



10-31-1988

A sagebrush community type classification for mountainous northeastern Nevada rangelands

M. E. Jensen

U.S. Forest Service, Missoula, Montana

L. S. Peck

University of Nevada, Reno

M. V. Wilson

Oregon State University, Corvallis

Follow this and additional works at: <https://scholarsarchive.byu.edu/gbn>

Recommended Citation

Jensen, M. E.; Peck, L. S.; and Wilson, M. V. (1988) "A sagebrush community type classification for mountainous northeastern Nevada rangelands," *Great Basin Naturalist*. Vol. 48 : No. 4 , Article 2. Available at: <https://scholarsarchive.byu.edu/gbn/vol48/iss4/2>

This Article is brought to you for free and open access by the Western North American Naturalist Publications at BYU ScholarsArchive. It has been accepted for inclusion in Great Basin Naturalist by an authorized editor of BYU ScholarsArchive. For more information, please contact scholarsarchive@byu.edu, ellen_amatangelo@byu.edu.

A SAGEBRUSH COMMUNITY TYPE CLASSIFICATION FOR MOUNTAINOUS NORTHEASTERN NEVADA RANGELANDS

M. E. Jensen¹, L. S. Peck², and M. V. Wilson³

ABSTRACT.—A synecological study of sagebrush-dominated rangelands was conducted on the Humboldt National Forest, northeastern Nevada, between 1983 and 1986. A total of 372 relatively undisturbed sites were sampled for both vegetation and soil parameters, with 35 grass, 39 shrub, and 140 forb species identified. Plant species production data were used to develop a hierarchical, floristic-based community type classification with TWINSpan. Seventeen sagebrush community types were identified in this analysis and named by their dominant shrub and grass species. The dominant sagebrush species of the community types are *Artemisia tridentata* ssp. *vaseyana* (5 community types), *A. tridentata* ssp. *wyomingensis* (3 community types), *A. tridentata* ssp. *tridentata* (2 community types), *A. arbuscula* (3 community types), *A. nova* (3 community types), and *A. longiloba* (1 community type). Multivariate analysis revealed that all community types contain significantly different plant species compositions. Shrub species are more effective in discriminating between community types than grass species, which, in turn, are more effective than forb species.

One approach toward rangeland plant community description in the Great Basin is the identification of habitat types (Daubenmire 1952, 1968). Habitat typing, which has traditionally been used in forest environments (Hoffman and Alexander 1976, Pfister et al. 1977), is being used increasingly to characterize rangelands [e.g., Zamora and Tueller (1973) in Nevada, Hironaka et al. (1983) in Idaho, and Mueggler and Stewart (1980) in Montana]. In this approach, climax plant communities are used as environmental integrators that permit the identification of environments (habitats) with similar biotic potentials throughout the landscape (Mueggler and Stewart 1980). Environments with the same potential to support a given climax plant community are classified within the same habitat type, regardless of current successional status. The application of habitat typing to western rangelands can present problems, however, due primarily to disturbance and the resulting lack of reference climax plant communities on the landscape.

Other approaches to rangeland plant community description include the range-site method commonly used by the USDA Soil Conservation Service, and the ecological-site method, which recently has been proposed as an alternative to range site or habitat type in identifying the basic unit of rangeland classification (RISC 1983). Much disagreement still

exists as to what type of classification approach should be used in describing rangeland plant communities (Anderson 1983, Dyksterhuis 1983 and 1985, Daubenmire 1984, Hoffman 1985, Hall 1985).

Komarkova (1983) compared the habitat type approach to other methods of vegetation classification. She concluded that vegetation classifications resulting from the habitat-type approach tend to be very similar to those obtained from floristic-based methods. Komarkova also stressed that vegetation should be described first in terms of floristic relationships, without undue concern for successional status in developing initial floristic classifications for an area. This basic philosophy was followed in this study.

Little quantitative information exists concerning the mountainous rangeland plant communities of northeastern Nevada. Even less information is available for successional processes operable in such communities. Continued use of these lands by livestock, mineral, wildlife, and watershed interest groups dictates that plant community classifications be developed by land management agencies, even though a universal acceptable method for rangeland classification is not available. Such classifications are required if consistent assessments of the landscape's potential for management are to be made.

¹U.S. Forest Service, Regional Office, Northern Region, Missoula, Montana 59807.

²Herbarium, University of Nevada at Reno, Reno, Nevada 89506.

³Department of Botany, Oregon State University, Corvallis, Oregon 97331

The goal of this paper is to present a rangeland plant community classification for the Humboldt National Forest of northeastern Nevada. The classification groupings presented are referred to as community types, in that they are based upon floristic similarities in both the overstory and undergrowth layers present at a given site. These groupings are, however, approximately equivalent to the potential natural communities of an ecological site (RISC 1983) since they represent vegetation associations that are in dynamic equilibrium with current environmental conditions. This classification provides land managers with a communication tool that will improve their ability to describe an area's land-based potentials.

STUDY AREA AND METHODS

The study was conducted in the years 1983–1986 on the eight mountain ranges of the Humboldt National Forest, northeastern Nevada (Fig. 1). The study area is characteristic of higher-elevation rangelands of the Great Basin having semiarid climates. Elevation ranges between 1,800 m and 3,100 m, and average annual precipitation is approximately 33 cm.

A total of 372 rangeland sites were sampled to correlate soils to plant community types in an order 3 soil survey of the forest, in cooperation with National Cooperative Soil Surveys. Site selection was based on "subjective sampling without preconceived bias" as described by Mueller-Dombois and Ellenberg (1974). Reconnaissance of an area was made prior to site selection to inspect for the dominant soil families and sagebrush species present. Samples were taken on dominant soil polypedons that supported an apparently representative plant community for an area. This approach minimized the number of environmental ecotones described through avoidance of inclusions of dissimilar soils within a soil map unit. Relatively undisturbed sites were sampled, with areas of obvious disturbance (e.g., recent burn, heavy livestock use, compaction) being omitted. The vegetation communities described were the best expressions of late seral or climax plant community development present in the study area.

Sampling at each site was conducted within a 323-m² macroplot located to represent average vegetation and soil conditions. Annual

biomass production was determined by plant species in ten 2.93-m² circular microplots located randomly in the macroplot. A weight-estimate method was used to determine plant species production, with two microplots being clipped at each site and cover estimates of production taken in the remaining microplots (Pechanec and Pickford 1937). Green weight production estimates were converted to dry weight values through use of conversion factors routinely used by Intermountain Region, U.S. Forest Service range personnel (USDA 1969).

Shrub species canopy cover was measured by the line intercept method (Canfield 1941) beneath five 15.2-m line transects. Transects were located randomly within the macroplot along the slope contour. Density of shrub species by age-class grouping was recorded by counting the total number of shrubs rooted within a 0.91-m belt oriented parallel to each line transect. Rooted frequency (Hyder et al. 1963) and ocular canopy cover estimates were obtained within five 25 × 50-cm quadrats located at 2.5-m intervals along each line transect. A total of 25 quadrats were measured within a macroplot. Cover assessments of soil surface parameters (e.g., bare soil, litter, gravel) were derived from sampling of five fixed points within each 25 × 50-cm quadrat.

The majority of plants were identifiable to the species level during the period of field sampling. Specimens of unknown plant species were collected for taxonomic verification. Sagebrush species and subspecies were identified using morphological characteristics (Winward 1980), with simple chromatographic tests based upon fluorescence in alcohol performed as a check on such classifications (Stevens and McArthur 1974). Taxonomic nomenclature follows Cronquist et al. (1984).

Soil descriptions were made within all macroplots using standard pedon description methods that facilitated classification to the family level of soil taxonomy (USDA 1975). Soils were described to a depth of 1.5 m or to a shallower depth if a restrictive layer was present (e.g., duripan, paralithic or lithic contact). Composite samples were collected for chemical analysis at each pedon at depths of 0–15 and 40–60 cm. Generalized site characterizations were made at each macroplot to indicate the geomorphic features present.

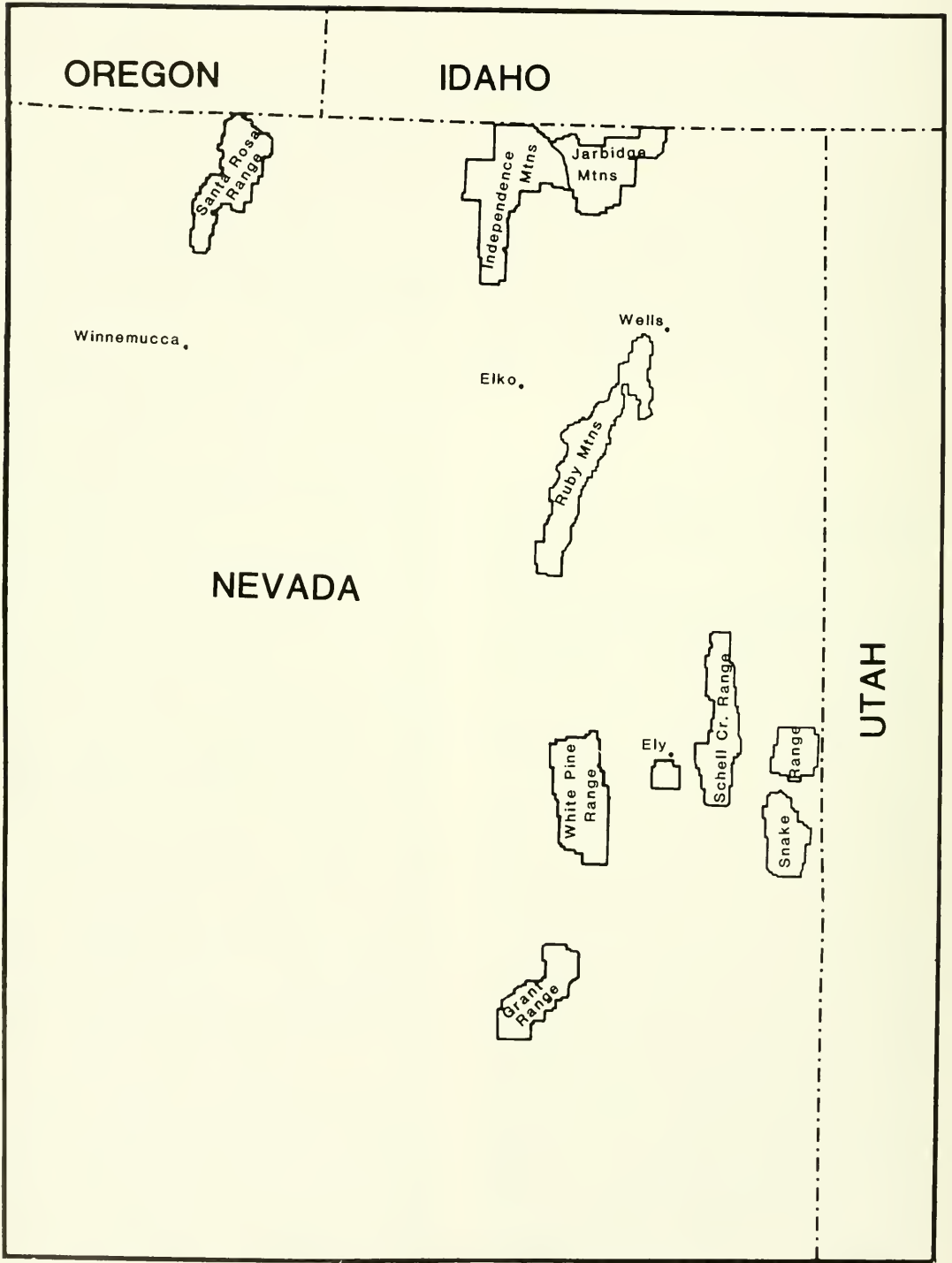


Fig. 1. The Humboldt National Forest of northeastern Nevada.

TABLE 1. Listing of dominant and indicator plant species found over the sagebrush communities studied.

GRASSES	SHRUBS		FORBS
<i>Agropyron spicatum</i>	<i>Amelanchier alnifolia</i>	<i>Achillea millefolium</i>	<i>Halogeton glomeratus</i>
<i>Agropyron trachycaulum</i>	<i>Artemisia arbuscula</i>	<i>Agoseris glauca</i>	<i>Hackelia patens</i>
<i>Bromus carinatus</i>	<i>Artemisia frigida</i>	<i>Agastache urticifolia</i>	<i>Heliomeris multiflora</i>
<i>Bromus inermis</i>	<i>Artemisia longiloba</i>	<i>Arabis holboellii</i>	<i>Helianthella uniflora</i>
<i>Bromus tectorum</i>	<i>Artemisia nova</i>	<i>Arenaira kingii</i>	<i>Hydrophyllum capitatum</i>
<i>Carex</i> spp.	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>	<i>Astragalus calycosus</i>	<i>Linum perenne</i>
<i>Elymus cinereus</i>	<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	<i>Astragalus purshii</i>	<i>Lomatium dissectum</i>
<i>Festuca idahoensis</i>	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i>	<i>Aster scopulorum</i>	<i>Lupinus argenteus</i>
<i>Koeleria cristata</i>	<i>Atriplex confertifolia</i>	<i>Balsamorhiza sagittata</i>	<i>Lupinus caudatus</i>
<i>Oryzopsis hymenoides</i>	<i>Chrysothamnus nauseosus</i>	<i>Castilleja chromosa</i>	<i>Mahonia repens</i>
<i>Poa ampla</i>	<i>Chrysothamnus viscidiflorus</i>	<i>Commandra pallida</i>	<i>Lomatium oblongifolia</i>
<i>Poa fendleriana</i>	<i>Cowania mexicana</i>	<i>Crepis acuminata</i>	<i>Opuntia polyacantha</i>
<i>Poa nevadensis</i>	<i>Ephedra nevadensis</i>	<i>Delphinium andersonii</i>	<i>Orobanche californica</i>
<i>Poa pratensis</i>	<i>Prunus virginiana</i> var. <i>melanocarpa</i>	<i>Epilobium angustifolium</i>	<i>Pedicularis centranthera</i>
<i>Poa sandbergii</i>	<i>Purshia tridentata</i>	<i>Erigeron argenteus</i>	<i>Penstemon watsonii</i>
<i>Sitanion hystrix</i>	<i>Symphoricarpos oreophilus</i>	<i>Eriogonum heracleoides</i>	<i>Phlox hoodii</i>
<i>Stipa columbiana</i>		<i>Eriogonum microthecum</i>	<i>Phlox longifolia</i>
<i>Stipa comata</i>		<i>Euphorbia albomarginata</i>	<i>Senecio integerrimus</i>
<i>Stipa lettermanii</i>		<i>Fraseria speciosa</i>	<i>Senecio multilobatus</i>
<i>Stipa thurberiana</i>		<i>Geranium fremontii</i>	<i>Sedum stenopetalum</i>
		<i>Geranium viscosissimum</i>	<i>Wyethia amplexicaulis</i>
		<i>Ceum triflorum</i>	<i>Stellaria jamesiana</i>

Two-Way Indicator Species Analysis, TWINSPAN (Hill 1979, Hill and Gauch 1980), was used to develop community type classifications for the sagebrush communities sampled. This is a polythetic, divisive, hierarchical classification technique similar to the Braun-Blanquet classification method in its emphasis on indicator species and production of an arranged species-sample data matrix (Gauch 1982).

All sites and species were included in initial TWINSPAN analyses utilizing, in turn, vegetation frequency, cover, and production attributes. Samples were tentatively assigned to a community type based upon their TWINSPAN cluster assignment. Each sample was then inspected to see if it contained abundances of indicator plant species similar to those contained by other samples in its assigned community type. Samples displaying low similarity to other samples in their community type were reassigned to a different community type when appropriate. A few samples were omitted from analysis since they displayed little similarity to other samples. The TWINSPAN analyses based upon frequency, cover, and production attributes produced similar arranged data matrices and indicator species lists. The analysis based upon production attributes yielded the clearest aggregation of samples into community types

and was used to produce the final community type classification.

Phases of community types were determined through similar TWINSPAN analyses of each community type subset. Phases were described for community types displaying floristically dissimilar subgroupings that could be related to major differences in soil properties.

DECORANA (Hill 1979) was used to ordinate the plant species and samples of the TWINSPAN analysis to facilitate determination of environmental gradients that influence the distribution of community types. Multivariate analysis programs of SPSS (Norusis 1985) detected differences in overall vegetation composition between community types and determined which plant species were most effective in discriminating between community types.

RESULTS

A total of 218 plant species were found within the 372 rangeland sites sampled. The graminoids were represented by 35 species, the shrubs by 39 species, and the forbs by 140 species. Tree species were present in minor amounts on some sites with four species described. A listing of the major plant species present is provided in Table 1.

TABLE 2. List of sagebrush community types and abbreviated codes referred to in the text.

Abbreviated code	Community type
ARNO/ATCO/SIHY	<i>Artemisia nova</i> / <i>Atriplex confertifolia</i> / <i>Sitanion hystrix</i>
ARNO/ORHY	<i>A. nova</i> / <i>Oryzopsis hymenoides</i>
ARNO/AGSP	<i>A. nova</i> / <i>Agropyron spicatum</i>
ARAR/AGSP	<i>A. arbuscula</i> / <i>Agropyron spicatum</i>
ARAR/FEID/POSA	<i>A. arbuscula</i> / <i>Festuca idahoensis</i> / <i>Poa sandbergii</i>
ARAR/FEID	<i>A. arbuscula</i> / <i>Festuca idahoensis</i>
ARLO/FEID	<i>A. longiloba</i> / <i>Festuca idahoensis</i>
ARWYO/SIHY	<i>A. tridentata</i> ssp. <i>wyomingensis</i> / <i>Sitanion hystrix</i>
ARWYO/POSA	<i>A. tridentata</i> ssp. <i>wyomingensis</i> / <i>Poa sandbergii</i>
ARWYO/AGSP	<i>A. tridentata</i> ssp. <i>wyomingensis</i> / <i>Agropyron spicatum</i>
ARTR/AGSP	<i>A. tridentata</i> ssp. <i>tridentata</i> / <i>Agropyron spicatum</i>
ARTR/FEID	<i>A. tridentata</i> ssp. <i>tridentata</i> / <i>Festuca idahoensis</i>
ARVA/AGSP	<i>A. tridentata</i> ssp. <i>vaseyana</i> / <i>Agropyron spicatum</i>
ARVA/FEID	<i>A. tridentata</i> ssp. <i>vaseyana</i> / <i>Festuca idahoensis</i>
ARVA/ELCI	<i>A. tridentata</i> ssp. <i>vaseyana</i> / <i>Elymus cinereus</i>
ARVA/SYOR/AGSP	<i>A. t.</i> ssp. <i>vaseyana</i> / <i>Symphoricarpos oreophilus</i> / <i>Agropyron spicatum</i>
ARVA/SYOR/BRCA	<i>A. t.</i> ssp. <i>vaseyana</i> / <i>Symphoricarpos oreophilus</i> / <i>Bromus carinatus</i>

TWINSPAN classification based upon plant species production over all samples resulted in the identification of 15 sagebrush community types and 1 wet meadow complex (Fig. 1). Sagebrush community type names were derived by denoting the dominant shrub and grass species characteristic of each type (Table 2). Abbreviations for community names appear in Table 2. In all cases, such grass and shrub species were identified in the TWINSPAN analysis as being the principal indicator plant species for their respective community types. Forb species generally were not effective in separating community types, except at the phase level. Vegetation characteristics of these community types are discussed by Jensen et al. (1988).

The classification dendrogram developed from the TWINSPAN analysis of production shows the successive division of the data into more homogenous vegetation classification groupings (Fig. 2). The first TWINSPAN classification division separated most of the tall sagebrush communities (e.g., ARVA/AGSP, ARVA/FEID, ARTR/AGSP) from the low sagebrush communities (e.g., ARAR/AGSP, ARNO/ORHY). At the second classification division, the low sagebrush communities were split primarily into groupings that had *Artemisia arbuscula* or *A. nova* as the dominant shrub species. The tall sagebrush-dominated grouping was divided into a wet meadow community type and various sagebrush communities. The division process was continued until a given grouping displayed a

dominant shrub and codominant grass species and a reasonable consistency of secondary species; that is, until a sagebrush community type was obtained.

TWINSPAN was effective in displaying apparent community types within the sagebrush communities sampled. It does not, however, indicate whether such community types differ significantly in their vegetation composition. Many studies in plant community classification utilize various ordination or clustering techniques to define plant communities and habitat types (Hironaka et al. 1983, Marks and Harcombe 1981, Mueggler and Stewart 1980, Youngblood et al. 1985); yet rarely are such classification groupings tested for significance (Strauss 1982). The TWINSPAN-generated classification produced sagebrush community types that are significantly different from each other in overall vegetation composition (Table 3). Community types displaying large separations in the TWINSPAN classification dendrogram (Fig. 2) tend to show high F ratios in this analysis.

A variety of plant species are effective in discriminating between the sagebrush community types (Table 4). The plant species presented in this table are also the primary indicator species of the TWINSPAN analyses. These results suggest that shrub and grass species tend to have greater significance than forb species in determining plant community types for the rangelands studied.

A key to the sagebrush community types is presented in Table 5. The indicator species

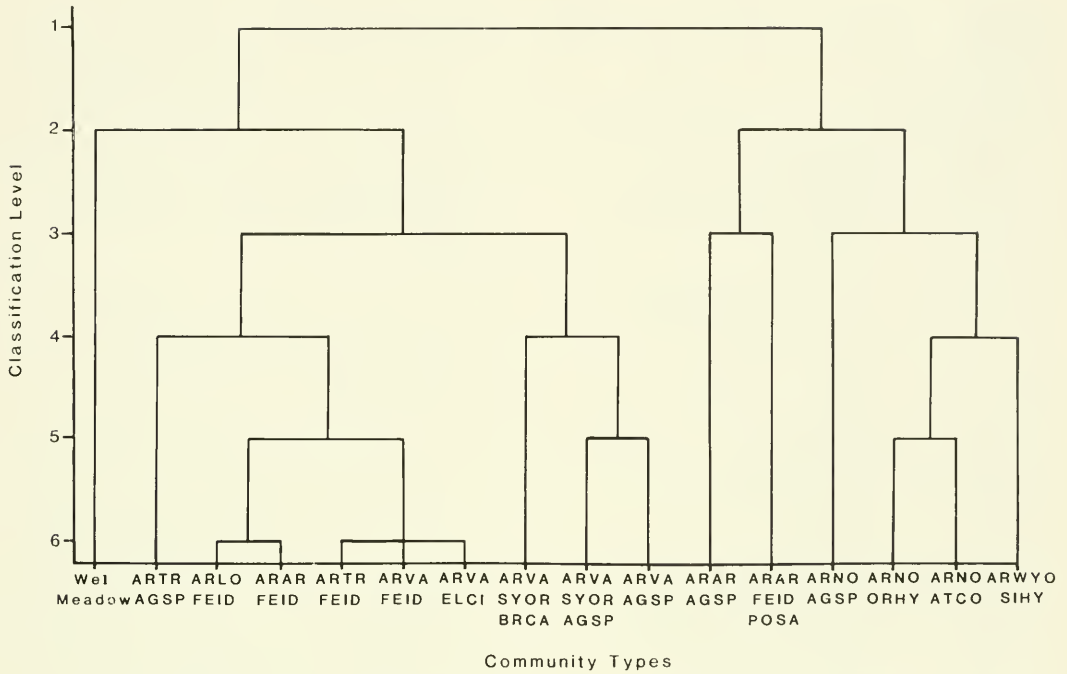


Fig. 2. TWINSpan classification dendrogram of the sagebrush community types.

TABLE 3. Multivariate F ratios testing the hypothesis that pairs of sagebrush community types differ in their average vegetation composition.

Community type	Community Type														
	ARNO ATCO SIHY	ARNO ORHY	ARNO AGSP	ARAR AGSP	ARAR FEID	ARAR POSA	ARAR FEID	ARLO FEID	ARWYO SIHY	ARTR AGSP	ARTR FEID	ARTR AGSP	ARVA FEID	ARVA ELCI	ARVA SYOR
ARNO/ATCO/SIHY	—														
ARNO/ORHY	2	—													
ARNO/AGSP	2	2	—												
ARAR/AGSP	14	13	20	—											
ARAR/FEID/POSA	13	12	16	5	—										
ARAR/FEID	7	6	6	4	2	—									
ARLO/FEID	11	10	11	9	6	4	—								
ARWYO/SIHY	14	14	17	14	14	10	13	—							
ARTR/AGSP	26	25	28	27	25	17	19	24	—						
ARTR/FEID	34	33	39	37	33	19	22	27	2	—					
ARVA/AGSP	20	17	31	27	17	6	8	19	26	38	—				
ARVA/FEID	14	12	17	16	6	3	6	16	22	30	6	—			
ARVA/ELCI	6	6	6	7	6	6	6	7	13	14	6	6	—		
ARVA/SYOR/AGSP	17	15	20	21	15	6	8	18	24	33	6	6	7	—	
ARVA/SYOR/BRCA	15	14	16	18	12	6	9	17	23	31	10	6	6	6	—

Note: All values are significant at the 95% confidence level.

discussed in this table are those that best distinguished between vegetation groupings in the TWINSpan analysis. The ARWYO/POSA and ARWYO/AGSP community types presented in Table 6 are not presented in the TWINSpan dendrogram (Fig. 2) because of limited sampling in these types (i.e., two descriptions each). They are included in the

community type key since they have been described in areas adjacent to this study (Hironaka et al. 1983) and may be more extensive in northern Nevada than our sampling indicates. The community type phases presented were derived through TWINSpan analysis of individual community type subsets of the

TABLE 4. Listing of the 30 most useful plant species in discriminating between the sagebrush communities studied.

Order of significance	Species
1	<i>Artemisia tridentata</i> ssp. <i>tridentata</i>
2	<i>A. arbuscula</i>
3	<i>A. nova</i>
4	<i>A. tridentata</i> ssp. <i>wyomingensis</i>
5	<i>Festuca idahoensis</i>
6	<i>A. longiloba</i>
7	<i>A. tridentata</i> ssp. <i>caseyana</i>
8	<i>Symphoricarpos oreophilus</i>
9	<i>Purshia tridentata</i>
10	<i>Elymus cinereus</i>
11	<i>Wyethia amplexicaulis</i>
12	<i>Agropyron spicatum</i>
13	<i>Poa sandbergii</i>
14	<i>Poa nevadensis</i>
15	<i>Poa fendleriana</i>
16	<i>Senecio multilobatus</i>
17	<i>Carex</i> spp.
18	<i>Agoseris glauca</i>
19	<i>Sitanion hystrix</i>
20	<i>Chrysothamnus nauseosus</i>
21	<i>Chrysothamnus viscidiflorus</i>
22	<i>Balsamorhiza sagittata</i>
23	<i>Lupinus argenteus</i>
24	<i>Helianthella uniflora</i>
25	<i>Oryzopsis hymenoides</i>
26	<i>Stipa columbiana</i>
27	<i>Bromus carinatus</i>
28	<i>Bromus tectorum</i>
29	<i>Geranium viscosissimum</i>
30	<i>Lupinus caudatus</i>

Note: All species listed display significant differences ($P < .05$) in abundance between sagebrush community types. Order of significance indicates the relative usefulness of a plant species in discriminating between community types, based upon its ability to reduce Wilks Lambda

original sample-species data matrix. Phases were designated when one or more secondary species showed consistent differences in distribution within a community type that could be related to variations in soil properties. Such differences were not sufficiently great, however, to warrant separate habitat type status.

The sagebrush community types display major differences with respect to soil and environmental features (Jensen 1988). Community types with *Artemisia nova* as the dominant shrub species tend to occur on Aridisols soil orders, while all other community types are primarily found on Mollisols (Table 6). Mollie epipedon thickness tends to be absent or low in community types dominated by *A. nova*, intermediate in community types dominated by *A. arbuscula*, *A. longiloba*, and *A. tridentata* ssp. *wyomingensis*, and highest

TABLE 5. Key to sagebrush community types of the Humboldt National Forest.

1.	<i>Artemisia nova</i> is the dominant sagebrush species	2
—	<i>Artemisia nova</i> is not the dominant sagebrush species	3
2(1).	<i>Sitanion hystrix</i> and <i>Poa nevadensis</i> are the dominant grasses. <i>Atriplex confertifolia</i> and <i>Ephedra nevadensis</i> are generally conspicuously present	Artemisia nova/Atriplex confertifolia/Sitanion hystrix c.t.
—	<i>Oryzopsis hymenoides</i> and <i>Sitanion hystrix</i> are the dominant grasses. <i>Atriplex confertifolia</i> and <i>Ephedra nevadensis</i> are lacking or present in small amounts	Artemisia nova/Oryzopsis hymenoides c.t.
—	<i>Agropyron spicatum</i> is the dominant grass. <i>Poa sandbergii</i> is conspicuously present and may replace <i>A. spicatum</i> in dominance on some sites	Artemisia nova/Agropyron spicatum c.t.
3(1).	<i>Artemisia arbuscula</i> is the dominant sagebrush species	4
—	<i>Artemisia arbuscula</i> is not the dominant sagebrush species	5
4(3).	<i>Agropyron spicatum</i> is the dominant grass. <i>Poa sandbergii</i> and <i>Poa fendleriana</i> are conspicuously present and may replace <i>A. spicatum</i> in dominance on some sites	Artemisia arbuscula/Agropyron spicatum c.t.
—	<i>Festuca idahoensis</i> is the dominant grass. <i>Poa sandbergii</i> is conspicuously present and may replace <i>F. idahoensis</i> in dominance on some sites	Artemisia arbuscula/Festuca idahoensis/Poa sandbergii c.t.
—	<i>Festuca idahoensis</i> is the dominant grass. <i>Agropyron spicatum</i> is conspicuously present with <i>Poa sandbergii</i> absent or present in only small amounts	Artemisia arbuscula/Festuca idahoensis c.t.
5(3).	<i>Artemisia longiloba</i> is the dominant sagebrush species. <i>Festuca idahoensis</i> is the dominant understory grass with <i>Agropyron spicatum</i> occurring in varying amounts	Artemisia longiloba/Festuca idahoensis c.t.
—	<i>Artemisia longiloba</i> is not the dominant sagebrush species	6
6(5).	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> is the dominant sagebrush species	7
—	<i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> is not the dominant sagebrush species	8
7(6).	<i>Sitanion hystrix</i> is the dominant grass	Artemisia wyomingensis/Sitanion hystrix c.t.
—	<i>Poa sandbergii</i> is the dominant grass	Artemisia wyomingensis/Poa sandbergii c.t.
—	<i>Agropyron spicatum</i> is the dominant grass with <i>Festuca idahoensis</i> occurring in varying amounts	Artemisia wyomingensis/Agropyron spicatum c.t.

TABLE 5. Continued.

- 8(6). *Artemisia tridentata* spp. *tridentata* is the dominant sagebrush species 9
- *Artemisia tridentata* spp. *tridentata* is not the dominant sagebrush species 10
- 9(8). *Agropyron spicatum* is the dominant grass. *Bromus tectorum* is conspicuously present and may replace *A. spicatum* in dominance on some sites *Artemisia tridentata*/*Agropyron spicatum* c.t.
- *Festuca idahoensis* is the dominant grass. *Agropyron spicatum* is present in varying amounts *Artemisia tridentata*/*Festuca idahoensis* c.t.
- 10(8). *Artemisia tridentata* spp. *vaseyana* is the dominant sagebrush species. *Symphoricarpos oreophilus* is usually absent, or, if present, it does not contribute significantly to the shrub component (i.e., less than 3% canopy cover) 11
- *Artemisia tridentata* spp. *vaseyana* is the dominant sagebrush species. *Symphoricarpos oreophilus* is conspicuously present, or, if lacking, *Amelanchier alnifolia* is usually present 12
- 11(10). *Agropyron spicatum* is the dominant grass. *Poa fendleriana* and *Poa sandbergii* are conspicuously present and may share dominance with *A. spicatum* on some sites. *Festuca idahoensis* is usually absent, or, if present, it occurs in trace amounts in varying amounts *Artemisia vaseyana*/*Agropyron spicatum* c.t.
- (1). *Purshia tridentata* is absent, or, if present, it occurs in trace amounts. *Poa fendleriana* shares dominance with *Agropyron spicatum* on most sites *Poa fendleriana* phase
- (2). *Purshia tridentata* is conspicuously present, usually with canopy cover greater than 5%. *Poa fendleriana* shares dominance with *Agropyron spicatum* on most sites *Purshia tridentata* phase
- (3). *Purshia tridentata* is commonly present, usually with canopy cover greater than 3%. *Poa fendleriana* is absent, or, if present, it occurs in trace amounts. *Balsamorhiza sagittata* is the dominant forb on most sites *Balsamorhiza sagittata* phase
- *Festuca idahoensis* is the dominant grass. *Agropyron spicatum* is commonly present, in varying amounts. *Purshia tridentata* is usually absent *Artemisia vaseyana*/*Festuca idahoensis* c.t.
- (1). *Purshia tridentata* is usually absent, or, if present, it occurs in trace amounts. *Lupinus caudatus* is commonly the dominant forb

TABLE 5. Continued.

- species. *Lupinus argenteus* is usually absent, or, if present, it occurs in trace amounts *Lupinus caudatus* phase
- (2). *Purshia tridentata* is usually absent, or, if present, it occurs in trace amounts. *Lupinus argenteus* is commonly the dominant forb species. *Lupinus caudatus* is usually absent, or, if present, it occurs in trace amounts *Lupinus argenteus* phase
- (3). *Purshia tridentata* is commonly present, usually with canopy cover greater than 5%. *Lupinus* species are not dominant forb components on most sites *Purshia tridentata* phase
- *Elymus cinereus* is the dominant grass. Forb species are generally abundant, with *Balsamorhiza sagittata* and *Wyethia amplexicaulis* sharing dominance with *E. cinereus* on some sites *Artemisia vaseyana*/*Elymus cinereus* c.t.
- 12(10). *Artemisia tridentata* spp. *vaseyana* is the dominant sagebrush species. *Symphoricarpos oreophilus* is conspicuously present, usually with canopy cover greater than 3%. *Balsamorhiza sagittata* is commonly present, in varying amounts 13
- 13(12). *Agropyron spicatum* is the dominant grass with *Poa fendleriana* conspicuously present. *Festuca idahoensis* may replace *A. spicatum* in dominance on some sites. Grass species occur in higher abundance than forb species on most sites *Artemisia vaseyana*/*Symphoricarpos oreophilus*/*Agropyron spicatum* c.t.
- *Bromus carinatus* is the dominant grass. *Festuca idahoensis*, *Agropyron trachycaulum*, and *Elymus cinereus* are conspicuously present and may replace *B. carinatus* in dominance on some sites. Forb species occur with the same abundance as grasses on most sites *Artemisia vaseyana*/*Symphoricarpos oreophilus*/*Bromus carinatus* c.t.
- (1). Grass species occur in equal or higher abundance than forb species on most sites. *Agropyron trachycaulum* is commonly the dominant grass species present. *Geranium viscosissimum* is usually absent, or, if present, it occurs in trace amounts *Agropyron trachycaulum* phase
- (2). Forb species occur in greater abundance than grass species on most sites. *Geranium viscosissimum* is commonly the dominant forb species present *Geranium viscosissimum* phase

in community types dominated by *A. tridentata* ssp. *tridentata* and *A. tridentata* ssp. *vaseyana*.

Environmental gradients that influence community type distribution are evident in the ordination of average community type

scores along two DECORANA axes (Fig. 3). The transition from community types dominated by *A. tridentata* ssp. *vaseyana* to *A. tridentata* ssp. *tridentata*, *A. arbuscula*, and *A. nova* displayed along axis 1 is considered to represent a gradient of decreasing soil

TABLE 6. Listing of the major sagebrush community types of the Humboldt National Forest with general site characterizations provided.

Community type	Sample size	Principal soil great group	Elevation range (m)	Slope (%)		Soil depth (cm)		Thickness mollic epipedon (cm)	
				x	s	x	s	x	s
ARNO/ATCO/SIHY	12	Haplargids	1,829-2,225	23	20	90	32	0	
ARNO/ORHY	16	Paleorthids	1,859-3,048	15	11	77	28	0	
ARNO/AGSP	44	Calciorthiss	1,829-3,048	20	13	81	32	16	16
ARAR/AGSP	27	Argixerolls	1,981-2,926	24	13	73	26	26	9
ARLO/FEID/POSA	19	Argixerolls	1,524-3,109	13	10	71	28	22	9
ARAR/FEID	19	Cryoborolls	1,768-2,438	13	9	74	26	28	9
ARLO/FEID	4	Argixerolls	1,829-1,981	6	3	81	26	29	4
ARWYO/SIHY	4	Haploxerolls	1,829-2,134	4	2	99	37	27	38
ARTR/AGSP	6	Haploxerolls	1,707-1,920	20	21	118	39	43	34
ARTR/FEID	8	Haploxerolls	1,615-2,103	16	13	132	35	48	26
ARVA/AGSP	63	Cryoborolls	1,829-3,048	24	16	104	38	37	21
ARVA/FEID	66	Cryoborolls	1,707-2,743	17	14	111	36	45	19
ARVA/ELCI	9	Cryoborolls	1,859-2,316	33	18	117	25	37	11
ARVA/SYOR/AGSP	23	Cryoborolls	2,012-2,743	26	16	117	39	43	16
ARVA/SYOR/BRCA	46	Cryoborolls	1,768-2,499	28	15	136	26	53	17

Note: x = mean, s = standard deviation.

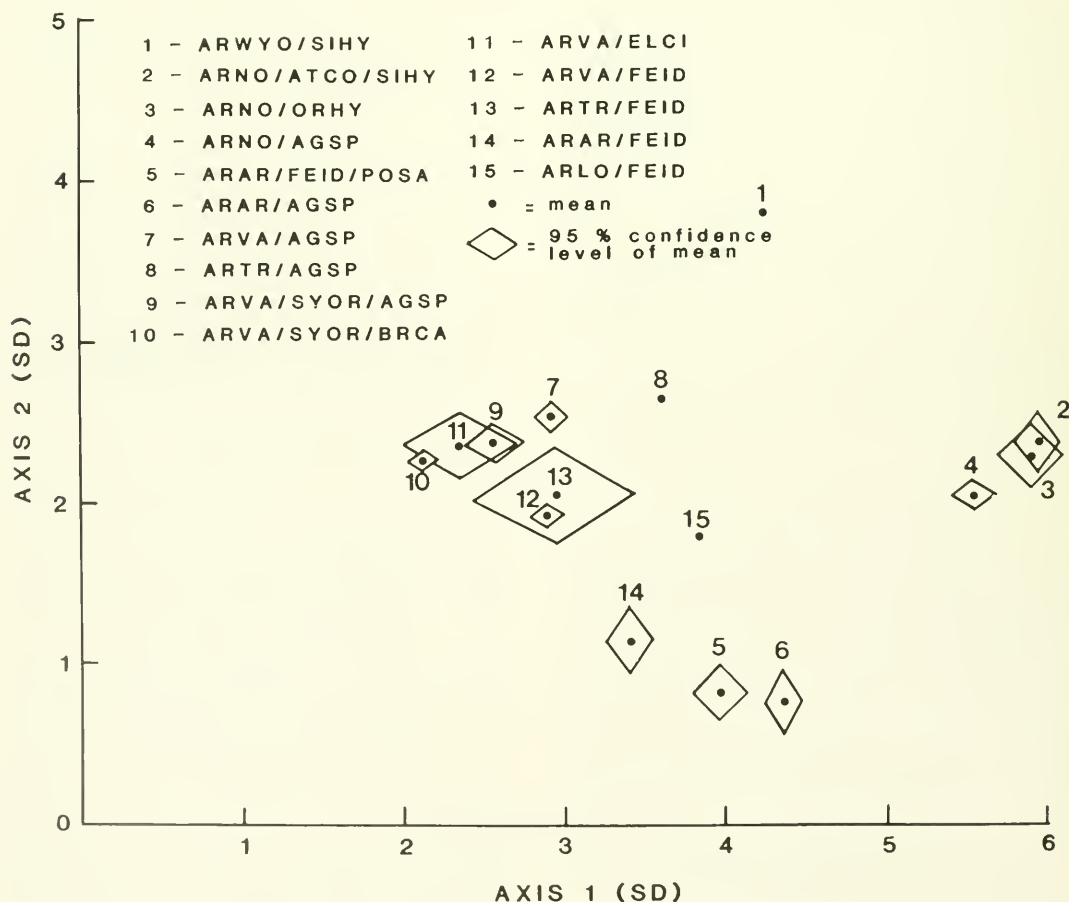


Fig. 3. Ordination of average community type scores along two DECORANA axes. The rectangles represent the 95% confidence interval of the mean with respect to each axis. Confidence intervals are not presented for the ARWYO/SIHY, ARTR/AGSP, and ARLO/FEID community types because of high variances associated with limited sampling in those types.

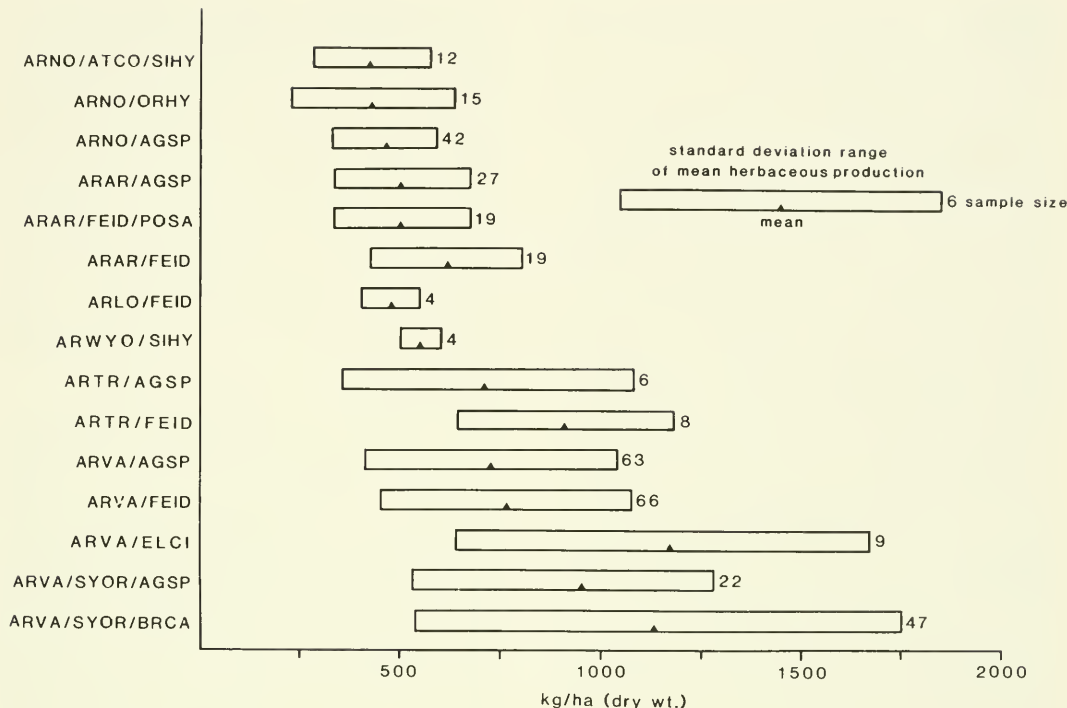


Fig. 4. Average annual dry weight production of the sagebrush community types. The standard deviation range represents one standard deviation of the sample above and below the observed mean value.

moisture and increasing soil temperature. This observation is supported by visual assessments of soil moisture status and soil temperature measurements collected at each site. Axis 2, based upon inspection of soil profile descriptions, is considered to represent a gradient of decreasing soil clay content and increasing soil depth.

Total annual production for the community types follows this apparent soil moisture gradient, with *A. tridentata* spp. *vaseyana*-dominated community types displaying highest production levels (Fig. 4). Production variability tends to be greatest on higher production sites, with the ARVA/SYOR/BRCA community type displaying the widest range in average production values. Such high variability in observed production within certain community types acts to limit their predictive significance for assessing site potentials on the landscape.

DISCUSSION

The sagebrush community types presented are similar to vegetation classification types

identified by other researchers. Floristic compositions are relatively similar between our community types and comparably named habitat types identified in southern Idaho (Hironaka 1983). Of the 17 community types presented, 14 are comparably named in the southern Idaho classification. Only the ARNO/ATCO/SIHY, ARNO/ORHY, and ARVA/SYOR/BRCA community types of this study are not identified in that classification. This fact supports Komarkova's (1983) contention that floristic-based classification methods that use stand taxa composition as a basis for analysis produce similar results to the habitat-type approach. The low sagebrush community types presented are also similar to the low sagebrush habitat types identified in Nevada by Zamora and Tueller (1973). Similarities are apparent between our classification and the mountain big sagebrush associations described in Nevada by Mooney (1985) and Tueller and Eckert (1987). The community types described also relate closely to the potential natural communities of an ecological site (RISC 1983) in that they represent the

vegetation association that is in dynamic equilibrium with current environmental conditions present at a given site.

The desired result in both the habitat-type or range-site methods of classification is to produce groupings of land with similar inherent productivity and climax vegetation expression (RISC 1983). The fact that these two methods often produce different classifications of a given area is due primarily to differences in objectives. The objective of habitat typing is to produce groupings (habitats) with similar internal biotic potentials (Hoffman 1984). A habitat may occupy a wide range of soil, topographic, and climate conditions, provided the ecological sum of the environment (i.e., the ability to support one particular climax plant association) is the same (Daubenmire 1952). The identification of groupings with similar internal biotic potentials is also an objective in range-site classification (Hall 1985). Such groupings, however, tend to be more specifically defined than habitat types since another common objective in range-site classification is to delineate major differences in the production potential of a given climax plant association. As a consequence of this objective, a narrower range in soil, topographic, and climatic conditions is tolerated in a range site as contrasted to a habitat type. In both methods the land's capability to support a particular climax plant association is the primary criterion in classification. It seems reasonable, therefore, that a range site should encompass a finer division of the environment than a habitat type. In other words, a habitat type or phase of habitat type could be divided into a number of range sites dependent upon classification objectives.

The community types identified in this study reflect similar groupings to those that would be developed by a habitat-type approach. Since no existing classification system was available for the study area, a broad-level classification was considered most appropriate for this initial study. The community types could, however, be subdivided into range sites based upon the production and soils data collected. The variability in total production recorded over the community types with *Artemisia tridentata* ssp. *vaseyana* and *A. tridentata* ssp. *tridentata* as the dominant shrubs (Fig. 4) suggests that these types should be considered for subdivision into range sites.

West et al. (1978) suggest that the distribution of sagebrush species in Nevada is controlled primarily by climatic conditions present at a site. Similar observations have been made in other areas (Beetle and Johnson 1982, Hironaka 1979, Hironaka et al. 1983) and in this study. Young et al. (1985) state that sagebrush habitat types do not follow an orderly moisture temperature gradient in the landscape due to soil edaphic influences on community distribution. Passey et al. (1982) emphasize that soil properties modify the effects of climate on rangeland plant communities.

Because of the apparent interaction between climate and soil properties on rangeland plant community distribution, it is not surprising to find plant communities described in one area on different soils in a distant location. For example, dwarf sagebrush species of Idaho (*A. nova* and *A. arbuscula*) are described as usually occurring on soils that are either shallow (i.e., less than 50 cm depth) or, if moderately deep, have a restrictive layer (Hironaka et al. 1983). These same species are found to occupy much deeper soils in this study (Table 6). Lower precipitation on these community types in Nevada results in a wetting front that probably does not extend throughout the entire soil. Consequently, even though deeper soils may support these community types in this study, the actual depth exploited by plants for soil moisture is probably comparable to that described in Idaho. Such interactions between climate and soil make it difficult to predict rangeland soil properties based upon plant community composition.

LITERATURE CITED

- ANDERSON, E. W. 1983. Ecological site/range site/habitat type—a viewpoint. *Rangelands* 5: 187–188.
- BEETLE, A. A., AND K. L. JOHNSON. 1982. Sagebrush in Wyoming. University of Wyoming Agric. Expt. Sta. Bull. 779.
- CANFIELD, R. H. 1941. Application of line interception method in sampling range vegetation. *J. Forestry* 39: 388–394.
- CRONQUIST, A., H. H. HOLMGREN, N. H. HOLMGREN, J. L. REVEAL, AND P. K. HOLMGREN. 1984. *Intermountain Flora*. Vol. 4. New York Botanical Garden, Bronx, New York. 573 pp.
- DAUBENMIRE, R. 1952. Forest vegetation of northern Idaho and adjacent Washington, and its bearing on concepts of vegetation classification. *Ecol. Monogr.* 22: 301–330.

- . 1968. Plant communities: a textbook of plant synecology. Harper and Row, New York. 300 pp.
- . 1984. Viewpoint: ecological site/range site/habitat type. *Rangelands* 6: 263–264.
- DYKSTERHUIS, E. J. 1983. Habitat type: a review. *Rangelands* 5: 270–271.
- . 1985. Follow-up on range sites and condition classes as based on quantitative ecology. *Rangelands* 7: 172–173.
- CAUCH, H. G. 1982. Multivariate analysis in community ecology. Cambridge University Press, Cambridge, England. 298 pp.
- HALL, F. C. 1985. Viewpoint: the habitat type controversy: two common concepts. *Rangelands* 7: 170–171.
- HILL, M. D. 1979. TWINSPAN—a FORTRAN Program for arranging multivariate data in an ordered two-way table by classification of the individuals and attributes. Cornell University, Ithaca, New York. 29 pp.
- HILL, M. D., AND H. G. CAUCH. 1980. Detrended correspondence analysis: an improved ordination technique. *Vegetatio* 42: 47–58.
- HIRONAKA, M. 1979. Basic synecological relationships of the Columbia River sagebrush type. *In: The sagebrush ecosystem: a symposium*. April 1978, Utah State University, Logan.
- HIRONAKA, M., M. A. FOSBERG, AND A. H. WINWARD. 1983. Sagebrush-grass habitat types of southern Idaho. *Bull. 35, University of Idaho For. Wildlife and Range Expt. Sta., Moscow*. 44 pp.
- HOFFMAN, G. R. 1984. Habitat types: a supportive view. *Rangelands* 6: 264–266.
- HOFFMAN, G. R., AND R. R. ALEXANDER. 1976. Forest vegetation of the Bighorn Mountains, Wyoming: a habitat type classification. USDA For. Serv. Res. Pap. RM-170, Rocky Mt. For. and Range Expt. Sta., Ft. Collins, Colorado. 38 pp.
- HYDER, D. N., C. E. CONRAD, P. T. TUELLER, L. D. CALVIN, C. E. POULTON, AND F. A. SNEVA. 1963. Frequency sampling in sagebrush-bunchgrass vegetation. *Ecology* 44: 740–746.
- JENSEN, M. E. 1988. Soil characteristics of mountainous northeastern Nevada sagebrush community types. *Great Basin Nat.* (in press).
- JENSEN, M. E., L. S. PECK, AND M. V. WILSON. 1988. Vegetation characteristics of mountainous northeastern Nevada sagebrush community types. *Great Basin Nat.* 48(4): 403–421.
- KOMARKOVA, V. 1983. Comparison of habitat type classifications to some other classification methods. *In: Moir and Hendzel, coord., Proceedings of the workshop on southwestern habitat types*. April 1983, Albuquerque, New Mexico.
- MARKS, P. L., AND P. A. HARCOTTE. 1981. Forest vegetation of the Big Thicket, southeast Texas. *Ecol. Monogr.* 51: 287–305.
- MOONEY, M. J. 1985. A preliminary classification of high elevation sagebrush-grass vegetation in northern and central Nevada. Unpublished thesis, University of Nevada at Reno. 123 pp.
- MUEGGLER, W. F., AND W. L. STEWART. 1980. Grassland and shrubland habitat types of western Montana. USDA For. Serv. Gen. Tech. Rept. INT-66, Intermt. For. and Range Expt. Sta., Ogden, Utah, 154 pp.
- MUELLER-DOMBOIS, D., AND H. ELLENBERG. 1974. Aims and methods of vegetation ecology. John Wiley and Sons, New York. 547 pp.
- NORUSIS, M. J. 1985. Statistical package for the social sciences. SPSS, Inc., Chicago, Illinois.
- PASSEY, H. B., V. K. HUCIE, E. W. WILLIAMS, AND D. E. BALL. 1982. Relationships between soil, plant community, and climate on rangelands of the Intermountain West. *Tech. Bull. 1669, USDA Soil Cons. Serv., Washington, D.C.*
- PECHANEC, J. F., AND G. D. PICKFORD. 1937. A weight estimate method for determinations of range or pasture production. *J. Amer. Soc. Agron.* 29: 894–904.
- PFISTER, R. D., B. L. KOVALCHIK, S. F. ARNO, AND P. C. PRESBY. 1977. Forest habitat types of Montana. USDA For. Serv. Gen. Tech. Rept. INT-34, Intermt. For. and Range Expt. Sta., Ogden, Utah. 174 pp.
- RISC. 1983. Guidelines and terminology for range inventories and monitoring. Report of the Range Inventory Standardization Committee. Soc. for Range Manage., Denver, Colorado. 13 pp.
- STEVENS, R., AND E. D. MCARTHUR. 1974. A simple field technique for identification of some sagebrush taxa. *J. Range Manage.* 27: 325–326.
- STRAUSS, R. E. 1982. Statistical significance of species clusters in association analysis. *Ecology* 63: 634–639.
- STURGES, D. L. 1977. Soil water withdrawal and root characteristics of big sagebrush. *Amer. Midl. Nat.* 98: 257–274.
- TUELLER, P. T., AND R. E. ECKERT. 1987. Big sagebrush (*Artemisia tridentata vaseyana*) and longleaf snowberry (*Symphoricarpos oreophilus*) plant associations in northeastern Nevada. *Great Basin Nat.* 47: 117–131.
- USDA. 1969. Range environmental analysis handbook. USDA For. Serv., Intermountain Region, Ogden, Utah.
- . 1975. Soil taxonomy. Soil Survey Staff, USDA Agric. Handb. 436. U.S. Govt. Printing Office, Washington, D.C.
- WEST, N. E., R. J. TAUSCH, K. H. REA, AND P. T. TUELLER. 1978. Taxonomic determination, distribution, and ecological indicator values of sagebrush within the pinyon-juniper woodlands of the Great Basin. *J. Range Manage.* 31: 87–92.
- WINWARD, A. H. 1980. Taxonomy and ecology of sagebrush in Oregon. *Agric. Expt. Sta. Bull. 642, Oregon State University, Corvallis*. 15 pp.
- YOUNG, J. A., R. A. EVANS, AND R. E. ECKERT. 1985. Successional patterns and productivity potentials of the sagebrush and salt desert ecosystem. *In: Developing strategies for rangeland management*. National Academy of Science. Westview Press, Boulder, Colorado.
- YOUNGBLOOD, A. P., W. G. PADGETT, AND A. H. WINWARD. 1985. Riparian community type classification of eastern Idaho—western Wyoming. USDA For. Serv. Regional Ecol. Note 85–01, Regional Office, Ogden, Utah.
- ZAMORA, B., AND P. T. TUELLER. 1973. *Artemisia arbuscula*, *A. longiloba*, and *A. nova* habitat types in northern Nevada. *Great Basin Nat.* 33: 225–242.