limited to areas with deeper soils and at least 10 inches of yearly precipitation. However, an effort should be made to maintain a mixture of sagebrush and native grasses and forbs in sites of the *A. nova/Agropyron spicatum* ht. Recovery of depleted range is slow if *A. nova* density is excesssive, as the community is temporarily closed to establishment of new plants. Where *Poa sandbergii* has replaced *Agropyron spicatum*, extremely long-term plant succession will be required to permit return of *Agropyron spicatum*. In such situations, the *A. nova* population may need to be thinned to permit establishment of grass seedlings. With an adequate seed source, reestablishment of *Agropyron spicatum* is achieved more easily in central and eastern Idaho because of the higher frequency of summer precipitation and less competition from annual species. In areas of comparable total annual precipitation in western Idaho, the precipitation occurs primarily during winter. *Bromus tectorum* is not a serious problem in the *A. nova/ Agropyron spicatum* ht. Under severely depleted conditions a large amount of bare ground may become exposed on sites of this ht.

ARTEMISIA NOVA/FESTUCA IDAHOENSIS HT
(Arno/Feid)

This existence of this ht was suspected but not verified until a few years ago. It was found at the upper reaches of the South Creek drainage in the Little Lost River valley. *Festuca idahoensis* dominates the understory with a good complement of *Agropyron spicatum*. The grass cover is greater than in the more xeric *A. nova/Agropyron spicatum* ht. With more thorough examination in the upper moisture zone of the *A. nova/Agropyron spicatum* ht, we may find that the occurrence of *Festuca idahoensis* in the understory of *A. nova* is more widely distributed than previously thought.

Soils: Only a single soil profile of this ht has been described. More information is needed before characterization of soils in this habitat type is to be attempted.

Management implication: Due to the limited extent of this ht and limited experience with it, recommendations concerning its management would be inappropriate. It would be supposed that the permanence of *Festuca idahoensis* in this ht is more precarious than in others because this species is at its extreme range of tolerance for moisture, temperature and the interacting effects of calcium carbonate.

ARTEMISIA ARBUSCULA/POA SANDBERGII HT
(Arar/Posa)

This ht is counterpart to the *A. rigida/Poa sandbergii* ht and involves those areas that support *A. arbuscula* instead of *A. rigida*. It occupies areas where the soil is too shallow to support *Agropyron spicatum* or *Festuca idahoensis*, but sufficient to support *Poa sandbergii*. The distribution of this habitat type is more subtle than that of the *A. rigida/Poa sandbergii* ht because it occurs as a mosaic with other hts of the *A. arbuscula* series and not members of the *A. tridentata* complex. It might be feasible to consider this ht as a variant of the *A. arbuscula/Agropyron spicatum* or *A. arbuscula/Festuca idahoensis* ht, whichever it is associated with.

The replacement of *A. rigida* by *A. arbuscula* is not understood. It is speculated that one of the factors which affects this distribution is winter light intensity and quality. Because of its deciduous nature, *Artemisia rigida* is able to tolerate low light intensities of the winter months to a greater degree than *A. arbuscula*. Research conducted by Pearson (1975) indicates that sagebrush photosynthesizes during the winter when leaf temperature is slightly above freezing, suggesting that evergreen sagebrush do not go into complete dormancy. For the same reason, it is speculated that evergreen sagebrush species are not able to persist in the Palouse grasslands where the number of cloudy winter days are too numerous to provide sufficient light to sustain the plant. Another feature influencing distribution of these two species may be related to bedrock fracturing. *Artemisia rigida* establishes itself in rock fractures where moisture is available later in the summer season. *Artemisia arbuscula* does not appear to have this affinity to fractured rock.

Soils: The soils of this ht are too shallow to support either *Agropyron spicatum* or *Festuca idahoensis*. There is little or no soil development involved.

Management Implications: Because this ht forms a complex with others of the *A. arbuscula* series, its low productivity and potential must be given due consideration; otherwise, results of management may be poorly evaluated. The lack of good ground cover and the absence of deep rooted bunchgrass in this ht are normal.

ARTEMISIA ARBUSCULA/AGROPYRON SPICATUM HT
(Arar/Agsp)

This dwarf sagebrush has an unique distribution; it is suspected that we are dealing with at least two ecotypes of *A. arbuscula*. In the Birch Creek and Little Lost River drainages of eastern Idaho, *A. arbuscula/Agropyron spicatum* ht abuts against the mesic side of the *A. nova/Agropyron spicatum* ht on calcareous, shallow, gravelly soils. Usually *A. nova* is on calcareous soils, often with a restrictive B layer or parent rock at 6-14 inches. *Artemisia arbuscula* is on similar noncalcareous surface soils. In this area the precipitation is 8-12 inches annually with more than 40 percent of the precipitation occurring during the May-August period.

The understory is dominated by *Agropyron spicatum* with considerable amounts of *Poa sandbergii. Phlox hoodii* is a constant member of this ht. *Koeleria nitida* is a common species and appears to be of a different ecotype than that which occurs in areas of higher precipitation.

This ht occurs in an environmental setting where the precipitation is higher than 8-12 inches, yet not high enough to support *Festuca idahoensis*. This type is more prevalent in western and extreme southeastern Idaho. The soils in this more mesic *A. arbuscula/Agropyron spicatum* ht have a well-developed indurate claypan that restricts infiltration. They are often stony, but with considerable amount of clay development which restricts internal drainage. The understory is composed primarily of *Agropyron spicatum* and *Poa sandbergii*.

Soils: This ht occurs at mid-elevations (5000-7000 ft), and soils supporting it have a restrictive layer in the upper 8-14 inches. Two distinct types of soils are produced dependent upon the kind of parent material involved. Soils derived from basalt or rhyolitic lava flows have a moderately dark, silt loam to silty clay loam surface horizon that grades into a strongly developed clay B horizon at about 12 inches. A strongly calcareous C horizon occurs at approximately 20 inches, which overlies bedrock at 32 inches.

Soils derived from limestone parent material differ in the following respects. The surface horizon is light to moderately dark colored, gravelly silt loam that is strongly calcareous. The surface horizon overlies a strongly calcareous C horizon with a strongly cemented duripan, very high in gravels, at 10 inches. Some soils may have a weakly developed cambic horizon between the surface horizon and the cemented duripan.

Soil families include: loamy-skeletal, mixed, frigid, Xerollic Durorthid; loamy-skeletal, mixed, frigid, Durixerollic Calciorthid; fine-loamy mixed, frigid, Typic Durixerol; fine-loamy, mixed, frigid, shallow Xerollic Durorthid; fine, montmorillonitic, frigid, Calcic Aridic Argixeroll.

Management Implications: The two kinds of situations that have been described for this ht affect management because soil conditions are so different. On the calcareous gravelly soils of eastern Idaho a muddy soil surface is not a problem, and animals may utilize this kind of range during the wet season with little or no trampling damage. The drier climate where this ht is found in eastern Idaho also permits use of these ranges in the late winter-early spring period before spring growth begins. Recovery of the vegetation by means of management can be expected in a relatively short period because of the favorable precipitation pattern for perennial seedling establishment, assuming an adequate seed source and not too dense a sagebrush cover. If *A. arbuscula* and/or *Poa sandbergii* have increased to the near exclusion of other species, some type of thinning of these two dominants may be required before additional understory species can become established.

The extension of this ht onto areas of higher precipitation and strongly developed claypan soils can result in excessive trampling damage to soil and vegetation if animals graze when the soil is wet. Natural damage to young plants by frost heave action is commonplace due to the fine soil texture. Surface soil runoff during spring snow melt is common and poses a difficult management problem. Benefits of higher moisture are offset by greater mortality due to frost heaving, offering fewer "safe sites" for seedling establishment.

ARTEMISIA ARBUSCULA/FESTUCA IDAHOENSIS HT
(Arar/Feid)

The soils of this ht are shallow to moderately deep, generally with a strongly developed claypan; the mantle is saturated during the spring. The temperatures are lower and the moisture is greater than in the *A. arbuscula/Agropyron spicatum* ht.

Festuca idahoensis is the dominant understory grass with *Agropyron spicatum* conspicuously present to virtually absent. The forb population is richer in species as well as density than in the *A. arbuscula/Agropyron spicatum* ht because of the more mesic conditions. Common forb species include *Phlox hoodii, Phlox longifolia, Antennaria rosea, Crepis acuminata* and *Senecio integerrimus. Balsamorhiza hookeri* instead of *Balsamorhiza sagittata* is generally associated with *A. arbuscula*.

This ht is widespread in western Idaho but is uncommon in eastern Idaho and has not been found to occur on soils derived from limestone parent material.

Soils: The soils of this ht have much in common throughout its distribution. They are derived from basalt or rhyolitic parent materials. Strongly developed claypan soils are characteristic of this ht at moderate elevation (5000-7000 ft).

At the drier and warmer portion of this ht the soils are generally moderately deep, and developed from basalt mixed with loess. The surface horizon is moderately dark silt loam, which overlies a strongly developed clay B horizon at about 7 inches. A silica-cemented duripan is often present at 23 to 27 inches, just above bedrock. The soil is noncalcareous throughout.

In slightly more mesic areas, the soil is moderately deep and derived from rhyolitic welded tuff. Surface horizon is a moderately dark silt loam to a depth of 13 inches, overlying a very strongly developed clay B horizon. A thin silica-cemented duripan occurs at 24 to 36 inches, over a welded tuff bedrock. The soil is noncalcareous throughout.

At the upper elevational limits of this ht, above 7000 feet, the soil is moderately deep and developed from rhyolitic welded tuff. The surface soil is a moderately dark, gravelly loam to a depth of 10 inches. The B horizon has weak to moderate development and is a very gravelly and cobbly loam with slight increase in clay with depth. The B horizon extends to a depth of 25 inches.

At high elevations, the weakening in development and high concentrations of coarse fragments in the B horizon are characteristic of soils in this ht. At mid-elevations, the soils have a strongly developed clay B horizon from 11 to 13 inches, whereas, at the drier end of the ht the soils are very gravelly with a lime-silica hardpan restrictive layer.

Soil families included: loamy-skeletal, mixed, Argic Pachic Cryoboroll; very fine-montmorillonitic, Argic Cryoboroll; fine-montmorillonitic, Argic Cryoboroll.

Management Implications: Due to the wetness of the soil in the spring, vegetation growth is delayed in comparison with surrounding vegetation that supports *A. tridentata* or *A. vaseyana*. The trampling damage to vegetation becomes a real problem if animal use is permitted when soil is saturated. Frost heaving of seedlings and established *Poa sandbergii* is common in this ht.

Although most stands of this habitat type are unsuited for improvement through cultivation, a few areas have been successfully reseeded to *Agropyron cristatum* through a no-till operation. Where *Poa sandbergii* is abundant this may not be possible. Generally, management of this ht should be geared to maintaining an open canopy of sagebrush with an understory of bunchgrass and forbs. Consideration should be given to wildlife, since they tend to use these areas extensively. *Artemisia arbuscula* is among the more preferred sagebrush taxa as forage for mule deer and domestic sheep (Sheehy and Winward 1981).

ARTEMISIA LONGILOBA/FESTUCA IDAHOENSIS HT
(Arlo/Feid)

The *A. longiloba/Festuca idahoensis* ht is associated with the *A. arbuscula/Festuca idahoensis* ht in that both are supported on strongly developed claypan soils. *Artemisia longiloba* is restricted to claypan soils, whereas *A. arbuscula* is not. The most extensive area occupied by this ht in Idaho is in Blaine and Camas counties, although it is also found in the Owyhee Upland. *Festuca idahoensis*, with varying amounts of *Agropyron spicatum*, has been consistent in the understory of *A. longiloba*. An *A. longiloba/Agropyron spicatum* ht has not been reported in Idaho or Nevada

(Zamora and Tueller 1973), but has been described in Colorado (Robertson et al. 1966). *Poa sandbergii* is found in all stands, whereas *Stipa thurberiana* may be found in some (Hugie et al. 1965, Tisdale et al. 1965). The landscape on which this ht occurs is flat to gently rolling. In most situations, without the presence of *A. longiloba* it would be difficult to know whether one is dealing with an *A. longiloba/Festuca idahoensis* or an *A. arbuscula/Festuca idahoensis* ht if a claypan soil is involved. Forbs that are often present include *Mertensia longiflora, Antennaria stenophylla, Aster scopulorum, Allium accuminatum* and *Arabis holboellii*.

Soils: The soils of this ht are generally rocky and morphologically not separable from some soils of the *A. arbuscula/Festuca idahoensis* ht. They are moderately deep with a moderately dark, fine-textured, surface horizon. A strongly developed clay B horizon within 13 inches of the surface is characteristic of these soils.

Management Implications: Due to the heavy clay soils involved, trampling damage is severe if used when wet, but soil erosion is not as severe as one would expect because of the gentle terrain. The soils are supersaturated in the spring, and frost heaving poses a problem to seedling establishment. Due to the rocky nature of the terrain, overseeding with a rangeland drill may be a feasible way to seed this habitat type. Sagebrush control is limited to herbicidal or mechanical means that are effective with a minimum amount of equipment breakage. It is recommended that rhizomatous species such as *Agropyron intermedium* or *Agropyron trichophorum* be included in a seeding mix because they provide better erosion control on fine textured soils than cespitose species.

Artemisia longiloba has an earlier phenology than other *Artemisia* species by several weeks. This may affect the effectiveness of herbicidal control where *A. longiloba* is intermingled with other species of sagebrush.

ARTEMISIA THERMOPOLA/FESTUCA IDAHOENSIS HT
(Arth/Feid)

Artemisia arbuscula ssp. *thermopola* is probably the result of hybridization between *A. arbuscula* and *A. tripartita* (Beetle 1960). This species has retained more of the characteristics of *A. arbuscula*, being short in stature and occupying shallow, poorly drained soils. The attribute obtained from *A. tripartita* is the deeply cleft leaves.

This ht has been described previously by Schlatterer (1972). It occupies ridgetops and glacial outwash areas that are thinly mantled and poorly drained. *Festuca idahoensis* is the primary perennial grass and *Agropyron spicatum* may or may not be present. Some high elevation areas may support *Carex elynoides* in addition to the *Festuca idahoensis* (Schlatterer 1972). Associated species are similar to those found in the *A. arbuscula/Festuca idahoensis* ht. Virtually nothing is known about the ecology of *A. thermopola* except that it has an earlier phenology than *A. arbuscula* and is limited in its distribution to relatively high elevation sites, usually within forest openings.

Due to the widespread and excessive disturbance of this ht, probably caused by its accessible terrain, the *Festuca idahoensis* is generally lacking and has been replaced by *Stipa lettermanii*.

Soils: The soils are shallow and have a strongly developed clay horizon.

Management Implications: Our experience is very limited with this ht. Management practice similar to that used on *A. arbuscula/Festuca idahoensis* ht that occurs at high elevation is recommended until more information becomes available. The availability of seed source of desired species and that of adequate seed coverage would pose major problems in the reestablishment of good ground cover. The short growing season and plant water stress during the seedling establishment stage due to high solar insolation would make revegetation extremely difficult.

ARTEMISIA WYOMINGENSIS/POA SANDBERGII HT
(Arwy/Posa)

This ht is restricted to a small area in western Idaho where precipitation is less than 7 inches annually. There appears to be insufficient moisture to support deep-rooted, long-lived perennial grasses. Where the sagebrush, which averages 2 to 2.5 feet in height, obtains its water for late summer growth remains a puzzle. A similar ht type was described by Franklin and Dyrness (1969) and Daubenmire (1970) but their sagebrush was identified as *Artemisia tridentata* ssp. *tridentata*. We are confident that the ht in the Columbia Basin is similar to the *A. wyomingensis/Poa sandbergii* ht we have in Idaho.

In the *A. wyomingensis/Poa sandbergii* ht, the principal understory species is *Poa sandbergii* with a scatter of *Phlox longifolia* and *Sitanion hystrix*. Ground cover is provided primarily by *Poa sandbergii* and *Tortula ruralis*, a moss that occurs throughout the drier sagebrush types of western Idaho. Annuals such as *Descurania pinnata* and *Vulpia* species may occur sporadically and become abundant where disturbance occurs. *Atriplex spinosa*, a xeric shrub, may be lightly scattered throughout this ht. Under severely disturbed situations, annuals dominate. Where this occurs it is difficult to separate this ht from other disturbed *A. wyomingensis* hts on the basis of vegetation alone.

The *A. wyomingensis/Poa sandbergii* ht borders on the *Ceratoides lanata/Poa sandbergii* and *Atriplex confertifolia* communities on the xeric side and *A. wyomingensis/Stipa thurberiana* or *A. wyomingensis/Agropyron spicatum* hts on the mesic side.

Soils: The soils of this ht occur in the 7 to 8-inch precipitation zone on parent material that is primarily loess over alluvial and lacustrine sediments. The Scism Soil Series is a representative soil of this ht.

The surface horizon is a thin, light-colored silt loam, overlying a weakly developed, strongly calcareous, silt loam B horizon. The B horizon is over a very strongly calcareous, moderately cemented duripan, C horizon at 16 inches. The C horizon grades into stratified alluvial deposits at 36 inches that are high in soluble salts.

The soil family classification is coarse-silty, mixed, mesic, Haploxerollic Durorthid.

Management Implications: This ht has limited value to cattle grazing because of low forage productivity. If used for this purpose, it should be confined to a short period in the spring to utilize the *Poa sandbergii*. There is the danger that the lack of deep-rooted perennial bunchgrass is interpreted as the result of mismanagement or lack of response to management when this is not the case. The ht does not have the capability to support deep-rooted bunchgrasses.

Artificial seeding of this ht would be extremely risky because of low precipitation and the competitiveness of *Poa sandbergii*. Successful establishment on well-prepared seedbed would occur only in those years with precipitation above normal and fortuitous distribution for seedling establishment. Artificial seeding is not recommended in this ht.

The climax vegetation of this ht is generally a low fire-hazard type. Under the right combination of wind and high temperatures, it can burn. Once the sagebrush has been destroyed and *Bromus tectorum* becomes abundant, the vegetation becomes a high fire risk.

ARTEMISIA WYOMINGENSIS/SITANION HYSTRIX HT
(Arwy/Sihy)

This ht was described by Winward (1970) in eastern Idaho, but its authenticity is questioned. The juxtaposition of *A. wyomingensis/Agropyron spicatum* ht on similar soils in the immediate vicinity suggests that the *A. wyomingensis/Sitanion hystrix* ht is either a seral stage or is ecotonal. If large extensive areas with no evidence of deep-rooted, long-lived perennial grasses other than *Sitanion hystrix* occur, it would be reasonable to recognize the area as being a part of the *A. wyomingensis/Sitanion hystrix* ht. If the areas are small, it is likely that the communities are seral and should be considered as part of the *A. wyomingensis/Agropyron spicatum, A. wyomingensis/Stipa thurberiana* or *A. wyomingensis/Stipa comata* ht, depending on the soils involved.

Soils: Adequate profile descriptions are unavailable.

Management Implications: Due to the uncertainty of its habitat type status, no recommendation is made concerning its management. If one gives it a habitat type status, the longevity of *Sitanion* must be kept in mind. It is a relatively short-lived perennial with a life span of less than 10 years, but a prolific seed producer which possesses an effective means of seed dissemination. A significant fluctuation in the population density of *Sitanion hystrix* should be expected in the natural state. More research is needed to determine whether *Sitanion hystrix* represents a subclimax or climax stage.

ARTEMISIA WYOMINGENSIS/STIPA THURBERIANA HT
(Arwy/Stth)

This ht is unique to Idaho and is found on the lower Snake River Plain from Paul to Bruneau. It does not support *Agropyron spicatum*. The primary understory species are *Stipa thurberiana* and *Poa sandbergii. Sitanion hystrix* is a consistent member of the understory and *Agropyron riparium* or *Agropyron dasystachyum* are generally present. The latter species appear to be more responsive to disturbance, i.e., they are seral species.

Annual grasses, particularly *Bromus tectorum*, may be present in varying amounts in any stand. In some areas *Vulpia octoflora* and *Vulpia microstachys* (formerly *Festuca reflexa* and *Festuca pacifica*) occur with and without *Bromus tectorum*.

Perennial forbs are few and well dispersed. Species include: *Phlox longifolia, Antennaria dimorpha, Crepis* *occidentalis, Erigeron pumilis, Allium accuminatum, Astragalus beckwithii* and *Astragalus purshii*. These species may not all occur together in any individual stand, however.

On disturbed portions of this ht, the list of annuals in any single stand is generally greater than the perennial forb list. The annuals are small and generally exert very little influence on the community. In any particular year, any of about ten annual forb species may be dominant among the forb populations.

Tortula ruralis, a moss, is an important contributor to the ground cover. In this and other hts of *A. wyomingensis*, *Tortula* and other cryptogams may contribute in excess of 50 percent.

Disturbance alters the vegetation to a *Bromus tectorum* dominated stand if fire and abusive grazing are involved. Where fire influence is absent and *Stipa thurberiana* has been removed by grazing, the understory is dominated by *Poa sandbergii*. *Sitanion hystrix* is the first large bunchgrass to establish in secondary succession. *Stipa comata* and *Agropyron riparium* may also increase on certain portions of this ht. The reestablishment of *Stipa thurberiana* is extremely difficult because of its low germination and very low seedling vigor. It is unlikely that *Stipa thurberiana* can be reestablished by management alone if the area is dominated by *Bromus tectorum*.

Soils: Common soil series associated with this ht are Minidoka, Portneuf and Pocatello Silt Loam. The boundaries of this ht do not coincide with the distribution of the above soil series, but the ht is restricted to the area from Burley to Hammett on both sides of the Snake River where these soils occur. In some areas, the soils in this ht have been mapped as "Minidoka-like."

The soils have a silt loam surface that is light colored. The profile is very deep and weakly developed. A weakly to strongly developed lime-silica hardpan occurs at 15 to 20 inches.

The soils are classified as coarse-silty, mixed, mesic, Xerollic Camborthid, Typic Camborthid or Durixerollic Camborthid. Temperature is mesic and the moisture regime is aridic. Annual precipitation amounts to 10-11 inches.

Management Implications: Restoration of this ht back to *Stipa thurberiana* dominance is probably unrealistic if the vegetation is dominated by *Bromus tectorum* or is modified to an *A. wyomingensis/Poa sandbergii* community type with few or no *Stipa thurberiana* plants remaining. In case of *Bromus tectorum* dominance it seems that artificial seeding with *Agropyron desertorum* would be the simplest way to attain a perennial grass cover. The other alternative would be to manage for the maximum production and utilization of *Bromus tectorum*.

ARTEMISIA WYOMINGENSIS/AGROPYRON SPICATUM HT
(Arwy/Agsp)

This ht supports *Agropyron spicatum* in the understory in varying amounts. The understory is shared with *Poa sandbergii* and *Sitanion hystrix*. On some microsites *Stipa thurberiana* and *Stipa comata* also occur. This is a widely distributed ht and extends across the upper and lower Snake River Plain and adjacent foothills in Idaho. It occurs where the precipitation is generally less than 12 inches annually. Genetically, there is much variability in *A. wyomingensis*. In eastern Idaho, *A. wyomingensis* is typically short, averaging 18 to 20 inches in height, whereas in western Idaho, it generally grows 24-30 inches tall with increased variability in leaf shape, tending toward what one would expect in *A. tridentata*.

The *Agropyron spicatum* also is variable in this ht. In eastern Idaho, individuals of this species are consistently smaller, generally less than 4 inches in diameter, whereas farther west, plants exceeding 6-8 inches in diameter are common. Neither the rhizomatous form nor the awnless variety of this species, *Agropyron spicatum* var. *inerme* has been found in this ht.

In this classification, areas that support or supported *Stipa thurberiana* and *Stipa comata* as mixtures with *Agropyron spicatum*, are considered to be members of the *A. wyomingensis/Agropyron spicatum* ht. Eckert (1957) considered areas with mixtures including *Agropyron spicatum* to be a phase, i.e., *Stipa thurberiana* phase of the *Artemisia tridentata/Agropyron spicatum* ht. Where *Stipa comata* is the climax dominant, the soils are sandy, coarse textured and/or calcareous.

Sitanion hystrix and *Poa sandbergii* are consistent members of the understory in this ht. *Sitanion* is a seral species and is the first bunchgrass to respond to lessening of disturbance stress, as its seeds are readily disseminated and seedlings are easily established (Schlatterer 1968). Technically speaking, the *Sitanion* that occurs in the *A. wyomingensis* series is *Sitanion hystrix* var. *hystrix*.

Depleted stands in this ht are difficult to distinguish from other depleted stands in the *A. wyomingensis* series. With the understory destroyed by abusive grazing, the density of sagebrush increases, and the understory is reduced to *Poa sandbergii* and annuals.

Destruction of the perennial understory does not automatically convert the vegetation to a *Bromus tectorum* community type. The *Bromus* is unable to flourish and dominate unless the *Artemisia* cover is destroyed or weakened. In situations where there is a good dense cover of *Bromus* under the sagebrush, close examination normally will reveal that the area has experienced fire and the *Artemisia* has established in the *Bromus tectorum* stand.

In depleted stands where the shrub cover is left intact, release from grazing stress generally will permit reestablishment of *Sitanion hystrix* if *Artemisia* cover has not increased to form a closed community (Robertson and Pearse 1945). The return of *Agropyron spicatum* is slow even though scattered remnants are present because of low seed production, low seedling vigor and slow seedling development, particularly in western Idaho where summer precipitation is infrequent.

Because of competition, there is little chance for *Agropyron spicatum* to become reestablished where the shrub cover is destroyed, and *Bromus tectorum* dominates even though a seed source is made available in western Idaho.

Bromus tectorum flourishes extremely well in this ht in southwest Idaho, eastern Oregon, northern Nevada and northern Utah. In eastern Idaho, *Bromus tectorum* does not readily occupy and persist on disturbed sites as it does in western Idaho. There is probably a correlation with the short statured *A. wyomingensis* that was mentioned previously, but this has not been tested.

Soils: The soils of this ht are much varied due to a great variety of soil parent materials and the amount and distribution pattern of precipitation. Common soil series include the Newdale, Panchery, Chilcott, and Elizah among others.

Due to the wide variety of soils and climatic conditions in the 7-12 inch precipitation zone in which this ht occurs, typical examples of soils from five widely different areas are presented.

West of Dubois the soils of the *A. wyomingensis*/*Agropyron spicatum* ht occur on alluvial fans of limestone gravel. The soil surface is light-colored, silt loam over a weakly developed, gravelly loam that is strongly calcareous throughout. Lime-silica cemented gravels occur at about 20 inches deep. This area receives about 9 inches of precipitation annually, with much occurring during the summer growing period.

On the Arco desert, the soils on this portion of the Snake River Plain are formed from loess over basalt bedrock. These soils are Panchery-like with lime accumulation occurring about 12 inches deep. The surface soil is a light-colored, silt loam over a weakly developed B horizon, which overlies a strongly calcareous C horizon. Basalt bedrock occurs at about 4 feet. Precipitation is about 10 inches annually with more than 40 percent occurring during the April-August period. The topography is gently undulating with a thin mantle of loess over basalt flows.

South and east of Twin Falls, the surface horizon is light-colored silt loam over a weakly developed, noncalcareous B horizon. Basalt bedrock is encountered at about 24 inches. Precipitation is about 11 inches with the bulk occurring during the winter and spring period. Topography is gently sloping, following the contour of shield volcanos.

In the Mountain Home area, the soils are more strongly developed and are light-colored silt loam over a strongly developed, noncalcareous, clay loam B horizon that overlies a silica-cemented duripan at 24 inches. The parent material is a thin mantle of loess over a granitic influenced alluvium. Numerous slick spots are associated with these soils.

The soil families included in this ht are loamy, mixed, frigid, Xerollic Camborthid; fine-loamy, mixed, frigid, Xerollic Camborthid; coarse-silty, mixed, frigid, Xerollic Camborthid; coarse-loamy, mixed, mesic, Xerollic Durargid; loamy-skeletal, mixed, frigid, shallow Xerollic Durorthid.

Management Implications: This ht is important spring-fall range for livestock and winter range for big game animals and sagegrouse. *Artemisia wyomingensis* is seasonally browsed by big game and contributes importantly to their diet during the winter months. This is especially true in eastern Idaho where the genotype(s) of this sagebrush subspecies is more palatable than in western Idaho. Livestock use of this sagebrush subspecies is light to moderate, depending on the amount of understory herbage available. Where feasible, a good cover of *Agropyron spicatum* scattered among the shrubs should be a management goal. Where closed communities already exist, grazing management alone will not bring about significant improvement in the understory. In such cases, the shrub cover will need to be reduced to permit the understory to improve.

Opportunities for prescribed burning are limited in this habitat due to low and scattered fuel. Mechanical, and especially chemical treatments remain the most suitable overall methods for decreasing shrub cover and increasing native understory species or establishing new seedlings. Drastic reduction of shrub cover without adequate perennial understory will probably result in rapid invasion by weedy annuals such as *Salsola kali, Sisymbrium altissimum, Descurania pinnata* and/or *Bromus tectorum*. A gradual reduction in shrub cover would permit resident understory perennials to regain vigor and produce a continuous supply of seed for establishment of new seedlings. This is particularly true with *Sitanion hystrix* and *Poa sanbergii*. The return of *Agropyron spicatum* is more rapid in eastern Idaho where the precipitation distribution is more conducive for perennial grass seedling establishment than in western Idaho.

Where reestablishment of perennial grass is the desired management objective and the area is dominated by

Bromus tectorum, artificial seeding appears to be the only solution. *Agropyron desertorum, Elymus junceus, Agropyron inerme* and other introductions suited to the dry sagebrush types are recommended. *Medicago sativa, Melilotus* spp. and other commonly seeded forbs are seldom adapted to this ht. Although short-lived, *Sanguisorba minor* is adapted and can be established (Monsen 1982). *Atriplex canescens*, a salt tolerant shrub, may be successfully established in this ht if the more drought resistant varieties are used. However, *Purshia tridentata*, which is rarely a natural component of this ht is seldom, if ever, successfully established and maintained in this or other *Artemisia wyomingensis* hts.

ARTEMISIA WYOMINGENSIS/STIPA COMATA HT
(Arwy/Stco2)

This ht is edaphically controlled and is restricted to sandy loam or uniformly, highly calcareous silt loam soils in the 8-12-inch precipitation zone. The sandy loam texture precludes *Agropyron spicatum* or *Stipa thurberiana* establishment. *Oryzopsis hymenoides* and *Sitanion hystrix* are consistent members of this community. *Stipa comata* var. *comata* is the complete technical name for the needle-and-thread grass that occurs in all *Artemisia wyomingensis* hts. *Chrysothamnus viscidiflorus* occurs in most stands, showing a natural affinity for sandy textured soils.

Soils: The soils of this ht have not been adequately sampled. The sandy texture and weak to moderate development of the B horizon are the dominant traits. Among others, soils classified in the coarse-loamy, mixed, frigid, Aridic Haploxeroll soil family occur in this ht.

Management Implications: The warm sandy soils are conducive to invasion by *Bromus tectorum* when perennial plant cover is destroyed. Due to the low precipitation, warm temperatures, and sandy soils, this habitat type is highly susceptible to wind erosion when plant cover is destroyed. Where reseeding is contemplated, some type of non-tillage operation may be required. A spring spray program followed by direct-drilling the following fall is often successful. Species for reseeding are the same as those described for the *A. wyomingensis/Agropyron spicatum* ht. However, since this ht tends to be slightly more xeric because of the sandy soil, establishment of seeded species may be a bit more difficult to achieve.

Stipa comata is probably easier to reestablish than many other native perennials because of the tendency of its seeds to bury themselves, and the strong vigor of its seedlings. To increase plant density, management practice that promotes seed production and seedling protection for a two-year period is recommended. Grazing should be postponed during the seed ripening period because the sharp callus on the tip of the caryopsis may inflict eye and mouth injury to animals.

ARTEMISIA TRIDENTATA/AGROPYRON SPICATUM HT
(Artr/Agsp)

The areal extent of this ht has been drastically reduced by cultivation. Areas supporting *A. tridentata* are often confined to swales and edges of cultivated fields. *A. tridentata* is easily recognized by its tall stature, generally exceeding 4 feet in height. Such individuals are often found along roadsides and irrigation ditches where extra moisture is available. Originally, *A. tridentata* occupied much of the floodplains, where the soils are deep and fertile. These were also the areas of early settlements and successful homesteads. The old adage "taller the sagebrush, better the land" suggests that the *A. tridentata/ Agropyron spicatum* ht received the brunt of the impact of homesteading and cultivation more than other hts types in the sagebrush region. *Artemisia tridentata* has been shown to be low on the palatability scale for both domestic livestock and wildlife.

Only a few stands of *A. tridentata* with a perennial grass understory were found. The understory components appeared much like those of the *A. wyomingensis/Agropyron spicatum* ht, except for greater productivity due to deeper and more fertile soils in areas of comparable precipitation. There appears to be no consistent difference in the species make-up to be diagnostic except for the differences in *Artemisia* that make up the overstory.

Because nearly all areas of this ht have been altered, *Bromus tectorum* is found in nearly all stands. *Chrysothamnus viscidiflorus* and/or *Chrysothamnus nauseosus* are generally present. Some stands support a scattering of *Purshia tridentata*.

Soils: We do not have sufficient examples of soil profile descriptions to characterize the soils of this ht. The primary difference between soils of this ht and that of the adjacent *A. wyomingensis/Agropyron spicatum* ht appears to be one of soil depths. The *A. tridentata/Agropyron spicatum* ht occurs on deeper soils.

Soil families included in the *A. tridentata/Agropyron spicatum* ht are mixed, frigid, Xerollic Camborthid; fine, montmorillonitic, mesic, Xerollic Haplargid.

Management Implications: The management of this ht is made difficult because this habitat type is generally restricted to draws and narrow valleys where animals concentrate. The difficulty in improving the understory is further increased because of the ever-present occurrence of *Bromus tectorum* associated with this ht today. The competition provided by *Bromus tectorum* makes reestablishment of native perennials extremely difficult and slow. *Sitanion, Poa* and/or *Stipa* are probably the major native grasses that would act as vanguards before *Agropyron spicatum* would be able to become established in stands dominated by *Bromus tectorum* in this habitat type. Before perennial grasses would be able to reestablish, the competition provided by *A. tridentata* would need to be reduced.

In some situations, removal of the tall *A. tridentata* may not be wise if protective cover for livestock and wildlife is desired. The shade and wind protection provided by this *Artemisia* subspecies may more than offset the benefits obtained by converting to a perennial grass type by artificial seeding, particularly where *A. tridentata* is restricted to narrow stringers in draws and swales.

Where there are large expanses of the *A. tridentata/Agropyron spicatum* ht, management opportunities are fair, as the land productivity is moderately high due to its deep, fertile soils. The fertile soils also bring the problem of *Bromus tectorum*, as it thrives well on soils of high fertility. If *Bromus tectorum* dominates in the understory, artificial seeding is the only practical method of regaining a perennial grass cover. Where annual grass competition is not a problem and a suitable seed source is available, restoration of a perennial grass understory by means of management is economically and realistically achievable. This is particularly true in eastern Idaho where the precipitation pattern is more conducive to perennial seeding establishment than in western Idaho.

Available soil moisture generally persists two to four weeks longer in *A. tridentata* hts compared with *A. wyomingensis* hts. Potential productivity in this ht is from 1.5 to 2 times higher than in the *A. wyomingensis/Agropyron spicatum* ht.

Seeding opportunities include species mentioned for all *A. wyomingensis* hts plus *Agropryon intermedium* and *Agropyron trichophorum*. Additionally, *Medicago, Sanguisorba* and *Melilotus* species and certain ecotypes of *Purshia tridentata* may be successfully seeded.

Fire, chemical and mechanical treatments all have been successful in removing competing shrub cover from poor condition stands in this ht. Decisions as to when and which treatment to use will need to be made on an on-site basis.

ARTEMISIA TRIDENTATA/FESTUCA IDAHOENSIS HT
(Artr/Feid)

The areal extent of this ht is very limited. Others working in the sagebrush region have not reported on the occurrence of this ht, but Lewis (1975) hinted of its probable existence in Nevada. This habitat type was observed in several areas at moderate elevations (6000-7000 ft.). In this ht the understory is dominated by *Festuca idahoensis* and the *Artemisia* overstory varys from 4.5 to 6 feet. The *A. vaseyana/Festuca idahoensis* ht is generally in contact or close proximity to this ht.

It appears that the distribution of this ht may have been more recognizable in the past. Its distribution is probably restricted to well-drained bottom lands of moderate elevation valleys, where precipitation is in excess of 16 inches and the soils are deep and well aerated. Bottomlands supporting vigorous sagebrush in the 6000-7000-foot elevation zone might well belong to this ht. It is possible that the original vegetation has been altered so that the dominant *Artemisia* is presently *A. vaseyana*. This is because *A. tridentata* is readily killed by fire and its reestablishment is relatively slow as compared with that of *A. vaseyana*. Thus, periodic fires where *A. vaseyana* seed source is available may favor temporary encroachment of *A. vaseyana* onto some *A. tridentata* sites.

Soils: These soils occur at mid-elevation of 5500-7000 feet with precipitation of 16-18 inches annually. They are generally found on sloping fans, footslopes, rolling hills and on deep well-drained alluvial bottomlands.

Examples are presented from two widely separated areas, Shoshone Basin near the Idaho-Nevada border, and in the Craters of the Moon National Monument area near Carey, Idaho.

In the Craters' area, the soil is deep with a very thick, dark-colored, silt loam mollic horizon over a weakly developed, silty clay loam B horizon. The B horizon overlies a highly calcareous, silt loam or silty clay loam C horizon at 33 inches.

In the cooler Shoshone Basin, the soil is very deep with dark-colored, loam mollic horizon over a weakly developed, silty clay loam B horizon, which overlies a highly calcareous C horizon at 42 inches. Light to medium amounts of quartzite gravel occur in the profile.

The diagnostic characteristic that separates the *A. tridentata/Festuca idahoensis* ht from an adjacent *A.*

vaseyana/Festuca idahoensis ht is that the soil of the former has a thicker mollic horizon and deeper overall profile than the latter.

Soil families included in this ht are fine-loamy, mixed, Argic Pachic Cryoboroll; and fine-loamy over sandy, mixed, Argic Pachic Cryoboroll.

Management Implications: We have little specific knowledge as to how this ht should be managed. Practices to maintain or to enhance the *Festuca idahoensis* and associated forb species should be of prime consideration. The "Pachic" soil family descriptor indicates that this is a well-drained, deep fertile soil that would respond favorably and rapidly to sound management practices.

ARTEMISIA TRIDENTATA/STIPA COMATA HT
(Artr/Stco2)

This ht has an understory dominated by *Stipa comata* var. *comata* with a shrub layer of *A. tridentata. Purshia tridentata* may contribute significantly to the overstory in some stands. *Agropyron spicatum* and/or *Festuca idahoensis* may be present in small amounts with *Stipa comata. Poa sandbergii, Sitanion hystrix* and/or *Oryzopsis hymenoides* are also often present.

Climatically, this ht is situated between the *A. wyomingensis/Stipa comata* and *A. vaseyana/Stipa comata* hts. It is edaphically controlled and occurs on deep, sandy soils or deep, well-drained, uniform highly calcareous soils.

Stipa comata generally is an increaser species in adjacent hts dominated by *Agropyron spicatum* or *Stipa thurberiana*. Sites that support considerable amounts of *Stipa comata* but with soils of fine or medium texture should be suspected of belonging to another habitat type. Exceptions would be highly calcareous loess soils such as soils that belong to the Wheeler soil series.

The reason for the relationship between sandy soil texture and *Stipa comata* is not precisely known. In our studies, all soils that possess sandy loam or loamy sand texture supported *Stipa comata*. It might be *Stipa's* ability to germinate and emerge from depths of two or more inches that permits it to become established in sandy soils, whereas others fail. The greater depth at which germination and emergence occur enables the root system to remain in contact with a relatively moist environment, while other species are unable to cope with a rapidly drying soil surface because of shallow germination depth.

Soils: This ht occurs in the 10 to 14-inch precipitation zone on deep soils that are sandy or coarse-textured throughout. In low rainfall areas, the surface horizon is a thin, light-colored, noncalcareous, fine sandy loam layer. This overlies a calcareous loam to a sandy loam C horizon, which extends to depths beyond 65 inches.

In the high rainfall portion of its distribution the surface soil is moderately dark-colored, noncalcareous, sandy loam over a weakly developed, sandy loam to loam B horizon. The C horizon is a noncalcareous sandy loam with a moderately developed lime hardpan at about 52 inches.

Soil families include coarse-loamy, mixed, mesic, Xerollic Calciorthid; coarse-loamy, mixed, frigid, Typic Calcixeroll.

Management Implications: Fire, grazing and insects have serious impact on this ht. Summer wildfires are particularly damaging because of the associated high heat that is generated. *Stipa* is readily damaged by fire (Wright and Klemmedson 1965). The lack of vegetational cover after fire exposes the sandy soils to wind erosion, causing dust storms and blowouts. The unstable soil surface is a harsh environment for seedling establishment. Some insect damage comes primarily from *Aroga websterii*, the sagebrush moth. Because of the protection provided by defoliated, but still standing shrubs, wind erosion is generally not a serious problem after insect damage.

ARTEMISIA VASEYANA/AGROPYRON SPICATUM HT
(Arva/Agsp)

The climate of this ht is cooler and more mesic than *A. wyomingensis* and *A. tridentata* hts. *Agropyron spicatum* is the principal understory member. In areas where the soil is of medium to heavy texture this habitat type occupies a narrow elevational zone, whereas in areas where the soil is derived from monzonite (granitic) or limestone, it may be quite broad. The interacting effects of soil moisture, temperature, texture and/or soil nutrients on the distribution of *Agropyron spicatum* are not well understood. This makes interpretation about the distributional pattern of this major bunchgrass species extremely difficult. For example, on limestone derived soils of eastern Idaho, *Agropyron spicatum* dominates on sites that receive up to 16 inches of precipitation annually, whereas on basalt or rhyolite derived soils this species is replaced by *Festuca idahoensis* at about 12-14 inches of precipitation.

The *A. vaseyana/Agropyron spicatum* ht contains considerable amounts of *Purshia tridentata* but does not occur in every stand. *Koeleria nitida* is generally present as are *Eriogonum heracleoides* (and/or *Eriogonum umbellatum), Balsamorhiza sagittata, Lupinus caudatus* (or *Lupinus laxiflorus* or *Lupinus argenteus), Lithospermum ruderale,* and *Achillea millifolium*. Showy forbs such as *Senecio integerrimus, Crepis accuminata* and *Calochortus macrocarpus* may also be present. On disturbed sites annual bromes, notably *Bromus tectorum* and *Bromus mollis* and/ or *Bromus japonicus* often invade on south slopes.

The distinguishing trait of this ht from others that support *A. vaseyana* is the absence of *Festuca idahoensis, Melica bulbosa* and shrubs, such as *Symphoricarpos, Prunus, Ribes* or *Amelanchier*.

Due to more favorable moisture conditions, past disturbance seldom destroys all indicator species of this habitat type. Remnant evidence of *A. vaseyana, Agropyron spicatum, Balsamorhiza sagittata* and *Purshia tridentata* generally persist. Widespread invasion of exotics is not characteristic of depleted conditions, but reduction in density of bunchgrasses with accompanying increases in less desirable forbs such as *Achillea millifolium, Microsteris gracilis, Collinsia parviflora, Lupinus* spp. and bare ground are common.

Soils: The soils of this ht have not been adequately studied. The few soils that have been examined are classified as loamy-skeletal, mixed, Lithic Cryoboroll; coarse-loamy, mixed, Typic Cryoboroll.

Management Implications: Due to the steep south slopes, and particularly on monzonite parent material where this ht is most extensive, management constraints are based more on physical site factors than on vegetation characteristics. Trampling damage probably is more detrimental to the vegetation than grazing. However, wildfires may extensively damage vegetation on steep south slopes during hot, dry summers. Natural reestablishment of seedlings is slow because of unstable soil surface conditions, intense surface temperatures and poor moisture relations.

Due to the southerly exposure, this ht is utilized by big game before many of the plants have had time to build up reserves. This is especially so with *Agropyron spicatum*, which cannot tolerate continued close grazing. Shortly after big game move off the areas, livestock often follow, giving plants very little time to produce adequate reserves for the succeeding season. It would be good practice in those areas where this ht is used as winter big game range to retain a fair abundance of *A. vaseyana* for winter browse, as it is relatively palatable and provides much energy for big game, especially on portions of this habitat type.

Artemisia vaseyana tends to occur in greater density and foliage cover compared with other *Artemisia* species. Seed from *A. vaseyana* which is present in the upper 2 cm of soil can be stimulated during prescribed burning while seeds of other subspecies are either not influenced or are damaged by fire. This unique property, along with its relatively favorable site conditions, may result in rapid reestablishment of *A. vaseyana*. This should be a consideration in selecting kind of treatment to reduce shrub cover on *A. vaseyana* hts, as it can influence the life expectancy of the project.

Important seeding species include all grasses, forbs and shrubs mentioned for the *A. wyomingensis* and *A. tridentata* habitat types. Additionally, *Poa ampla, Bromus carinatus* and *Bromus inermis* may be seeded.

ARTEMISIA VASEYANA/FESTUCA IDAHOENSIS HT
(Arva/Feid)

This ht occurs in a cooler and more mesic position than the *A. vaseyana/Agropyron spicatum* ht. On non-limestone soils of fine to medium texture this ht begins at about 5000 feet in elevation in the 12 to 14-inch precipitation zone. It has not been found on coarse textured granitic soils with south exposure but is found on south facing slopes on soils that are fine or medium textured. The distribution of *Festuca idahoensis* is not as simple as once believed. Soil texture interacts with moisture, slope exposure (solar radiation, hence temperature) and/or nutrients and affects *Festuca's* distribution. *Festuca* is absent on monzonite derived soils on south slope at elevations in excess of 7000 feet, even though precipitation is in excess of 16-18 inches annually. Limestone derived soils support *Festuca idahoensis* only in areas where precipitation exceeds 16 inches annually in southern idaho. It has not been determined whether the physical or chemical properties of these two kinds of soils are responsible for the restricted distribution of *Festuca idahoensis* where moisture and temperature conditions appear suitable.

This ht is similar to the *A. vaseyana/Agropyron spicatum* ht except for the conspicuous presence of *Festuca. Balsamorhiza, Lupinus, Crepis, Senecio,* and *Castilleja* are common forb members in both habitat types.

Soils: Due to the wide distribution of this ht, soil profile characteristics from five widely separated areas are presented to illustrate their commonality and show their differences.

North of the Dubois Sheep Station in Clark County, the soil is deep with a thick, moderately dark, silt loam surface horizon overlying a weakly developed, silt loam B horizon. The C horizon of basalt cobbles and boulders is strongly calcareous. Basalt bedrock occurs at about 50 inches.

In the upper Birch Creek Drainage, the soils are deep to moderately deep over limestone gravels. The soils are skeletal with a moderately thick, dark, silt loam surface horizon, overlying a calcareous, gravelly silt loam C horizon. A weakly formed silica-cemented duripan occurs at 36 inches.

In the Big Wood Drainage, near Sun Valley, the soils are deep residuals derived from rhyolitic volcanics. The surface horizon is very thick and a very dark loam. The B horizon is a moderately developed, gravelly sandy clay loam overlying a very gravelly clay loam C horizon. The soil is noncalcareous throughout.

In the Shoshone Basin, south of Twin Falls, at about 6000 feet in elevation, the soil is moderately deep and residual from old alluvial basalt gravels. The surface horizon is thick, dark colored, silt loam that overlies a gravelly silty clay loam B horizon. The C horizon of basalt gravels begins at 30 inches.

In Owyhee County, near Three Creek, the soil is moderately deep, developed from alluvial basalt gravels. The mollic surface horizon is very thick and moderately dark, overlying a moderately developed, clay loam B horizon that grades into a basalt gravel C horizon at 30 inches. The soil is noncalcareous throughout.

Soil families included are fine-loamy, mixed, Calcic Pachic Cryoboroll; loamy-skeletal, mixed, Calcic Cryoboroll; fine-loamy, mixed, Argic Pachic Cryoboroll; fine-skeletal, mixed, Argic Pachic Cryoboroll. A common feature of all *A. vaseyana/Festuca idahoensis* sites is the 4-8 inch mollic surface horizon.

Management Implications: Other than the physical constraints, there is no special hazard. Wildfires are not overly common in this ht due to its generally more mesic environment. When they do occur, however, significant mortality in *Festuca idahoensis* may result. Unless a good understory cover is present, the reestablishment of *A. vaseyana* after a wildfire may be such that the shrub density may increase many-fold.

During the winter of 1976-1977, widespread mortality of *A. vaseyana* occurred in this ht above 7000 feet due to lack of snow cover (Hanson et al. 1982). Interestingly, mortality was restricted to the north-easterly slopes and scattered bottomlands, whereas *A. vaseyana* on uplands and on southerly slopes escaped damage.

As in the *A. vaseyana/Agropyron spicatum* ht, the density of *A. vaseyana* often is increased after wildfires due to reduction in bunchgrasses, suitable soil surface moisture conditions for *Artemisia* seedling establishment, and the tendency for *A. vaseyana* seed to be stimulated by fire. Investigations have shown that *A. vaseyana* seed germination is enhanced by heat treatment. As the crowns of the individual sagebrush plants coalesce, the understory is further reduced because of shading.

At some locations dense stands of this *Artemisia* subspecies are used by wildlife, especially during portions of their reproductive cycle. Some of these special areas may need to be maintained in a dense shrub stage for this purpose. Generally a 10-20 year cycle of shrub removal or thinning will have to be used to maintain proper densities of associated herbaceous species.

All seeding species adapted for the *A. vaseyana/Agropyron spicatum* ht are suitable for establishment in this ht. Some species, notably *Purshia tridentata*, may be established more successfully on ecotypes that closely match the relatively short frost-free growing period of this ht.

ARTEMISIA VASEYANA/STIPA COMATA HT
(Arva/Stco2)

This ht, restricted to sandy soils within the elevational and precipitation range of *A. vaseyana*, is not extensive. *Stipa comata* var. *intermedia* is the principal understory species. According to Winward (1970), this variety of *Stipa comata* is restricted to the *A. vaseyana/Stipa comata* ht, whereas *Stipa comata* var. *comata* is associated with hts that occur in the warmer and drier climates. *Agropyron spicatum* and/or *Festuca idahoensis* and *Koeleria nitida* are generally present at least on scattered microsites. At the upper elevational range a scatter of *Symphoricarpos oreophilus, Amelanchier alnifolia* and/or *Purshia tridentata* may also be present. *Chrysothamnus viscidiflorus* and *Tetradymia canescens* are common.

Soils: Presently, no standard soil profile description is available for this ht.

Management Implications: Care should be taken in grazing as the seed ripe stage of *Stipa* approaches. The sharp callus of the caryopsis may cause mouth injury to livestock. Hot summer wildfires can seriously damage *Stipa* *comata*. Assuming that *Stipa comata* var. *intermedia* and var. *comata* respond similarly to clipping and burning (Pearson 1964, Wright and Klemmedson 1965, Wright 1967), it would appear that burning or heavy grazing during June through August would be damaging to the plant.

Nonstructural improvement practices would be similar to those practiced in the *A. vaseyana/Agropyron spicatum* ht, except that additional care must be used not to expose the soil surface to wind erosion.

ARTEMISIA VASEYANA/SYMPHORICARPOS OREOPHILUS/AGROPYRON SPICATUM HT
(Arva/Syor/Agsp)

This ht occurs toward the upper elevational range of *A. vaseyana*. Mountain brush species such as *Symphoricarpos oreophilus, Prunus virginiana, Amelanchier alnifolia* and/or *Ribes cereum* are conspicuously present. Although *Symphoricarpos oreophilus* is included in the name of this habitat type, it may not be present in all stands. *Purshia tridentata* occurs in many stands of this habitat type. The elevational range of this ht is between 6000 and 8500 feet on granitic or gravelly soils with southerly exposure. This ht often adjoins forest types dominated by *Pinus contorta, Abies lasiocarpa* or *Pinus albicaulis*.

The principal understory species is *Agropyron spicatum* var. *inerme* with a good representation of *Melica bulbosa. Festuca idahoensis* is lacking, or present only in trace amounts. The reason for the lack of *Festuca* is not understood. The presence of *Stipa columbiana* in the higher elevation is an indication of past disturbance and not an indication of good ecological condition, although it provides good ground cover. *Linanthastrum nuttallii* often occurs at the upper elevation range of this ht. The variety of forbs is generally significantly less on soils derived from granitic parent material (monzonite) than from basalt or rhyolite under comparable growing conditions.

Soils: We do not have sufficient experience with the soils of this ht to characterize their properties.

Management Implications: This ht is important summer-fall range for big-game animals. The palatability of the shrub species are generally fair to good for livestock as well as for big game. Steepness of slope and erosive nature of the soils must be considered in using this ht for livestock grazing. Potential to respond to management practice would be considered fair to good provided that an adequate seed source of the desired species is available.

ARTEMISIA VASEYANA/SYMPHORICARPOS OREOPHILUS/FESTUCA IDAHOENSIS HT
(Arva/Syor/Feid)

This ht supports *Festuca idahoensis* in the understory. The ht occurs on all exposures except southerly exposed sites with coarse textured soils. The combination of southerly exposed slopes and coarse textured soils appears to preclude the occurrence of *Festuca idahoensis. Melica bulbosa* and *Koeleria nitida* are conspicuously present with *Festuca idahoensis*. Due to more productive soils and better moisture conditions, the ground cover is more complete and the forb component is richer than in the *A. vaseyana/Symphoricarpos oreophilus/Agropyron spicatum* ht.

High densities of *Stipa columbiana* and/or *Stipa lettermanii* are indications of past disturbance. There is no evidence that these two *Stipas* are climax dominants in any sagebrush-grass associations but are species that increase with disturbance. Little is known about their ecology.

Soils: Soils of this ht occur at moderate to high elevation on acid igneous to basalt parent materials. On acid igneous materials, the soils have dark to very dark grayish brown, very thick, gravelly loam surface horizons. The underlying B horizons are gravelly loam that is high in clay to gravelly clay loam. The development is moderate and depths are moderate.

Soils derived from basalt are finer textured, being higher in silt and clay, and lower in gravel content than soils developed from acid igneous materials.

Soil families of this ht include fine-silty, mixed, Calcic Pachic Cryoboroll; coarse-loamy, skeletal, mixed, Typic Cryoboroll.

Management Implications: Potential for response to proper management is good. In areas where *A. vaseyana* is overly dense, control with herbicides is good, but there may be a 2-to 5-year reduction in production of some forb species. Reduction of some species may be beneficial if they, like sagebrush, are out of balance with the natural species composition of the site. On the other hand, temporary loss or severe reduction of certain species that are especially valuable to wildlife may preclude chemical treatment in some localities. A properly prescribed burn should also be considered as possible means to reduce the density of *A. vaseyana*. Mortality of associated shrubs would be minimal because most would resprout. Follow through management is a must after treatment.

Special prescription may be needed to avoid permanent loss of *Purshia tridentata, Festuca idahoensis* and decadent mountain brush species due to fire damage. Reduction of *Artemisia vaseyana* cover will likely be more temporary with fire compared with 2,4-D, due to the stimulating effect of fire on the germination of *A. vaseyana.* Not enough is presently known concerning the effect of fire on most perennial forb species. Fire should be used with caution as a means of altering species composition on all *Artemisia vaseyana* hts.

ARTEMISIA VASEYANA/SYMPHORICARPOS OREOPHILUS/CAREX GEYERI HT
(Arva/Syor/Cage)

This is a very restricted ht. It is located at a higher elevation than the *A. vaseyana/Symphoricarpos oreophilus/Agropyron spicatum* ht and receives more precipitation. *Carex geyeri* is the prominent understory species. *Agropyron caninum* is probably more important than *Agropyron spicatum* in these higher elevation hts, but separation of the two species is not readily apparent. The ht occurs on all exposures and is not constrained by soil textures. It is essentially an altitudinal extension of the *Artemisia vaseyana/Symphoricarpos oreophilus/Agropyron spicatum* ht, and may occur as high as 8000 to 8500 feet in some areas. *Linanthastrum nuttallii* is a common forb, and *Balsamorhiza sagittata* is a prominent member even at this higher elevation, extending its distribution across the entire range of *A. vaseyana* and *A. "spiciformis."* Forb production generally exceeds that of the grass and grass-like component of the understory.

It appears where soils are deep at these high elevation conditions, that the *A. vaseyana* is replaced by *A. "spiciformis"* without obvious difference in the associated species. The extensiveness of the *A. vaseyana/Symphoricarpos oreophilus/Carex geyeri* may be so restricted or transitional to *A. "spiciformis"/Symphoricarpos oreophilus/Carex geyeri* ht, that it may merge with the latter. More study is needed to identify the true differences between the two hts. At present, if they occur in separable mapping units, the identity of the two hts should be kept.

Soils: The soils of this ht have not been adequately described.

Management Implications: Production of herbaceous species is high, and under proper summer use this ht provides valuable summer range for domestic livestock as well as for deer and elk. Due to the steep slope of much of the terrain which this ht occupies, physical management constraints predominate. Animal distribution and trampling problems on steep erosive soils would be of primary concern.

ARTEMISIA VASEYANA "XERICENSIS"/AGROPYRON SPICATUM HT
(Arxe/Agsp)

The distribution of this ht is strictly in western Idaho, occurring primarily in Elmore, Ada, Boise, Gem, Payette and Washington counties. The distribution of *A. "xericensis"* is climatically controlled, restricted to a narrow zone less than 4500 feet in elevation, with precipitation in excess of 12 inches, but with relatively warm summer temperatures. At higher elevations, the summer temperatures are cooler, and *A. vaseyana* replaces *A. "xericensis."*

Artemisia "xericensis" is easily confused with subspecies *A. tridentata*, as there is little difference in growth form and stature of shrub, both possessing an uneven topped appearance and often exceeding 4 feet in height. In typical specimens, there is a distinct difference in leaf morphology, the *A. tridentata* possessing a narrow strapped-shaped leaf with a length/width ratio exceeding 4.0. The *A. "xericensis"* has a broader leaf with a length/width ratio of less than 4.0. There are numerous situations where the leaf shape is an intergrade of the two subspecies that positive identification based on leaf morphology alone is not always reliable.

Positive separation between *A. "xericensis"* and *A. tridentata* is made by the blue-cream fluorescence of *A. "xericensis"* when immersed in methanol or water and illuminated with a long wave ultra-violet lamp in a darkened room. *Artemisia tridentata* fluoresces reddish brown (Tables 2 and 3).

The *A. "xericensis"/Agropyron spicatum* ht occupies nearly the entire range of this *Artemisia* subspecies. Although precipitation is ample, the high summer temperatures at low elevation are apparently responsible for the absence of *Festuca idahoensis*, except on steep north slopes.

There is considerable variability in this ht due to the wide range of precipitation, elevation and parent materials. At the xeric end, *Agropyron spicatum* is a typical bunchgrass, whereas at the mesic end of the ht, individual *Agropyron* clumps are weakly rhizomatous. The forb component increases in importance with moisture. Prominent forbs are *Balsamorhiza sagittata, Lupinus laxiflorus, Achillea millefolium, Hydrophyllum capitatum* and *Eriogonum heracleoides*, all indicators of better moisture conditions than hts of the *A. wyomingensis* series.

Purshia tridentata is well-represented in the habitat type on all soils, although its abundance is much reduced because of repeated fires. The *Purshia* ecotype is of the tall upright form, which is more susceptible to fire damage than other ecotypes. *Chrysothamnus nauseosus* is much more prominent in this ht than is *Chrysothamnus viscidiflorus.*

Much of this ht has been badly abused in the past by improper grazing and repeated fires. The original bunchgrass understory vegetation has been largely replaced by *Bromus tectorum* and other annuals, particularly *Bromus japonicus* and *Vulpia megalura*. During the past 25 years, *Taeniatherum asperum*, an introduced winter annual grass, has invaded and replaced the annual bromes and presently dominates that portion of the ht that occurs on heavy-textured soils. *Bromus tectorum* still dominates on the light-textured soils.

On coarse-textured monzonite derived soils from Emmett to Boise along the "Boise Front," *Aristida longiseta*, an unpalatable native perennial bunchgrass, occurs as the dominant understory species in scattered localities. The ecological status of this species is not known but is suspected to be seral to *Agropyron spicatum*, at least in this area.

Soils: The soils of this ht are deep to very deep with a very thick, dark-colored loam to silt loam surface soil. The B horizon is of clay to clay loam texture and overlies a C horizon that is loam to clay loam at depths greater than 45 inches. These soils are noncalcareous throughout. The soils are derived from strongly weathered basalt or granitic parent materials.

Soil families include fine-loamy, mixed, mesic, Pachic Argixeroll; fine, montmorillonitic, Pachic Argixeroll.

Management Implications: The *A. "xericensis"/Agropyron spicatum* ht has high production potential as it has good moisture and temperature conditions for growth in spring and summer. Today, most areas are producing considerably less than their potential, however. Much of the ht occupies terrain that is steep and rocky, making direct range improvement difficult. *Taeniatherum asperum* is a serious management problem. The natural replacement of *Taeniatherum* and other annuals by secondary succession is *Sitanion hysterix* var. *californica* (Sindelar 1968). Rapid reestablishment of *Agropyron spicatum* after *Sitanion* is doubtful because of lack of natural seed source and poor competitive ability of *Agropyron spicatum* seedlings, particularly against introduced annuals. Succession to the *Sitanion* stage by management appears attainable where a seed source is available. However, unless the *Sitanion* is soon replaced by a long-lived perennial, the area will vacillate back to the annual grass stage because *Sitanion* is short-lived.

Direct seeding efforts have been successful where adequate seedbeds have been prepared. In the xeric portion of this ht, *Agropyron desertorum, Agropyron sibiricum, Agropyron cristatum* and *Elymus junceus* have all been successful in species trials. In the higher precipitation areas, which receive more than 14 inches annually, rhizomatous species such as *Agropyron intermedium* and *Agropyron trichophorum* provide better soil protection than do the bunchgrasses on heavy-textured soils. Frost heaving is a serious problem for seedling establishment on-heavy textured soils.

ARTEMISIA VASEYANA "XERICENSIS"/FESTUCA IDAHOENSIS HT
(Arxe/Feid)

There is a narrow moisture-temperature zone in which the distribution of *A. "xericensis"* and *Festuca idahoensis* overlaps, which is the basis for recognizing this ht. The ht occupies a narrow zone where the temperature is low enough to support *Festuca idahoensis*, but not cool enough for *A. vaseyana* to replace *A. "xericensis."*. This ht occurs on steep north slopes in areas that are predominately of the *A. "xericensis"/Agropyron spicatum* and *A. rigida/Poa sandbergii* hts. The forb population is slightly richer than in the more xeric *A. "xericensis"/Agropyron spicatum* ht. In general, the associated species in the two hts do not differ greatly, and many of the species are shared.

Soils: No soil profile has been critically examined and described for this ht.

Management Implications: The areal extent of this ht is very limited. At the higher elevational reaches of *A. "xericensis"* distribution, *Taeniatherum asperum* is not a problem as it is in the warmer and more xeric *A. "xericensis"/Agropyron spicatum* ht. Management of this ht should be aimed at maintaining or increasing ground cover, as soil stability is of primary concern. Frost heaving tends to be naturally severe because of high soil-clay content.

ARTEMISIA VASEYANA "SPICIFORMIS"/BROMUS CARINATUS HT

(Arsp/Brca)

Artemisia "spiciformis" is found at the upper elevational range of *A. vaseyana*, and generally occupies the well-drained bottomlands and gentle slopes from 7000 to 9500 feet elevation in areas that receive more than 18 inches of precipitation. This sagebrush is distinguished from *A. vaseyana* by its large ephermeral leaves that measure 3-5 cm or more in length. The number of florets per spikelet is greater than six, whereas *A. vaseyana* has four to six florets per spikelet.

This ht is recognized by the presence of *A. "spiciformis"* and the absence of *Carex geyeri* in the understory. It includes those communities that support significant amounts of *Bromus carinatus* and/or *Festuca idahoensis*, with or without *Symphoricarpos oreophilus*. Communities supporting measurable amounts of *Carex geyeri* are included in the *A. "spiciformis"/Carex geyeri* ht (Winward 1970, Schlatterer 1972). *Symphoricarpos* may or may not be conspicuously present in either habitat type.

The shift of the dominant understory species from site to site remains unexplained, and we lack adequate knowledge concerning these high elevation species. The ecological amplitude of *A. "spiciformis"* is restricted, but includes a range of conditions that support a wide variety of understories.

Soils: The soils are derived from acid igneous rocks on glacial moraines that are gently sloping at elevations between 7000 and 9500 feet. The soils are deep to very deep and well drained.

The soils have very dark, grayish brown, moderately thick, umbric surface horizons that are very gravelly sandy loam to very gravelly silt loam. The surface horizons overlie a weakly developed, very gravelly, sandy loam to loam B horizon, which extends to depths of 45 to 48 inches. The C horizon is very gravelly glacial till material.

The soil families included in this ht are coarse-loamy, skeletal, mixed, Typic Cryumbrept; fine-loamy, skeletal, mixed, Typic Cryumbrept.

Management Implications: The *A. "spiciformis"/Bromus carinatus* ht often occupies gently rolling or level terrain, making this ht more suitable for cattle than other hts that support *Symphoricarpos*. The behavior of *A. "spiciformis"* is similar to that of *A. vaseyana*, and will increase in density and cover with reduction in herbaceous cover. Successful prescribed burning may be more difficult to attain. Fire spread from shrub to shrub would be minimal in this vegetation type due to its mesic nature and gentle terrain. Spray-release programs generally have been successful, since native understory species normally persist under the sagebrush crowns. Managers should consider temporary damage to the rich forb populations associated with this ht before treatments are initiated. Where seeding is required, *Agropyron intermedium* and *Bromus inermis* have been most successful. *Bromus carinatus, Phleum pratense* and *Dactylis glomerata* also may be seeded, but are generally relatively short-lived in this ht.

ARTEMISIA VASEYANA "SPICIFORMIS"/CAREX GEYERI HT

(Arsp/Cage)

This ht is essentially similar to *A. vaseyana/Symphoricarpos oreophilus/Carex geyeri* ht with *A. vaseyana* replaced by *A. "spiciformis."* This replacement is suggestive that deeper soils are involved, as indicated by the pachic designation in the soil classification. The understory is dominated by *Carex geyeri*, with associated species including *Festuca idahoensis, Sitanion hystrix, Poa nervosa, Eriogonum heracleoides,* and *Haplopappus suffruticosus. Symphoricarpos oreophilus* and *Ribes cereum* are generally present. Productivity has been estimated at 500-700 pounds per acre (Schlatterer 1972).

Soils: The soils in this ht have not been adequately studied.

Management Implications: Deterioration is apparent with the breakup of *Carex geyeri* sod and replacement by *Festuca idahoensis, Stipa occidentalis* and *Bromus carinatus* (Schlatterer 1972). Little is known about the recovery process of *Carex geyeri*. Observations indicate that reestablishment by seed is rare or nonexistent, and recovery of *Carex geyeri* is limited to vegetative spread, making recovery a very slow process.

ARTEMISIA TRIPARTITA/AGROPYRON SPICATUM HT

(Artr2/Agsp)

The *Artemisia tripartita/Agropyron spicatum* ht is restricted to the eastern half of Idaho and climatically occupies a position between *A. wyomingensis* and *A. vaseyana* series. Its distribution is sporadic and discontinuous. No diagnostic or recurring soil characteristics appear to be related to the distribution of *A. tripartita*. Interestingly, the *A. tripartita/Agropyron spicatum* ht is apparently unique to Idaho. Both Montana and Washington have reported the presence of the *A. tripartita/Festuca idahoensis* ht but not the drier *A. tripartita/Agropyron spicatum* ht.

Artemisia tripartita behaves differently than the species and subspecies of the *A. tridentata* complex. This species has the ability to resprout from the base after defoliation or fire. Some populations tend to sprout more than others. In areas where widespread mortality of *A. vaseyana* had occurred during the winter of 1976-1977, *A. tripartita* recovered and produced vigorous root sprouts in individuals whose crowns were severely damaged or killed back by the unusual winter conditions (Hanson et al. 1982).

The dominant grass in this ht is *Agropyron spicatum. Koeleria nitida* is generally present, but in low abundance. *Poa sandbergii* is a common increaser species. The perennial forb population is relatively rich. When present, *Balsamorhiza sagittata* contributes substantially to the annual production.

Soils: Soils supporting *A. tripartita* do not have any outstanding diagnostic characteristics. In the Pocatello area, near the southern limit of the *A. tripartita* distribution, the soil is very deep, developed from calcareous loess, with a thick, moderately dark, silt loam mollic surface horizon. The B horizon is weakly developed, and grades into a highly calcareous silt loam C horizon that may extend deeper than 8 feet.

In the Dubois area, the soil is moderately deep, developed from a mixture of basalt and loess. The mollic surface horizon is a moderately dark silt loam, overlying a weakly developed, silt loam B horizon. Basalt bedrock is encountered at 26 inches.

In the Birch Creek drainage, the soil is derived from alluvial limestone gravel and is moderately deep. The mollic surface horizon is a very thick, moderately dark loam overlying a weakly developed, calcareous loam B horizon. The C horizon is very cobbly, gravelly, highly calcareous loam sand, which has a strong lime-silica cemented duripan at 29 inches. The soil is gravelly to very gravelly throughout.

In the Salmon area, the soil is deep, developed from granite diorites. It has a very thick, moderately dark, loam mollic surface horizon, which overlies a gravelly, moderately developed, clay loam B horizon. The C horizon is at a depth of 40 inches and is a gravelly loam. This soil is noncalcareous throughout.

Soil families in this ht include fine-loamy, mixed, frigid, Calcic Haploxeroll; loamy, mixed, frigid, Calcic Haploxeroll; loamy-skeletal, mixed, Calcic Pachic Cryoboroll; fine-loamy, mixed, Calcic Pachic Cryoboroll.

Due to *A. tripartita's* ability to resprout, spraying with 2,4-D or burning has provided only limited sucess in controlling this sagebrush. There is evidence that prescribed burning of *A. tripartita* in some areas may encourage a large number of plants to sprout, whereas in other areas, only a few plants would do so. There is evidence that we may be dealing with different ecotypes of this sagebrush species, and that some populations are responding differently to the same prescribed burning treatment.

Artemisia tripartita provides food, cover and nesting habitat for sagegrouse. To what extent it is commonly utilized by big game is not known. *Bromus tectorum* is generally not a problem in this ht even though the vegetation may be severely disturbed.

Periodic chemical or mechanical treatments may be the only way to keep densities of *A. tripartita* at a low enough level to allow healthy stands of herbaceous species. Reseeding species would include those adapted to the drier *A. vaseyana* habitat type.

ARTEMISIA TRIPARTITA/FESTUCA IDAHOENSIS HT

(Artr2/Feid)

This ht occupies a more mesic position than the *A. tripartita/Agropryon spicatum* ht. Its upper elevational limit is about 7500 feet. *Festuca idahoensis* is the primary understory species with *Agropyron spicatum* occurring in varying amounts.

Tetradymia canescens is present in most stands, suggesting that fire may have played an important role in many *A. tripartita* stands. Perennial forbs such as *Antennaria microphylla, Crepis acuminata, Microseris nutans* and *Astragalus miser* have high constancy. *Poa pratensis* is a common increaser species. The terrain occupied by this ht is generally gentle and the soils are moderately deep. An explanation for the distribution pattern of *A. tripartita* is not presently available.

Soils: There is no consistent diagonstic soil profile characteristic that differentiates soils of this ht from those of the adjacent *A. vaseyana/Festuca idahoensis*. The soils are moderately deep with moderately dark-colored surface horizon. Soil families in this ht include fine-loamy, mixed, frigid, Calcic Argixeroll; fine-loamy, mixed, frigid, Calcic Haploxeroll; loamy-skeletal, mixed, frigid, Typic Haploxeroll; loamy-skeletal, mixed, Calcic Cryoboroll.

Management Implications: *Artemisia tripartita* is used to some degree by big game and provides cover, food and nesting habitat for sagegrouse. The shrub density tends to increase with overgrazing as the understory cover is thinned. Control of *A. tripartita* by use of herbicide has had limited success because the shrub tends to sprout when the crown is damaged or killed. The same is true when fire is used. Due to the forb component in this ht being richer than in the *A. tripartita/Agropyron spicatum* ht, serious consideration of tradeoffs between use of fire or herbicide should be given. With early spring burning some loss would be expected in *Festuca idahoensis*, but may be acceptable considering what is gained. Regardless of the method of control of *A. tripartita*, management must capitalize on the temporary reduction in sagebrush competition to establish understory species once temporary control is attained.

ARTEMISIA CANA SSP *VISCIDULA/FESTUCA IDAHOENSIS* HT

(Arvi/Feid)

This ht, described by Schlatterer (1972), often occurs as stringers along stream courses or meadows where soil moisture is high. Associated species in addition to *Festuca idahoensis* often include: *Agropryon caninum, Potentilla glandulosa, Taraxacum officinale* and other species associated with high moisture conditions. A scatter of *Potentilla fruticosa* may be present (Tuhy 1981), but if abundant, an *Artemisia cana* ssp. *viscidula/Potentilla fruticosa* ht should be considered. Extensive areas of *A. viscidula* do not occur in Idaho (Beetle 1960), whereas in the Gros Ventre area of Wyoming, extensive meadow-like areas support this sagebrush subspecies. The *A. viscidula/Festuca idahoensis* ht has not been intensively studied in Idaho.

Soils: The soils under *A. viscidula* are basically well drained during part of the season, with the water table generally dropping below a meter in depth. The soils reported are classified as Mollic Cryoboralf and Aquic Cryoboroll (Tuhy 1982).

Management Implications: Due to inexperience with this ht, only a few management recommendations are offered. This ht is capable of producing over 2000 pounds of dry weight herbage per acre. Lowering in vegetational condition shows up in an obvious loss of vigor of understory species with a subsequent change in species composition. *Poa pratensis* is a common increaser species as the bunchgrasses decline. Proper livestock grazing should be stressed because follow-up improvement treatments are difficult after severe depletion has occurred.

PURSHIA TRIDENTATA/AGROPYRON SPICATUM HT

(Putr/Agsp)

We have not personally observed this ht in southern Idaho, but it may be present as small isolated stands overlooked particularly in the transition area with the Palouse grasslands. It has been reported in Montana, west of the Continental Divide in the Bitterroot Valley (Mueggler and Steward 1980). In Oregon and Washington, this ht is associated with the *Pinus ponderosa/Purshia tridentata* ht and adjacent grassland (Daubenmire 1970). A likely area where this ht may occur in Idaho would be the Middle Fork drainage of the Salmon River (Claar 1973).

Purshia is distributed in scattered and varying amounts where *A. vaseyana, A. "xericensis"* and *A. tridentata* occur. It is not associated with *A. wyomingensis* except in unique situations. It may occasionally be found growing on rocky sites that support *A. arbuscula*.

The shrub layer of the ht is predominately *Purshia tridentata* with varying amounts of *Chrysothamnus nauseosus*. Woody *Artemisia* species are virtually absent, and the aspect gives one the impression of a *Purshia* stand superimposed on a Pacific Northwest grassland. The understory consists of *Agropyron spicatum, Poa sandbergii* and frequently *Koeleria nitida*. Annual bromes, particularly *Bromus tectorum*, are generally present. *Balsamorhiza sagittata, Achillea millefolium* and *Lupinus* species are the conspicuous perennial forbs.

Soils: Soils are coarse textured, particularly in the Idaho batholith region. The soils are rocky, dry and erosive due to parent material, exposure and steepness of slope. Soil surface temperatures in excess of 65 degrees are common.

Management Implications: This ht is particularly valuable as big game winter range. Its southerly exposure makes for conditions where snow accumulation is minimal and *Purshia* provides the bulk of the browse. Livestock also prefer *Purshia* as browse. Sheep utilize it throughout the grazing season, but cattle use it more intensively after leader growth has approached maturity, usually in late June and early July. Repeated browsing in excess of 60 percent during winter may cause gradual stand deterioration. Browsing during mid- and late-summer is more damaging than early browsing. Earlier use provides the shrub sufficient time to grow back and to restore food reserves. Normally, establishment of *Purshia* seedlings is difficult because of highly variable soil surface temperatures and plant competition. In addition, seed of *Purshia* is highly sought after by small rodents (Holmgren 1956, Holmgren and Basile 1959). Seeds not consumed immediately after seed fall are often cached. Unrecovered caches are often microsites for new seedlings.

Due to steep slopes and the inherent erosive nature of granitic soils, trampling effect is greatly magnified in central Idaho. Young plants that manage to survive the first season are susceptible to physical displacement by animal hooves. Thus, stand recovery is slow after the perennial understory is destroyed. Reestablishment of perennials is further impeded by plant competition from annuals, particularly *Bromus tectorum*. This annual species does extremely well because of the warm, sunny, southerly exposure and ample moisture.

PURSHIA TRIDENTATA/STIPA COMATA HT
(Putr/Stco2)

This habitat type is neither extensive nor has it been properly described. In areas of sand, such as northeast of Idaho Falls, sagebrush is replaced by *Purshia tridentata*, with an understory dominated by *Stipa comata*.

Soils: No soil profile description is available.

Management Implications: Due to the sandy soils, blowouts would be of primary concern. An adequate ground cover needs to be preserved.

CERCOCARPUS LEDIFOLIUS/AGROPYRON SPICATUM HT
Celo/Agsp)

The distribution of *Cercocarpus ledifolius* occurs in the upper foothills that surround the Snake River Plain, except for the northwest sector. Extensive stands of *Cercocarpus* occur in the Big Lost and Little Lost River drainages, some as large as 200 acres. In other areas, the stands are generally small and often limited to rock outcrops. *Cercocarpus ledifolius* var. *ledifolius* appears to be associated with the distribution of the sagebrush types in the Intermountain region. The var. *intercedens* has a more northerly distribution, occurring in Washington, Oregon, northern Idaho, northern Wyoming and Montana.

Cercocarpus ledifolius has a sporadic distribution, and occurs with *A. vaseyana*, *Juniperus occidentalis*, *Juniperus osteosperma*, and *Pseudotsuga menziesii*. Occasionally it is found with *Pinus ponderosa* and *Pinus flexilis*.

The *Cercocarpus ledifolius/Agropyron spicatum* ht occurs on limestone derived soils. *Agropyron spicatum* and *Poa sandbergii* are the principal perennial grasses. An intermediate shrub layer, composed of *A. vaseyana* and *Chrysothamnus viscidiflorus*, is a common occurrence. *Balsamorhiza sagittata* is a consistent forb member in this ht.

Soils: Detailed soils information is not presently available. This ht generally occurs on rocky limestone soils on southerly exposed slopes. Moisture and temperature conditions do not appear suitable for *Festuca idahoensis*.

Management Implications: *Cercocarpus ledifolius* stands are highly utilized by big game, particularly deer. This ht occurs between the *A. vaseyana* type and coniferous forest. Livestock use is limited due to steepness of terrain and rockiness.

OTHER HABITAT TYPES

Several habitat types that are known to be present in Idaho and adjacent states but were not studied include:

Artemisia nova/Stipa comata ht
Artemisia tripartita/Stipa comata ht
Artemisia cana bolanderi/Muhlenbergia richardsonis ht
Artemisia vaseyana/Stipa thurberiana ht
Artemisia tridentata/Elymus cinereus ht
Artemisia vaseyana/Elymus cinereus ht

Artemisia nova/Stipa comata (comata) ht

Described in Nevada by Zamora and Tueller (1973), this ht occurs in localized areas in Lower Birch Creek in the vicinity of Lidy in Clark County.

Artemisia tripartita/Stipa comata (comata) ht

This ht occurs primarily from Dubois to Blackfoot and other areas in southeast Idaho. To date, *Stipa comata* var. *intermedia* has not been found growing with *Artemisia tripartita*.

Artemisia cana bolanderi/Muhlenbergia richardsonis ht

This ht is found in internally drained basins northeast of Bliss. *Muhlenbergia* and *Juncus balticus* provide only a sparse cover even under the best of conditions. In some areas in Oregon *Poa nevadensis* is the dominant understory species in this ht.

Artemisia vaseyana/Stipa thurberiana ht

This is a fairly prominent ht in Oregon but may not be present in Idaho. One should be aware of its possible occurrence, however.

Artemisia tridentata/Elymus cinereus ht

This ht has been documented at Squaw Butte (Oregon) in an exclosure and has since been identified in several states. Areas with too high a water table to support *Artemisia tridentata* previously, have become able to support both *A. tridentata* and *Elymus cinereus* after the water table was lowered. The original distribution of this ht was primarily as small stringers at the side of drainages or patches near seeps and springs in bottomland settings.

Artemisia vaseyana/Elymus cinereus ht

In western states this ht is quite common. The *Elymus cinereus* may include different ecotypes since this ht occurs as stringers along drainage ways and also occupies upland positions. Apparently under the latter situation *Elymus cinereus* is able to tap water tables that are 2 or more feet deep and where there is sufficient soil aeration for the *Artemisia vaseyana* root system to function normally.

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SCIENTIFIC . . . . COMMON NAMES

Trees

Abies lasiocarpa	subalpine fir
Juniperus occidentalis	western juniper
Juniperus osteosperma	Utah juniper
Pinus albicaulis	whitebark pine
Pinus contorta	lodgepole pine
Pinus flexilis	limberpine
Pinus ponderosa	ponderosa pine
Pseudotsuga menziesii	Douglas-fir

Shrubs

Amelanchier alnifolia	serviceberry
Artemisia arbuscula ssp. *arbuscula*	low sagebrush
Artemisia arbuscula ssp. *thermopola*	cleftleaf sagebrush
Artemisia cana ssp. *bolanderi*	Bolander silver sagebrush
Artemisia cana ssp. *viscidula*	mountain silver sagebrush
Artemisia longiloba	early or alkali sagebrush
Artemisia nova	black sagebrush
Artemisia rigida	scabland sagebrush
Artemisia tridentata ssp. *tridentata*	basin big sagebrush
Artemisia tridentata ssp. *vaseyana*	mountain big sagebrush
form *spiciformis*	subalpine big sagebrush
form *xericensis*	no common name
Artemisia tridentata ssp. *wyomingensis*	Wyoming big sagebrush
Artemisia tripartita	three-tip sagebrush
Atriplex canescens	four-wing saltbush
Atriplex confertifolia	shadscale
Atriplex spinosa	spiny hopsage
Ceratoides lanata	winterfat
Cercocarpus ledifolius	curlleaf mahogany
Chrysothamnus nauseosus	gray rabbitbrush
Chrysothamnus viscidflorus	green rabbitbrush
Potentilla fruticosa	shrubby cinquefoil
Prunus virginana	common chokecherry
Purshia tridentata	bitterbrush
Ribes cereum	squaw current
Symphoricarpos oreophilus	mountain snowberry
Tetradymia canescens	spineless horsebrush

Grasses and Grass-likes

Agropyron caninum	bearded wheatgrass
Agropyron cristatum	crested wheatgrass
Agropyron dasystachyum	thickspike wheatgrass
Agropyron desertorum	desert wheatgrass
Agropyron inerme	Whitmar wheatgrass
Agropyron intermedium	intermediate wheatgrass
Agropyron riparium	streambank wheatgrass
Agropyron sibiricum	Siberian wheatgrass
Agropyron spicatum	bluebunch wheatgrass

Agropyron trichophorum . . . . pubescent wheatgrass
Aristida longiseta . . . . three-awn grass
Bromus carinatus . . . . California brome
Bromus inermis . . . . smooth brome
Bromus japonicus . . . . Japanese chess
Bromus mollis . . . . soft chess
Bromus tectorum . . . . cheatgrass
Carex elynoides . . . . Kobresia-like sedge
Carex geyeri . . . . elk sedge
Dactylis glomerata . . . . orchard grass
Elymus cinereus . . . . basin wildrye
Elymus junceus . . . . Russian wildrye
Festuca idahoensis . . . . Idaho fescue
Koeleria nitida . . . . junegrass
Juncus balticus . . . . Baltic rush
Melica bulbosa . . . . onion grass
Muhlenbergia richardsonis . . . . mat muhly
Oryzopsis hymenoides . . . . Indian ricegrass
Phleum pratense . . . . timothy
Poa ampla . . . . big bluegrass
Poa nevadensis . . . . Nevada bluegrass
Poa pratensis . . . . Kentucky bluegrass
Poa sandbergii . . . . Sandberg bluegrass
Sitanion hystrix . . . . squirreltail
Stipa columbiana . . . . Columbia needlegrass
Stipa comata . . . . needle-and-thread grass
Stipa lettermanii . . . . Letterman needlegrass
Stipa thurberiana . . . . Thurber needlegrass
Taeniatherum asperum . . . . medusahead
Vulpia megalura . . . . foxtail fescue
Vulpia microstachys . . . . small fescue
Vulpia octoflora . . . . six-weeks fescue

Forbs

Achillea millefolium . . . . yarrow
Allium acuminatum . . . . tapertip onion
Antennaria dimorpha . . . . low pussy-toes
Antennaria rosea . . . . rosy pussy-toes
Antennaria stenophylla . . . . narrow-leaf pussy-toes
Arabis holboellii . . . . Holboell's rockcress
Aster scopulorum . . . . crag aster
Astragalus beckwithii . . . . Beckwith's milk-vetch
Astragalus miser . . . . weedy milk-vetch
Astragalus purshii . . . . Pursh's milk-vetch
Balsamorhiza hookeri . . . . hairy balsamroot
Balsamorhiza sagittata . . . . arrowleaf balsamroot
Castilleja angustifolia . . . . northwest paintbrush
Calochortus macrocarpus . . . . green-banded star-tulip
Collinsia parviflora . . . . small-flowered blue-eyed Mary
Crepis acuminata . . . . tapertip hawksbeard
Crepis occidentalis . . . . western hawksbeard
Descurania pinnata . . . . tansy mustard
Erigeron pumilus . . . . shaggy fleabane

Eriogonum baileyi . . . . Bailey's buckwheat
Eriogonum heracleoides . . . . parsnip-flowered eriogonum
Eriogonum umbellatum . . . . sulfur buckwheat
Hydrophyllum capitatum . . . . ballhead waterleaf
Linanthastrum nuttallii . . . . linanthastrum
Lithophragma bulbifera . . . . bulbiferous fringecup
Lithospermum ruderale . . . . Columbia puccoon
Lomatium triternatum . . . . nine-leaf lomatium
Lupinus argenteus . . . . silvery lupine
Lupinus caudatus . . . . tailcup lupine
Lupinus laxiflorus . . . . spurred lupine
Medicago sativa . . . . alfalfa
Melilotus spp. . . . . sweet clover
Mertensia longiflora . . . . long-flowered bluebell
Microseris nutans . . . . nodding microseris
Microsteris gracilis . . . . microsteris
Opuntia spp. . . . . prickly pear
Phlox hoodii . . . . Hood's phlox
Phlox longifolia . . . . long-leaf phlox
Potentilla glandulosa . . . . sticky cinquefoil
Salsola kali . . . . Russian thistle
Sanguisorba minor . . . . small burnet
Senecio integerrimus . . . . western groundsel
Sisymbrium altissimum . . . . tumble mustard
Taraxacum officinale . . . . dandelion