Introduction

The portion of the Intermountain West where perennial grassland, or steppe, vegetation occurs on zonal soils is designated the northern Section of the *Agropyron spicatum* Province by Daubenmire (1978). Steppe vegetation of this region can be further subdivided on the basis of physiognomy into three zones: shrub steppe, true steppe, and meadow steppe (Figure 1) (Daubenmire 1970; Franklin and Dyrness 1988). Principal diagnostic characteristics of true steppe vegetation are the caespitose growth form of *Agropyron*, and "the overwhelming dominance of perennial grasses over forbs" (Daubenmire 1942:65). In contrast to this, in meadow steppe, located along the eastern and northern borders of Washington's true steppe, the perennial grasses are accompanied by "an infusion" of large perennial forbs (Daubenmire 1942:65).

In 1942 Daubenmire referred to the steppe and meadow steppe of Washington as "Palouse grasslands" (Daubenmire 1942:78). In this usage, Palouse grasslands was an ecological term defined on the basis of vegetation rather than a geographic term (Figure 2A). Subsequent authors tended to define the Palouse as a geographic region encompassing southeastern Washington, adjacent northern Idaho, and northeastern Oregon, and to define it more narrowly than the region denoted by Daubenmire (Figure 2B). (See Lichthardt and Moseley 1997 for discussion.) In this usage, the Palouse region includes the eastern portions of Washington's steppe and meadow steppe zones, which occur on relatively mesic loessal soils (Thiele and Omernik 1993; Bailey 1995; Lichthardt and Moseley 1997). Steppe and meadow steppe zones outside of the Palouse region occur to the west (Poulton 1955), north (Tisdale 1983), and in a disjunct area to the east in Montana (Mueggler and Stewart 1980). Tisdale termed these "Pacific Northwest Bunchgrass grasslands" (PNBG). The PNBG have been subdivided into several ecological divisions, one of which is the Palouse Grassland (Idaho Natural Heritage Program et al. 1986; The Nature Conservancy et al. 1987).

Another division of PNBG has been termed Canyon Grassland (The Nature Conservancy et al. 1987). This division occurs throughout canyons of the Columbia Plateau. Excellent examples occur in the canyons of the Snake and Salmon rivers and their major tributaries (Tisdale 1986; Johnson and Simon 1987). The grassland communities of the Canyon Grassland are steppe or meadow steppe, similar in structure to (although somewhat different in composition from) communities of other parts of the PNBG. This term does not designate a unique physiognomic type of grassland; rather, Canyon Grassland is distinguished by its characteristic topography and flora. The steep contours of the deeply dissected canyons result in pronounced habitat diversity due to differences in elevation, aspect, and soil depth over short distances (Tisdale 1986; Johnson and Simon 1987).

Palouse Grassland was dramatically reduced in extent when its deep, fertile soils were converted to cropland (Buss and Dziedzic 1955). Most remnants of this vegetation type are small, privately-owned parcels surrounded by cultivated fields, and Palouse Grassland is now considered a critically endangered ecosystem (Noss et al. 1995). Many of the elements that remain on unprotected sites are threatened by rural residential development and invasion of exotic weeds (Lichthardt and Moseley 1997).

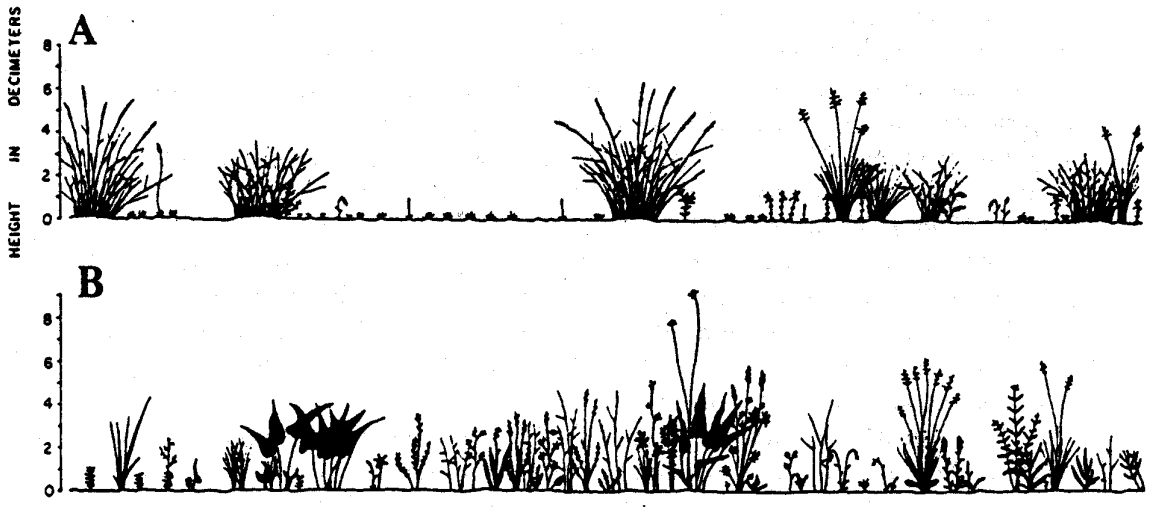

Figure 1. Physiognomy of steppe (A) and meadow steppe (B) vegetation in Washington. Based on Daubenmire 1970.

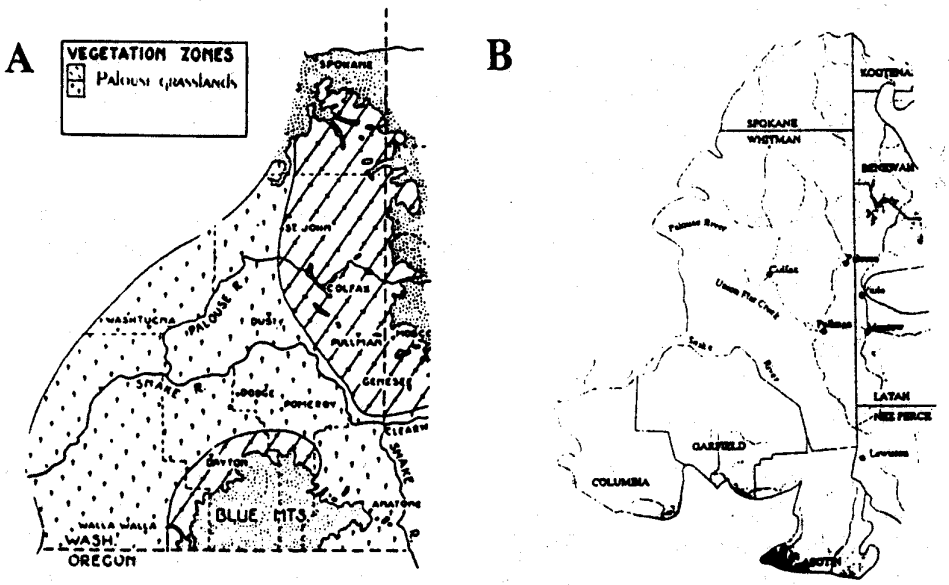

Figure 2. A. Zones of Washington referred to as Palouse grasslands by Daubenmire (1942). B. Portion of Bailey's Palouse Bioregion in Washington (Bailey 1995). Note that Bailey's Palouse Bioregion does not extend as far west as the Palouse grasslands designated by Daubenmire.

Canyon Grassland, because of its steepness, has not been extensively converted to other uses, but much of the native Canyon Grassland vegetation has been altered by extensive grazing (Daubenmire 1940; Young 1943; Tisdale 1961); nevertheless, there remain substantial areas that have not received heavy grazing pressure because of their steep slopes, shallow soils, inaccessibility, and distance from water (The Nature Conservancy et al. 1987). These are well represented in natural areas owned by The Nature Conservancy and state and federal agencies (Mancuso and Moseley 1994, Hill 1995a,b, 1996; Hill and Gray 1998a,b).

As early as 1942 Daubenmire noted a high degree of endemism in plants of the Palouse grasslands (Daubenmire 1942:77). Currently, over a dozen sensitive plant taxa occur in the Palouse and Canyon grasslands (Table 1). All of these have geographic ranges that are restricted to the PNBG, and several are restricted to the Palouse or Canyon Grasslands. (See Results, below.)

This report summarizes the results of Phase 1 of a project designed to assess threats to Palouse Grassland and Canyon Grassland communities and associated sensitive plant taxa and to increase the number of high quality occurrences of these elements that are protected through private conservation agreements. The objectives of Phase 1 of this project were:

1) to rank in terms of their conservation value known locations of native Palouse Grassland and Canyon Grassland communities and associated rare plant taxa that are not currently protected;
2) to establish baseline monitoring on five selected examples of native Palouse Grassland or Canyon Grassland communities in order to track changes in community composition such as invasion by exotic species, shrub encroachment, and changes in plant species diversity at these sites; and
3) to conduct reconnaissance surveys of eight additional Palouse Grassland or Canyon Grassland sites to obtain information on the presence of sensitive plant taxa and threats from non-native species.

Methods

Prioritization of conservation sites

Our study area consisted of the Palouse Ecoregion of Bailey (1995) plus the portions of Idaho and northeastern Oregon to the south and east that contain Canyon Grasslands and Palouse Grasslands (western and southern Asotin County in Washington; Adams and Washington counties and southern Nez Perce, Lewis, and Idaho counties in Idaho; and Wallowa County in Oregon) (Figure 3).

We requested information on element occurrences (EOs) of 29 plant communities and 14 plant taxa found in the Palouse Grasslands or Canyon Grasslands of Washington, Oregon, or Idaho (Table 2). The plant associations we requested information on were those in the *Symphoricarpos albus* (common snowberry), *Agropyron spicatum* (bluebunch wheatgrass), *Festuca idahoensis* (Idaho fescue), and *Festuca scabrella* (rough fescue) alliances that occurred in the study area and were tracked in at least one state.

		State ranks			Federal ranks	
Taxon	**Global rank**	**Idaho**	**Washington**	**Oregon**	**US Fish and Wildlife Service**	**BLM**
Aster jessicae	G2	S2	Endangered S1S2	not present	Species of concern	Sensitive
Astragalus arrectus	G2G3	not considered rare	Sensitive S2	not present	--	--
Astragalus ripartus	G2G3	Extirpated?	Sensitive S2	not present	--	Watch
Calochortus macrocarpus var. maculosus	G4G5 T2	S2	Sensitive S1	S?	--	Sensitive
Calochortus nitidus	G3	S3	Threatened S1	S3	Species of concern	Sensitive
Chrysothamnus nauseosus ssp. nanus	G5 T4	Monitor, S2	Watch	not considered rare	--	Sensitive
Crepis bakeri spp. idahoensis	G4 T2	S2	not present	not present	--	Sensitive
Haplopappus liatriformis	G2	S2	Threatened S2	not present	Species of concern	Sensitive
Leptodactylon pungens ssp. hazeliae	G5 T1T2	S1	not present	Candidate S1	Species of concern	Sensitive
Lomatium dissectum var. dissectum	G5 T5	Monitor, S3	not present in study area in WA	not present in study area in OR?	--	Watch
Mirabilis macfarlanei	G2	S2	not present	Endangered S1	Threatened	Threatened
Silene spaldingii	G2	S1	Threatened S2	Endangered S1	Species of concern	Sensitive
Thelypodium laciniatum var. streptanthoides	G5 T4	Monitor, S2	not considered rare	not considered rare	--	Sensitive
Trifolium plumosum var. amplifolium	G4 T2	S2	not present in study area in WA	not present	--	Sensitive

Table 1. Fourteen plant taxa associated with Palouse Grassland and/or Canyon Grassland and considered rare or sensitive in Idaho, Washington, and/or Oregon. Explanation of symbols: G=global status, T=trinomial (infraspecific) status (used in conjunction with global rank), S=state status. 1=Critically imperiled because of extreme rarity or because of particular vulnerability to extinction or extirpation; typically 5 or fewer occurrences; 2=Imperiled because of rarity or because of vulnerability to extinction or extirpation; typically 6-20 occurrences; 3=Either very rare and local throughout its range or found locally (or even abundantly) in a restricted range; typically 21-100 occurrences; 4=Apparently secure; typically more than 100 occurrences; 5=Demonstrably widespread, abundant, and secure.

Scientific name	Common name
SPECIES	
Aster jessicae	Jessica's aster
Astragalus arrectus	Palouse milk-vetch
Astragalus riparius	Piper's milk-vetch
Calochortus macrocarpus var. *maculosus*	Green-band mariposa lily
Calochortus nitidus	Broad-fruit mariposa
Chrysothamnus nauseosus ssp. *nanus* [*Chrysothamnus nauseosus* var. *nanus*]	Dwarf gray rabbitbrush
Cirsium brevifolium	Palouse thistle
Crepis bakeri ssp. *idahoensis*	Idaho hawksbeard
Haplopappus liatriformis	Palouse goldenweed
Leptodactylon pungens var. *hazeliae*	Hazel's prickly phlox
Lomatium dissectum var. *dissectum*	Fern-leaved desert parsley
Silene spaldingii	Spalding's silene
Thelypodium laciniatum var. *robustior*	Purple thick-leaved thelypody
Trifolium plumosum var. *amplifolium* [*Trifolium plumosum* ssp. *amplifolium*]	Plumed clover
COMMUNITIES	
Agropyron spicatum-Festuca idahoensis	Bluebunch wheatgrass-Idaho fescue
Agropyron spicatum-Poa secunda [*Agropyron spicatum-Poa sandbergii*]	Bluebunch wheatgrass-Sandberg's bluegrass
Agropyron spicatum-Poa secunda basalt variant	Bluebunch wheatgrass-Sandberg's bluegrass basalt variant
Agropyron spicatum-Poa secunda granite variant	Bluebunch wheatgrass-Sandberg's bluegrass granite variant
Agropyron spicatum-Poa secunda scabland (lithosol)	Bluebunch wheatgrass-Sandberg's bluegrass scabland (lithosol)
Agropyron spicatum-Poa secunda/Astragalus cusickii	Bluebunch wheatgrass-Sandberg's bluegrass/Cusick's milk-vetch
Agropyron spicatum-Poa secunda/Balsamorhiza sagittata	Bluebunch wheatgrass/Arrowleaf balsamroot
Agropyron spicatum-Poa secunda/Erigeron pumilis	Bluebunch wheatgrass-Sandberg's bluegrass/shaggy fleabane
Agropyron spicatum-Poa secunda/Phlox colubrina	Bluebunch wheatgrass-Sandberg's bluegrass/Snake River phlox
Agropyron spicatum-Poa secunda/Scutellaria angustifolia	Bluebunch wheatgrass-Sandberg's bluegrass/narrow-leaved skullcap
Agropyron spicatum/Eriogonum heracleoides	Bluebunch wheatgrass/Wyeth buckwheat
Agropyron spicatum/Opuntia polyacantha	Bluebunch wheatgrass/starvation cholla
Festuca idahoensis-Agropyron spicatum	Idaho fescue/bluebunch wheatgrass
Festuca idahoensis-Agropyron spicatum Balsamorhiza sagittata variant	Idaho fescue/bluebunch wheatgrass arrowleaf balsamroot variant
Festuca idahoensis-Agropyron spicatum Lupinus sericeus variant	Idaho fescue/bluebunch wheatgrass silky lupine variant
Festuca idahoensis-Agropyron spicatum Phlox colubrina variant	Idaho fescue/bluebunch wheatgrass Snake River phlox variant
Festuca idahoensis-Agropyron spicatum ridgetop variant	Idaho fescue/bluebunch wheatgrass ridgetop variant
Festuca idahoensis-Danthonia californica	Idaho fescue/California oatgrass
Festuca idahoensis-Danthonia intermedia-Carex	Idaho fescue/timber oatgrass-sedge
Festuca idahoensis-Koeleria cristata	Idaho fescue-prairie Junegrass
Festuca idahoensis-Koeleria cristata high elevation variant	Idaho fescue-prairie Junegrass high elevation variant
Festuca idahoensis-Koeleria cristata low elevation variant	Idaho fescue-prairie Junegrass low elevation variant
Festuca idahoensis-Koeleria cristata mounds variant	Idaho fescue-prairie Junegrass mounds variant
Festuca idahoensis-Koeleria cristata ridgetop variant	Idaho fescue-prairie Junegrass ridgetop variant
Festuca idahoensis/Eriogonum caespitosum	Idaho fescue/mat buckwheat
Festuca idahoensis/Potentilla diversifolia	Idaho fescue/diverse-leaved cinquefoil
Festuca idahoensis/Rosa nutkana	Idaho fescue/Nootka rose
Festuca idahoensis/Symphoricarpos albus	Idaho fescue/common snowberry
Festuca scabrella-F. idahoensis [*Festuca idahoensis-Festuca scabrella*]	Rough fescue-Idaho fescue [Idaho fescue-rough fescue]

Table 2. Taxa and plant communities for which element occurrences were considered in the prioritization of sites for conservation value.

We ranked unprotected element occurrences in terms of their conservation value. Sites on land owned by federal or state agencies, county governments, or The Nature Conservancy were considered protected. In addition, element occurrences registered with the Washington Register of Natural Areas Program, a voluntary, non-binding protection program, were considered protected. If information on ownership of a site was unavailable or ambiguous, the site was considered unprotected.

Unprotected EOs were ranked on the basis of four variables: size, proximity to other element occurrences, EO abundance (number of species or community elements at the same site), and quality of occurrence (EO rank, a subjective measure of EO quality that considers population size, disturbance, and degree of alteration) (Table 3). Large EOs and those that were near other EOs were considered to have higher conservation value than small, isolated EOs, because large EOs would be expected to support large populations and clusters of EOs could exchange propagules and mutualists. Information on proximity was obtained by calculating the distance from each EO to the nearest EO, using Arc/INFO. This spatial analysis was conducted by the University of Idaho Gap Analysis Program's Landscape Dynamics Laboratory. EOs with the same latitude and longitude or that were judged to be the same location on the basis of their site descriptions were considered a single site. Information on the other three variables was obtained from the files of the state heritage programs. If more than one element was present at a site, we used the highest ranked element for that site's rank score. For each site, scores were averaged for each variable for which information was available. Occurrences of historic or extirpated records were deleted.

Variable	Categories	Point values
Size	0-40 acres	0
	40-80 acres	1
	80-160 acres	2
	160-320 acres	3
	>320 acres	4
Proximity to nearest EO	>2250 m	0
	1050-2250 m	1
	450-1050 m	2
	150-450 m	3
	0-150 m	4
EO rank	C, CD, or D	0
	BC	1
	B	2
	AB	3
	A	4
EO abundance		Rank = number of EOs present at site

Table 3. Scales for variables used to rank EOs in terms of conservation priority.

Monitoring

We established baseline monitoring at five locations (Figure 3; Appendix 1). Two of the sites are privately owned (Paradise Ridge and Waha), and three are owned by state agencies (Smoothing Iron Ridge: Washington Department of Natural Resources; Colfax: Washington Department of Transportation; and Kramer Prairie: Washington State University). At the Kramer Prairie, Daubenmire had set up transects with one permanently-marked endpoint and obtained vegetation data in the 1950s. We were able to find the markers for two of these, and we repeated the vegetation sampling using the methods described in Daubenmire (1970). A 20 x 50-cm plot frame was placed at 0.5-m intervals along each 20-m transect, and the canopy coverage of all species of vascular plants was recorded using six coverage classes (0-5%, 5-25%, 25-50%, 50-75%, 75-95%, and 95-100%). At the other four monitor sites, the same methods were used except that transects were 25 m in length and the plots were spaced at 1-m intervals. Transects were placed in relatively undisturbed stands, because these are more useful for determining the potential natural vegetation of a site.

Sampling was carried out twice—once between April 11 and May 5 and once between June 8 and June 19, 1998—except at Paradise Ridge, which was sampled once in July. When vegetation sampling was conducted more than once, the highest coverage value for each taxon is reported. In addition, at the Waha site on June 8, we established three 50-m "weed transects" in disturbed vegetation, and the locations to the nearest 0.1 m of the start and end of each patch of non-native canopy intercepted by a meter tape stretched along the transect were recorded. We also initiated photomonitoring and censused any populations of sensitive plant taxa at each of the monitored sites.

Reconnaissance surveys

We conducted reconnaissance surveys of eight sites (Figure 3; Appendix 1). A partial list of vascular plant taxa occurring at each site was compiled, paying particular attention to rare plants and exotic taxa. In addition, at six of the sites vascular plant species coverage was recorded in one to four reconnaissance plots measuring approximately 5 x 5 m (Daubenmire 1970). Reconnaissance sites were subjectively ranked on the basis of size, presence of sensitive taxa, and plant community condition.

Results

Prioritization of conservation sites

Data were available for species and communities of interest in Idaho and Washington and for species in Oregon. We obtained data on 591 occurrences of the elements of interest in our study area. A subset of these occur on 308 sites that are currently believed to be unprotected (Figure 4). Twenty sites had conservation value ranks equal to or greater than 2.5 (Table 4).