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A Preliminary Classification of Snake River Canyon Grasslands in Idaho

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INTRODUCTION

The grasslands of the Middle Snake River Valley constitute, along with those of major tributaries such as the Salmon and Clearwater, a unique and important vegetation region of Idaho. The total area occupied by these grasslands in Idaho is about 486,000 hectares (1.2 million acres), perhaps half of which occurs in the area included in the present study. Similar grasslands occur on the west side of the Snake River in Oregon and Washington.

Due to its rugged topography, dry climate and stony soils, most of this grassland region has remained uncultivated. A mild winter climate and high quality forage provide choice grazing for both domestic livestock and wildlife. The grasslands stabilize steep slopes where accelerated erosion would be disastrous to water quality in the Snake River system. Recreational values are also high — much of the study area has recently been designated the Hells Canyon National Recreation Area.

These grasslands were used primarily by wildlife, before the coming of white settlers, although by the late 1800s horses acquired by the Nez Perce Tribe were grazed in the canyons; heavy use may have occurred in a few localities. White settlement became widespread after 1870, introducing large herds of cattle and sheep which often were grazed on a yearlong basis (Evans 1967). Most of the more accessible grassland became depleted. While much remains so at the present time, difficult access, precipitous slopes and lack of water have acted to protect some areas from overuse. Better range management has improved others. As a result, the study area contains numerous examples of relatively undisturbed vegetation, particularly in the central portion, where white settlement was sparse and heavy livestock use was restricted to lands close to homesteads.

The study area includes the main valley of the Snake and its immediate tributaries from the area around Lewiston in the north to Brownlee Dam at the south end (Fig. 1). Included are portions of Nez Perce, Idaho, Adams and Washington counties in Idaho; Whitman and Asotin in Washington; and Wallowa and Baker in Oregon. Most of the study was conducted in Idaho; a few sites were sampled and observations made in the other two states.

The total length of this area is about 192 km (120 miles); the width varies from about 2 to 25 km (1.2 to 15.5 miles). The topography is rugged, with elevation ranging from a low of 214 m (700 ft) on the valley floor near Lewiston to 2800 m (9185 ft) on the mountains forming the canyon rim. Grasslands occur from the valley floor to elevations of about 2400 m (7870 ft), but are

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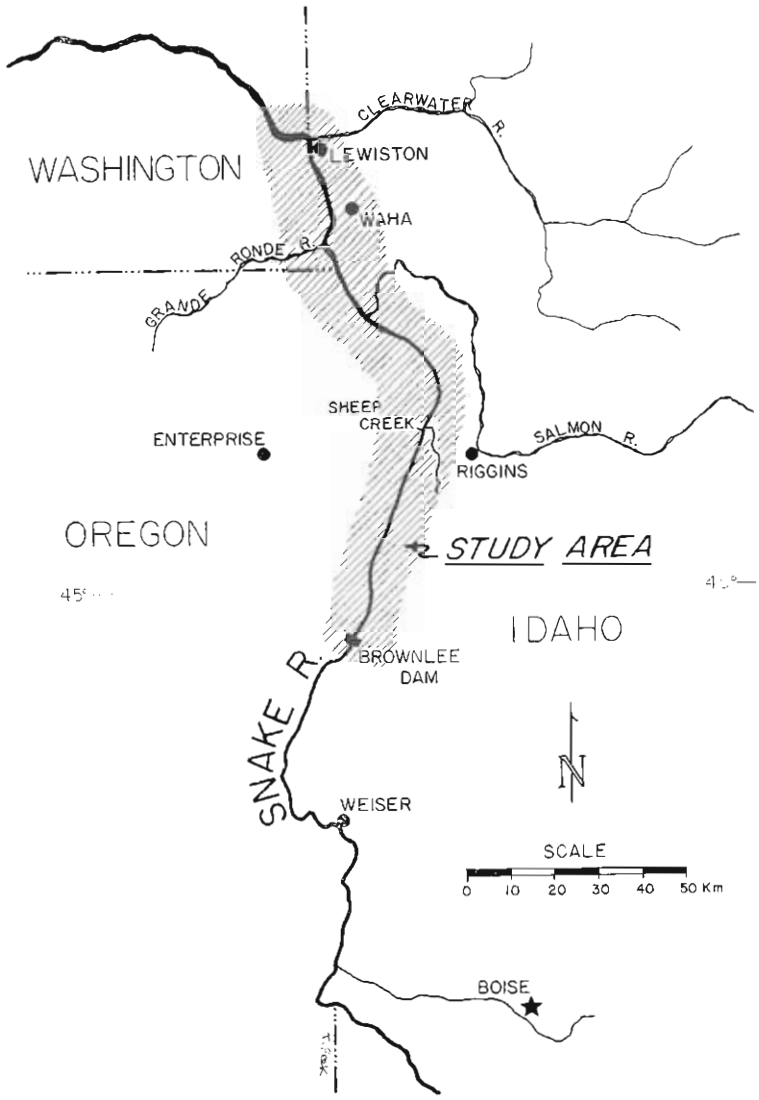

Fig. 1. Sketch map of Middle Snake River drainage, showing approximate boundaries of the study area.

confined to southerly slopes and ridge tops at higher elevations. Parts of the canyon have steep rock walls, but generally the valley sides rise in a series of slopes ranging from 20 to over 100 percent gradient. The majority of grassland slopes have gradients of 50 to 75 percent (Fig. 2).

Climatic data are limited to stations at Lewiston and Brownlee Dam. Both stations are located near the valley bottom. Mean annual precipitation and temperature data for these stations are presented below.

		Mean Precip (mm)		*%*	*Mean Temperature (°C)*		
Elev(m)	*Station*	*Annual*	*Nov-Mar*	*Nov-Mar*	*Annual*	*Jan*	*July*
562	Brownlee	407	249	58.5	11.9	-0.1	26.5
431	Lewiston	329	150	45.5	11.1	-0.3	23.3

The south end of the area is slightly warmer, but receives more precipitation than the north end. No data are available for intermediate points in the canyon.

The moisture pattern is characterized by a high percentage of winter precipitation, mainly in the form of rain. Mild winter climate is shown by the relatively high mean temperatures for January, and by the presence of disjuncts such as *Celtis reticulata* (hackberry), a species found primarily in the southwestern states.

The soils of the area are derived primarily from Columbia River basalt or the older Seven Devils volcanics, along with varying amounts of quaternary loess. Recent alluvial deposits are found in limited areas

on stream fans and terraces. Most of the grassland soils have formed on relatively steep slopes and contain a mixture of residual and colluvial materials. The soils are relatively stony, and depth varies greatly with aspect and slope. Textures range from loamy-sand to clay loam, with loams and silt loams most common. Taxonomically, loamy-skeletal Argixerolls and Haploxerolls predominate (Barker 1976, 1978; Soil Conservation Service 1975).

The vegetation of the study area consists mainly of grassland at the lower and middle elevations, with coniferous forest above. There is much interfingering of forest and grassland, however, due to differences in aspect. Communities dominated by shrubby species including *Cercocarpus ledifolius* (curlleaf mountain mahogany), *Celtis reticulata, Amelanchier alnifolia* (serviceberry) and *Prunus emarginata* (bitter cherry) occupy limited areas in the canyon. A narrow band of riparian vegetation along the river and its tributaries is dominated by *Alnus rhombifolia* (white alder) (Miller and Johnson 1976).

The southern end of the study area lies in the ecotone between the Pacific Northwest bunchgrass region and the sagebrush-grass or sagebrush steppe region.

PREVIOUS STUDIES

Little published information exists on the vegetation of the study area or of the canyon grasslands of the Pacific Northwest. Daubenmire's (1970) detailed study of the steppe vegetation of Washington covers the Palouse and Columbia Basin areas but not the canyon of the Snake River or its tributaries. Daubenmire described several habitat types dominated by either *Agropyron spicatum* or *Festuca idahoensis*. Most information relating directly to the study area occurs in theses and papers from the University of Idaho. Campbell (1962) studied vegetation dominated by *F. idahoensis* at the northern end. On a basis of very limited sampling he described two climax communities: *Agropyron spicatum/Festuca idahoensis* and *Festuca idahoensis/Koeleria cristata*. Evans (1967) and Evans and Tisdale (1972) reported on studies of lower elevation grasslands, mainly in the Salmon River drainage. Emphasis was on the ecology of *A. spicatum* and *Aristida longiseta* (three awn). Two seral communities based on soil differences were recognized, both in the *A. spicatum* series. Huschle (1975) was primarily concerned with a narrow strip of land immediately adjacent to the Snake River, but his studies included some upland vegetation. Although most of his sites were in depleted condition, he described a climax *Agropyron spicatum/Poa sandbergii* community which appeared more mesic than that recognized by Daubenmire (1970) in Washington.

Fig. 2. Typical rough topography and grassland vegetation of the Middle Snake River Canyon. Soils and vegetation are well developed on steep slopes (foreground), but considerable bare rock outcrop occurs, especially on south slopes (background).

METHODS

Field methods were designed for rapid sampling with reasonable accuracy, and required only simple, lightweight equipment. Most of the sites were reached by extensive foot travel. A jet boat was used to reach portions of the canyon not accessible by road.

Sampling was concentrated on areas selected to represent different portions of the study region. Criteria for sample areas included a range of topographic situations and soil types plus stands of vegetation in relatively undisturbed condition. Suitable areas were found in the vicinity of Waha in the northern part, Sheep Creek in the central part, and near the south end of the study area.

Sampling involved the use of a macroplot for recording general site characteristics and microplots for detailed study of vegetation and soil surface features. A macroplot of 15 by 30 m (50 by 100 ft) was used, with 20 microplots, each 2 by 5 dm (8 by 20 inches) in size. These

Table 1. Species constancy and frequency in grassland habitat types.(1)

CLASS AND SPECIES	*Festuca* Series						*Agropyron* Series			
	Festuca/Koeleria		*Festuca/Symph.*		*Festuca/Agropyron*		*Agropyron/Poa*		*Agropyron/Opuntia*	
	Const. %	Freq.	Const. %	Freq.	Const. %	Freq.	Const. %	Freq.	Const. %	Freq.
PERENNIAL GRASSES										
Festuca idahoensis Idaho fescue	100	94	100	66	100	85	22	1.0	0	0
Agropyron spicatum Bluebunch wheatgrass	100	55	100	90	100	74	100	81	100	76
Poa sandbergii Sandberg bluegrass	87	26	100	53	89	36	100	76	90	26
Koeleria cristata Junegrass	100	34	50	8.0	22	1.0	22	1.7	0	0
ANNUAL GRASSES										
Bromus brizaeformis(3) Rattlesnake brome	60	16	100	19	78	29	67	25	55	7.0
Bromus japonicus(3) Japanese brome	36	12	25	2.0	33	7.0	44	5	55	11
Bromus tectorum(3) Cheatgrass	27	2.0	50	19	56	21	67	41	91	43
Festuca megalura Foxtail fescue	20	5.0	25	15	22	3.0	56	21	36	16
PERENNIAL FORBS										
Achillea millefolium var. *lanulosa* Yarrow	93	34	100	23	100	32	89	23	91	16
Balsamorhiza sagittata Arrow-leaf balsamroot	53	3.5	75	13	44	11	67	11	64	6.0
Besseya rubra Red besseya	27	7.3	25	2.5	56	19	0	0	0	0
Brodiaea douglasii Wild hyacinth	60+	10	100	10	78+	17	44+	1.0	9+	-
Calachortus elegans Elegant cats-ear	53	12	25	2.5	11	-(2)	0	0	0	0
Castilleja hispida Rough paintbrush	87	6.0	75	2.5	22	1.0	44	1.5	0	0
Cirsium undulatum Wavy-leaved thistle	13	1.0	0	0	11	-	44	1.7	82	5.0
Erigeron pumilis Shaggy fleabane	33	7.0	25	-	44	1.0	33	1.0	55	1.0
Eriogonum heracleoides Parsnip-flowered buckwheat	40	10	75	2.5	44	9.0	22	1.0	9	1.5
Geum triflorum Three-flowered aven	40	8.0	100	19	11	4.7	0	0	0	0
Heuchera cylindrica Lava alum root	0	0	0	0	56	9.0	0	0	0	0
Hieracium albertinum Western hawkweed	53	4.0	25	-	11	-	0	0	0	0
Lithophragma parviflora Prairie star	60+	12	50+	18	78+	25	33+	4.0	0+	0
Lomatium triternatum Nine-leaf lomatium	47	4.5	75	36	78	6	56	12	9	2.0
Lupinus sericeus Silky lupine	40	14.3	100	12.5	22	2	22	4.0	18	0.5
Phlox colubrina and *P. longifolia* Long-leaved phlox	47	5.5	50	10	22	3	67	3.5	54	11
Potentilla gracilis Northwest cinquefoil	40	8.5	50	2.5	0	0	0	0	0	0
Scutellaria angustifolia Narrow-leaf skullcap	0	0	0	0	0	0	11	1.7	73	8.0
Opuntia polyacantha Prickly pear cactus	0	0	0	0	0	0	22	-	73	13
Phacelia heterophylla Varied-leaf phacelia	0	0	0	0	0	0	22	0.6	73	2.0
Tragopogon dubius(3) Yellow salsify	33	3.0	25	-	33	3.0	56	4.0	18	0.5
ANNUAL FORBS										
Draba verna(3) Spring whitlow wort	40+	24+	75	40	56+	45	33+	22	?	?
Stellaria nitens Shining chickweed	52+	36+	75	25	56+	42				
SHRUBS										
Rosa nutkana and *R. woodsii* Wild rose	13	0.3	50	4.0	0	0	0	0	0	0
Symphoricarpos albus Snowberry	7	0.3	100	40	0	0	0	0	0	0

(1) Includes only species which occur on 50% or more of the samples of one or more habitat types

(2) Indicates a frequency of less than 1%

(3) Indicates introduced species

plot sizes have been used extensively for grassland studies in the Pacific Northwest. The microplots were located at 2 m (6.5 ft) intervals along two randomly selected transects. Plot locations were marked by painted boulders or rock mounds and located on maps and aerial photographs.

Physiographic data included elevation, aspect, percent slope, and position on slope. Notes were made on amount of erosion, signs of present and past grazing use, and evidence of fire or other disturbance.

The soil profiles on each macroplot were exposed for study with a pit. Parent material, profile development, stoniness, solum depth, restrictive layers, etc. were recorded. Samples were taken to determine texture, pH, organic matter and color. Classification and nomenclature were based on the U.S.D.A. Soil Taxonomy Handbook (Soil Conservation Service 1975).

Data obtained from the microplots included frequency of rooted vascular species, an estimate of their foliage cover, and the percentage of cryptogams, litter, gravel and bare ground on the soil surface. A species list was made by inspecting the whole macroplot and adding species present but not recorded on the microplots. Herbarium specimens were collected for documentation, with nomenclature based on Hitchcock and Cronquist (1973).

Analysis of the data included preparation of association tables and statistical treatment. The first order sorting by cluster analysis was based on species presence or absence, following which quantitative factors of frequency and cover were considered. Classification was based on the vegetation, but soils and physiographic data were correlated with vegetation and incorporated into the description of each community. Soils were classified to family and, where possible, to series levels.

In recognizing communities, it was realized that the vegetation of an area represents a continuum within which groupings of similar stands can enhance understanding of ecosystems. In practice, physiographic differences, especially aspect, produced reasonably sharp boundaries for the communities recognized.

RESULTS

Forty-seven stands were sampled during the field seasons of 1976 and 1977. Additional data were obtained from 14 sites established earlier by Campbell (1962) and Evans (1967). A summary of results is presented in Tables 1 and 2. Analyses of these data indicate the presence of two vegetational series. The series is a group of vegetation systems, usually with a single dominant climax species. It corresponds to the term "vegetation zone" used by many workers. The *Festuca idahoensis* and *Agropyron spicatum* series recognized in the present study belong in the Pacific Northwest bunchgrass region.

Vegetational series are useful as a broad classification, but the objective in the present study is recognition of finer units. The habitat type is considered the basic ecosystem unit, defined as "the aggregate of all areas that support or can support the same primary climax" (Daubenmire 1970). The habitat type (ht) has relatively uniform biotic and abiotic structure and is a primary unit for management. The climax vegetation, considered to give the most meaningful integration of environmental factors affecting vegetation, provides recognition features for habitat types (Steele et al. 1976, Hironaka 1977).

Table 2. Vegetational and site characteristics of grassland habitat types.

	Festuca Series			*Agropyron* Series	
Species or Character (Average)	*Festuca/ Koeleria*	*Festuca/ Symphoricarpos*	*Festuca/ Agropyron*	*Agropyron/ Poa*	*Agropyron/ Opuntia*
Cryptogams (cover) %	26	25	23	18	10
Litter (cover) %	52	44	47	51	33
Gravel & Rock (cover) %	6	9	12	15	43
Bare Ground (cover) %	4	7	3	5	8
Perennial Grass Cover %	39.0	38.1	40.7	31.4	20.2
Perennial Forb Cover %	14.0	11.1	9.8	7.3	6.3
Av. No. Per. Forbs	16	15	11	11	10.7
Total Frequency Per. Forbs	276	220	196	122	102
Stones in Profile %*	30	42	30	42	60
Soil Profile Depth (cm)	84	67	85	65	54
A Horizon Depth (cm)	32	26	27	22	20
A Horizon Color (dry)	3/2	3/2	3.5/2	4/2	4/3
Organic Matter % (top 20 cm)	7.0	5.8	5.1	3.2	2.1
Aspect Class (average)	NE	EAST	NE	WEST	SW

*Estimated in the field.

KEY TO GRASSLAND COMMUNITIES

1 - *Festuca idahoensis* abundant and usually dominant — *Festuca* series

2 - *Symphoricarpos* and *Rosa* lacking or rare

3 - *Koeleria cristata* present and usually abundant — *Festuca idahoensis/Koeleria cristata* ht

3 - *Koeleria cristata* lacking or infrequent, *Agropyron spicatum* usually co-dominant with *Festuca idahoensis* — *Festuca idahoensis/Agroypyron spicatum* ht

2 - *Symphoricarpos* and *Rosa* common to abundant — *Festuca idahoensis/Symphoricarpos albus* ht

1 - *Festuca idahoensis* lacking or sparse, *Agropyron spicatum* dominant — *Agropyron spicatum* series

4 - *Poa sandbergii* abundant, litter cover usually 3 times greater than gravel pavement — *Agropyron spicatum/Poa sandbergii* (Idaho) ht

4 - *Poa sandbergii* sparse or lacking, litter cover usually less than gravel pavement, one or more of the following species present: *Opuntia polyacantha, Phacelia heterophylla, Scutellaria angustifolia* — *Agropyron spicatum/Opuntia polyacantha* ht

FESTUCA SERIES

This series occurs in the moister and/or cooler parts of the grassland area. The elevational range of sites sampled is from 540 to 1430 m (1770 to 4690 ft), but the type at the lower elevations is confined to northerly slopes. The series also extends to higher elevations. The vegetation is characterized by the dominance of *Festuca idahoensis.* Other common perennial grasses include *Agropyron spicatum, Koeleria cristata* and *Poa sandbergii. A. spicatum* is the most abundant of these and is co-dominant with *F. idahoensis* in some cases. Perennial forbs are abundant, with *Achillea millefolium* var. *lanulosa, Balsamorhiza sagittata. Brodiaea douglasii, Castilleja hispida, Lithophragma parviflora, Lomatium triternatum, Lupinus laxiflorus* (spur lupine) and *L. sericeus* most common. Annuals are less common, the only species with high constancy being a grass, *Bromus brizaeformis,* and two dwarf forbs, *Draba verna* and *Stellaria nitens.*

The soils have A horizons which are deep and dark colored with an organic content of 4 percent or more in the surface 20 cm (8 inches). Most belong in the loamy-skeletal, mixed, mesic Pachic Ultic or Ultic Argixerolls. These well drained soils are dry in summer, but store considerable moisture in the winter months. Dwarf cryptogams and litter comprise most of the soil cover, while gravel or rock and bare ground constitute much smaller portions.

This series provides high quality forage best suited for summer and fall use. It is relatively resistant to overgrazing, but with continued overuse the cover of perennial grasses and many perennial forbs is reduced, while annuals and some perennial forbs increase.

HABITAT TYPES - *FESTUCA* SERIES

Festuca idahoensis/Koeleria cristata ht

This is the principal habitat type of the *Festuca* series in the study area. The vegetation is characterized by dominance of *F. idahoensis* and constant occurrence of *Koeleria cristata. Agropyron spicatum* is usually present and often abundant, but with less cover than the *F. idahoensis.* Perennial forbs constitute about 25 percent of the total cover, with *Achillea millefolium, Castilleja hispida, Lithophragma parviflora, Hieracium albertinum, Balsamorhiza sagittata* and *Calochortus elegans* most common. Shrubs are represented only by *Spireaea betulifolia* (shinyleaf spiraea) which occurs sparingly.

The soils are dark, with an average organic content of 7 percent. Most belong to the Lawyer series, a loamy-skeletal, mixed, mesic Pachic Ultic Argixeroll, or to an undescribed series which resembles Bluesprin, but is darker and contains more organic matter. These categories indicate relatively moist, cool conditions for grassland soils, and correspond with the mesic nature of the vegetation and the dominance of *F. idahoensis.* The soil cover of dwarf cyptogams (lichens and mosses) and litter is almost complete.

Festuca idahoensis/Koeleria cristata represents a habitat type not presently described in the published literature, although Campbell (1962) used the term for one of the communities described. It differs from any of the habitat types described by Daubenmire (1970) in eastern Washington.

This habitat type is highly productive and well suited for summer and fall grazing. It is fairly resistant to heavy grazing, but less palatable forbs such as *Achillea millefolium* and annuals increase with continued overuse.

Festuca idahoensis/Agropyron spicatum ht

This type occurs mainly in the drier parts of the study area, at the north and south ends, usually on similar aspects but slightly lower elevations than the *Festuca idahoensis/Koeleria cristata.*

The vegetation is characterized by the shared dominance of *F. idahoensis* and *A. spicatum,* virtual absence of *K. cristata,* and by a lesser forb composition and cover than that of the *Festuca/Koeleria.* A characteristic forb is *Heuchera cylindrica,* uncommon elsewhere in the series. Shrubs are rare or lacking. The soil cover of litter and cryptogams is comparable to that in the *Festuca/Koeleria,* but gravel cover is higher.

Soils differ from those of the *Festuca/Koeleria* mainly in having lower organic content and lighter color. They belong mostly in the loamy-skeletal, mixed, mesic Ultic or Lithic Ultic Argixerolls, but vary considerably. Classification to series level has proved difficult to date, although soils resembling Bluesprin, Riggins and even Lawyer occur.

This community resembles in some respects the *Agropyron spicatum/Festuca idahoensis* ht of Daubenmire (1970), yet differs considerably in species composition. *Heuchera cylindrica, Balsamorhiza sagittata* and *Eriogonum heracleoides,* all common in the *Festuca idahoensis/Agropyron spicatum,* are lacking in Daubenmire's *Agropyron spicatum/Festuca idahoensis.* On the

other hand, *Phlox longifolia* and annuals such as *Plantago patagonica* (Indian-wheat) and *Festuca pacifica* (small fescue) are much more common in Daubenmire's type. Differences also occur in physiography and soils, for Daubenmire's sites are mainly of gentle topography with deep loessial soils.

Festuca idahoensis/Symphoricarpos albus ht

This habitat type is confined to the northern end of the study area, and sampling to date has been minimal (4 stands). It occurs at middle elevations in the *Festuca* series, on similar aspects to the *Festuca idahoensis/Koeleria cristata* ht.

Vegetationally it is closest to the *Festuca/Koeleria,* but differs in the presence of *Symphoricarpos albus* and *Rosa (nutkana/woodsii),* in the higher proportion of *Agropyron spicatum* and in the less consistent occurence of *K. cristata.* The soils are shallower, stonier, lower in organic matter, and lighter in color than those of the *Festuca/Koeleria.* They seem closest to a dark phase of Bluesprin, which is a loamy-skeletal, mixed, mesic Ultic Argixeroll.

The presence of *Symphoricarpos* and *Rosa* might suggest a more mesic community than the *Festuca/Koeleria,* but the weight of evidence from vegetation and soils indicates the opposite. This type differs from the *Festuca idahoensis/Symphoricarpos albus* ht of Daubenmire (1970), which exceeds it greatly in number and abundance of perennial forbs, as well as in depth and fertility of soil.

AGROPYRON SERIES

These communities occupy the largest portion of the canyon grasslands, extending from valley bottoms to elevations of about 1350 m (4430 ft). At higher elevations they become increasingly confined to southerly slopes and ridge tops.

The vegetation is characterized by the dominance of *Agropyron spicatum.* The only other perennial grass of high constancy, *Poa sandbergii,* usually constitutes only a small part of the perennial grass cover. Annual grasses, especially the bromes, occur commonly but with little cover. A large number of perennial forbs occur, but few species exhibit high constancy. The average number of perennial forb species per site is only two-thirds that of the *Festuca* series. The most common forbs are *Achillea millefolium, Balsamorhiza sagittata, Lomatium triternatum,* and *Phlox* spp. (*P. colubrina* and *P. longifolia*).

Annual forbs are relatively sparse, the main species being *Draba verna, Stellaria nitens* and *Myosotis* spp. (forget-me-not). A succulent, *Opuntia polyacantha,* is common in one habitat type. Shrubs are sparse, with *Chrysothamnus nauseosus* (rubber rabbitbrush) most common. Soil cover consists of a low content of dwarf cryptogams, moderate to dense litter, and a large amount of surface gravel in one habitat type.

The soils are lighter colored, with lower organic content, more stones, and shallower horizons than those of the *Festuca* series. Most are loamy-skeletal, mixed, mesic Argixerolls, Haploxerolls or Xerorthents indicating moisture and temperature conditions less favorable than those in the *Festuca* series.

This grassland is suited for fall and winter grazing and can also be utilized in the spring if use is not continued too long into the growing season. It is more easily disturbed by heavy use than the *Festuca* series. Depletion is shown by a decline in most perennials, especially *Agropyron spicatum,* and by a marked increase in annuals, including *Bromus tectorum,* other bromes and annual forbs.

HABITAT TYPES - *AGROPYRON SERIES*

Agropyron spicatum/Poa sandbergii (Idaho) ht

This habitat type is given the term "Idaho" to distinguish it from the *Agropyron/Poa* described by Daubenmire (1970). The "Idaho" type possesses a larger number and greater total frequency of perennial forbs than Daubenmire's habitat type. The more mesic annual bromes, i.e. *Bromus brizaeformis* and *B. japonicus,* occur commonly, but are rare or lacking in Daubenmire's community. Huschle (1975) describes a similar difference in annual brome species in samples of *Agropyron/Poa* in the middle Snake River Canyon. The *Agropyron/Poa* (Idaho) ht occurs throughout the study area on slopes of relatively favorable aspect and on deeper, less stony soils.

The vegetation is characterized by dominance and abundant cover of *A. spicatum,* with *P. sandbergii* the main "filler" species. *Achillea millefolium, Balsamorhiza sagittata, Phlox* spp. (*P. colubrina* and *P. longifolia*), *Lomatium triternatum* and *Brodiaea douglasii* are the most common perennial forbs. Shrubs are uncommon. The ground surface is occupied mainly by litter and dwarf cryptogams.

The soils are loamy-skeletal, mixed, mesic Calcic or Ultic Argixerolls, most belonging to the Tannahill series or to one not yet named which shows some characters resembling Bluesprin. These moderately deep soils provide favorable growth conditions during the spring months. Organic matter of the surface 20 dcm (8 inches) averages just over 3 percent and the dry color of the A horizon is dark grayish brown.

This is the most productive habitat type of the *Agropyron* series.

Agropyron spicatum/Opuntia polyacantha ht

This community occurs throughout the range of the *Agropyron* series, but on drier sites, with more southerly aspects than those occupied by the *Agropyron spicatum/Poa sandbergii* (Idaho) ht.

The vegetation is characterized by dominance of *A. spicatum,* but with less cover than in the *Agropyron/Poa* ht. *Poa sandbergii* is sparse in cover and occasionally absent. The perennial forb cover is less than that of the *Agropyron/Poa* and different in composition. The characteristic species, *Opuntia polyacantha, Phacelia*

heterophylla and *Scutellaria angustifolia,* belong to a group associated with gravelly sites. The soil surface is dominated by a gravel pavement which usually covers as much area as cryptogams and litter combined.

The soils are shallower, stonier, lower in organic matter and lighter in color than those of the *Agropyron/Poa* (Idaho) ht. Most are loamy-skeletal, mixed, mesic Lithic Haploxerolls or Lithic Xerorthents of the Lickskillet and Bakeoven series, respectively. These are shallow, stony soils and constitute the poorest sites for plant growth in the grassland area. Soils with slightly deeper profiles also occur in this habitat type; some of them resemble a shallow phase of Tannahill series. The *Agropyron/Opuntia* ht occupies the most xeric aspects with the *Agropyron* series, and produces less plant cover than the *Agropyron/Poa* ht.

DISCUSSION

Within the confines of regional climate, topographic variation constitutes the major ecological influence in the study area. Aspect, and to a lesser degree elevation, strongly inflence microclimate and hence the nature of vegetation and soils. Steepness of slope appears to be a lesser factor, at least up to the 75 percent limit set for sampling in this study. Response to topographic variation has produced a mosaic of vegetation and soil types, recognizable in the field and separable as taxonomic units.

One of the major objects of the current study is to investigate the relation between vegetation and soil units, particularly at the level of habitat type and soil series. Since vegetation and soils are developed by the same set of formative factors (Jenny 1958), there should be a close relationship. It is not total, however, for although vegetation and soils develop together, they do not directly determine one another (Major 1951). Furthermore, the taxonomic units of each are based on their own characteristics, thus the properties used to separate two soil series may not be critical for the vegetation of a particular area.

Despite these reservations, significant correspondence of vegetation and soils is shown in the present study. Relationship between habitat types and soil series is well marked for the two major habitat types, *Festuca idahoensis/Koeleria cristata* and *Agropyron spicatum/Poa sandbergii* (Idaho). In each case, two closely related soil series are found conjoined with a specific habitat type. The lesser degree of correlation for the other three habitat types indicates a need for further examination of both vegetation and soils of the areas involved. A weakness of the present study has been lack of joint field examination of vegetation and soils by specialists in each of these disciplines. Identification of soils from the study sites has been made on the basis of my brief descriptions and from soil samples. The soil surveys applicable to the study area were made at the reconnaissance level and did not cover all units of landscape, especially on the steep and relatively inaccessible areas which contain much of the Snake River grasslands.

I hope that this initial classification and description of the principal grassland communities will be useful to land managers and others concerned with the vegetation of the area. Feedback and tests of these keys and descriptions are needed to develop a more comprehensive treatment of these canyon grasslands.

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