INTERIOR COLUMBIA BASIN ECOSYSTEM MANAGEMENT PROJECT
ANALYSIS OF VASCULAR PLANTS

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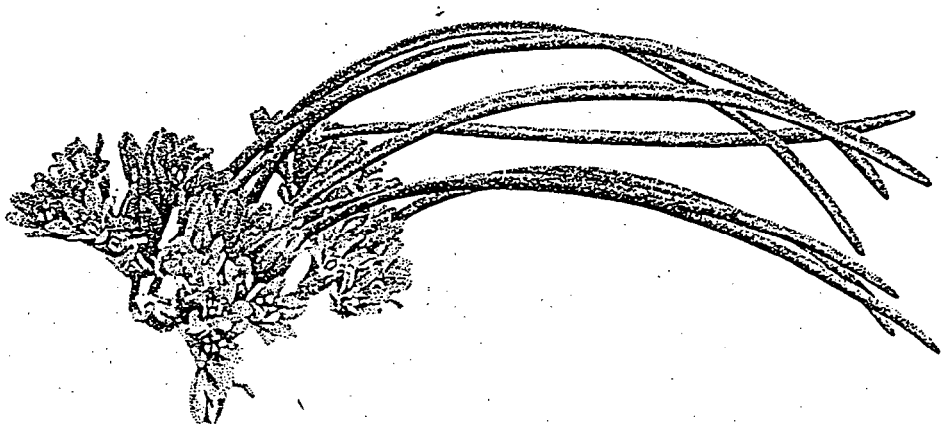

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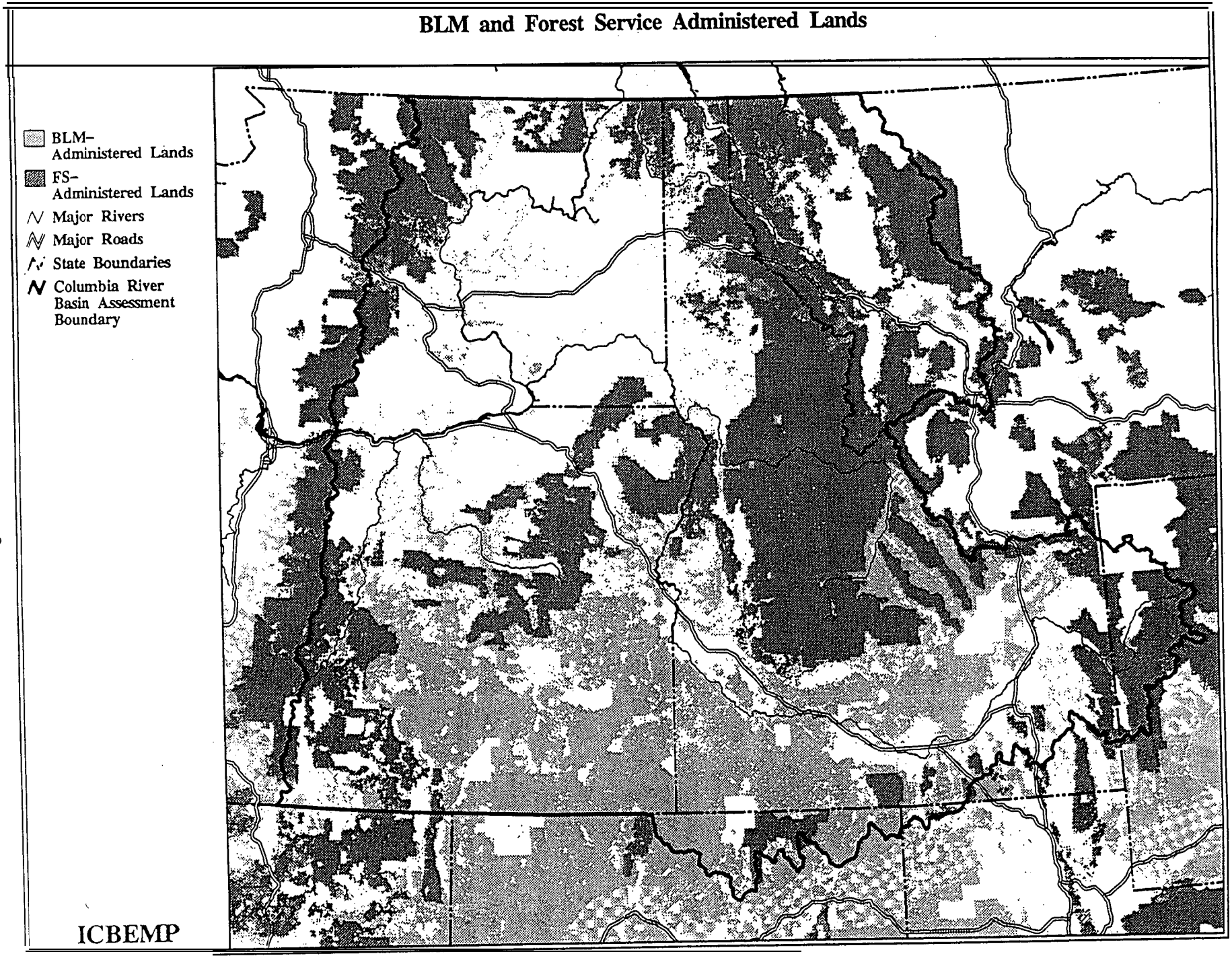
It is the hope of the authors that this document be a starting point for the recognition of the incredible diversity, richness and complexity of the flora, both vascular and non-vascular, of the interior Columbia Basin and that this resource be better understood and protected.

INTRODUCTION

Vascular plants are the most ubiquitous and taxonomically diverse macroorganisms in the Interior Columbia Basin Ecosystem Management Project (ICBEMP) assessment area (Figure 1). These organisms function as primary producers, capturing sunlight and carbon, and producing oxygen, via the process of photosynthesis. As such, they are the most critical components in the maintenance of dynamic, functional ecosystems. Vascular plants provide foods for animals and fungi, stabilize watershed functions, provide habitat and cover for numerous organisms, influence climatic patterns on local and regional scales, contribute to soil development and stabilization, have specialized relationships with pollinators and seed dispersers, and provide a variety of other critical ecological functions such as nitrogen fixation. In addition to these essential ecological functions, vascular plants and plant communities (assemblages of species) provide the foundation for the economic and social fabric of the ICBEMP analysis area. Commercial resources critical to the region's economy are provided by vascular plants, including timber, forage, and other special plant products; these resources are harvested on both large and small scales. In addition, vascular plants are a very important part of the cultural history of native peoples in the Pacific Northwest. Thus, evaluation of the status of vascular plants is the most critical aspect of ecosystem analysis and management.

Owing to large-scale vegetation shifts related to climatic changes, the presence of a high diversity of geological substrates, and barriers to gene flow caused by mountainous topography and other geographical barriers, western North America has been an area of very active evolution for vascular plants. The flora of the ICBEMP assessment area reflects this history of divergence. The native flora of the Columbia River basin includes a spectacular diversity of plant taxa that range from geographically restricted endemics, some known only from one or a few occurrences, to those that are common and widespread across the ICBEMP assessment area. Vascular plant life forms range from the largest terrestrial organisms in the ICBEMP assessment area (trees up to 100 meters in height) to the smallest flowering plants known (aquatic plants in the genus *Wolffia*, the individuals of which are 1 mm or less in size). Especially noteworthy is the high number of endemic vascular plants whose ranges lie wholly or partially in the ICBEMP assessment area. There are 76 such plant taxa that are local endemics; these taxa are restricted to very small geographic areas (e.g., one portion of a mountain range, one canyon, etc.). Local endemics are often also restricted to highly specialized habitats, e.g., chemically unique rock outcrops such as serpentine. In addition, there are 70 plant taxa that are regional endemics; these have larger geographic ranges than local endemics, but are still confined to a relatively small region (e.g., southeast Washington, northern Idaho, and northwest Montana for a palouse grassland endemic). Regional endemics may also be closely associated with certain habitats, and their ranges may again lie either entirely within, or on, the ICBEMP assessment area boundary. An example of a local endemic is *Castilleja christii*, a species that occurs only on one single mountain summit in the Albion Range in south-central Idaho. *Penstemon lemhiensis, an* example of a regional endemic, occurs in four counties in southwest Montana and one county in adjacent east-central Idaho.

BLM and Forest Service Administered Lands



The evolutionary history and resultant floristic diversity of the analysis area is a reflection of the complexity of biophysical environments in the Columbia River basin. The influence of many of these environments has been manifested through natural selection in edaphically or physically unique habitats, e.g., chemically stringent substrates weathered from ultramafic (serpentine) or calcareous (limestone) bedrock, coarse-textured soils, and climatically harsh alpine environments. The presence of extreme environmental gradients with respect to temperature and moisture has also contributed to evolutionary diversification in the flora of the ICBEMP assessment area. The assessment area is unique in North America in containing habitats that range from extremely arid deserts to temperate rain forests, across elevations from sea level to over 14,000 feet. Owing to this floristic and environmental diversity, the Columbia River basin also contains a very large number of seral and climax plant community types.

The objectives of the ICBEMP vascular plant analysis were designed to contribute towards several broad goals outlined for the development of the Lower and Upper Columbia River Basin Environmental Impact Statements, including:

- an evaluation of the species and habitats currently of conservation concern.
- promote assurance of the viability of species through time.
- provision of information needed for the support of dynamic ecosystems.
- identification of the role of disturbance mechanisms in the maintenance of viability of species and rare habitats of conservation concern.

Specifically, ten analysis objectives of the Vascular Plant Task Group were used to contribute to these goals:

- summarization of biological, ecological and status information for plant taxa of rangewide conservation concern; these include federally listed or proposed taxa (threatened, endangered), federal candidate taxa (Category 1 and 2), and those taxa that are currently being recommended for such listing or candidate status.
- delineation of groups of species that are locally rare in the ICBEMP assessment area, by broad habitat categories.
- inventory and status assessment for rare plant communities.
- delineation of geographic areas that are important centers for endemism and high floristic diversity in vascular plants.
- determination of species of cultural importance to native American peoples in the interior Columbia River basin.

- delineation of research, development and application needs for further analyses of vascular plants.

- development of a preliminary checklist of the vascular flora of the interior Columbia River basin.

- inventory of conservation measures available for vascular plant species, including species conservation strategies, agreements and status reports (see Appendix 2), and *ex situ* conservation approaches.

- assessment of effects of EIS alternatives on vascular plant taxa of concern.

- development of objectives, standards and guides for: vascular plant taxa of federal and conservation concern, nonvascular plants and for habitats containing numerous state rare species within the ICBEMP.

With the exception of recommended mitigation measures (suggested standards and guides) found in the Conclusions section of this document, the assessment of nonvascular plants and fungi have not been included in this report with the exception of *Texosporium sancti-jacobi,* which is designated as sensitive by the BLM and Forest Service. The contract reports specific to bryophytes (Christy and Harpel 1995), fungi (Castellano 1994, Fogel 1994, Miller and Miller 1994, and Weber 1994), and lichens (Eversman 1994, Hammer 1995, Kaltenecker and Wicklow-Howard 1994, McCune 1994, Rosentreter 1995, Ryan 1994, Wicklow-Howard 1994, and Wicklow-Howard and Kaltenecker 1994) summarize the status of these species groups. Potentially rare taxa are discussed in each.

Given the broad goals of the ICBEMP scientific assessment, the Vascular Plant Task Group analysis represents a pioneering effort to integrate management and conservation of vascular plants into a basin-wide, biologically comprehensive approach to ecosystem management. This analysis uniquely spans government jurisdictional boundaries, and involved numerous federal, state, and local agencies and private organizations having an interest in plant conservation.

METHODS AND RESULTS

VASCULAR PLANT ANALYSIS AREAS

In order to adequately assess the status of plant species and plant communities of conservation concern, the ICBEMP assessment area was divided into thirteen "vascular plant analysis areas." This was necessary due to the large number of species and habitats needing evaluation, and to the large size of the ICBEMP assessment area. The vascular plant analysis areas, while not conforming to ecological or physiographic province boundaries in every case, were used in order to most efficiently examine the status of the vascular flora and plant communities via expert panels (described below). The 13 vascular plant analysis areas were Blue Mountains of Washington and Oregon, Columbia River Basin, East Cascades North, East Cascades South, High Lava Plains, Idaho North, Idaho South, Northern Nevada, Northern Utah, Okanogan Highlands, Oregon Basin and Range/Owyhee Uplands, Western Montana, and Western Wyoming.
Each analysis area had a coordinator who collected information for that area and assisted in the organization of panels, wrote the species narratives and introductions for their area.
Coordinators were as follows: Kathy Ahlenslager, Okanogan Highlands, Columbia Basin, East Cascades North; Duane Atwood, Utah; Jerry Hustafa, Blue Mountains; Cathy Jean (with help from Amy Miller), Basin and Range, East Cascades South, High Lava Plains, Owyhee Uplands; Wayne Owen, Idaho North and South, Wyoming, Nevada; Steve Shelly, Montana.

Table 1 provides a crosswalk between the analysis areas and several other large-scale landscape deliniations.

TABLE 1. Area Crosswalk for Vascular Plant Analysis

STATE	VASCULAR PLANT ANALYSIS AREA	PHYSIOGRAPHIC PROVENCE*	BAILEY SECTIONS*
Idaho	Idaho South	Basin & Range Owyhee Uplands Snake River Plains, East Snake River Plains, West	M331D M332E M332F 342B 342C 342D

Idaho	Idaho North	Idaho Batholith Palouse Northern Rocky Mtns.	M332A M332F M332G M333A M333D 331A
Oregon	Basin & Range	Basin & Range	M261G 342B
Oregon	Blue Mountains	Blue Mountains	M332A 342H
Oregon	East Cascades South	High Cascades	M242C 331A
Oregon	High Lava Plains	High Lava Plains	M242C 342B
Oregon	Owyhee Upland	Owyhee Upland	342C
Montana	Montana	Northern Rocky Mtns. Western Great Plains	M332A M332B M333B M333C
Nevada	Nevada	Basin & Range Owyhee Uplands	342B 342C
Utah	Utah	Basin & Range	342B
Washington	Columbia Basin	Columbia Basin	331A 342I
Washington	East Cascades North	Northern Cascades Southern Washington Cascades	M242C
Washington	Okanogan Highlands	Okanogan Highlands	M242C M333A
Wyoming	Wyoming	Teton/Overthrust Ranges Yellowstone Plateau	M331A M331D

* Physiographic Provence does not read directly across to Bailey Sections. These categories are presented strictly alphanumerically.

The Blue Mountains of Washington and Oregon

The Blue Mountain Physiographic Province is situated in two states, Washington and Oregon. The southern boundary of this province is just north of Burns, Oregon, and the Harney Basin. From there it extends northeast through La Grande, Oregon, to just south of Pomeroy, Washington. The eastern boundary is clearly defined by the Snake River of Hells Canyon below the Seven Devils mountain range. From there, the Blue Mountains Province (BMP) extends west through John Day, to a few miles east of the confluence of the Crooked and Deschutes rivers near Prineville, Oregon.

Geologically, the BMP is remarkably complex. It spans an enormous variation in elevational ranges from canyons below 2,000 feet up through 10,000 foot mountain peaks. Several dominant mountain ranges punctuate the valleys, plains, canyons, plateaus, and hills of the BMP. The most notable ranges include the Ochoco, Strawberry-Aldrich, Greenhorn, Elkhorn, and Wallowa Mountains. The western portion of the BMP is comprised of ancient Paleozoic Era rock formations, including limestone, mudstone, sandstone, and siltstones (Franklin and Dyrness 1973). Later, Cenozoic Era vulcanism extruded deep layers of lava through numerous fissures to form the Clarno and Columbia River basalt flows (Johnson and Clausnitzer 1992). The Blue Mountains are thought to have uplifted through these basalt sheets (Johnson and Simon 1987). East of John Day, major ore deposits formed in the Strawberry, Greenhorn, and Elkhorn mountains during the Mesozoic Era. Here also the Columbia river basalts are prominent, surrounded by a matrix of Paleozoic formations comprised of schists, limestone, slate, argillite, tuff, chert, and siltstone (Franklin and Dyrness 1973). Mesozoic granitic rocks, limestones, shales and sandstones are prominently displayed in the Wallowa Mountains (Johnson and Simon 1987). Two dominant erosive events shaped these parent materials into the present terrain include hydrologic erosion and mass wasting and Pleistocene glaciation (Johnson and Simon 1987).

Soils within the BMP are highly variable due to the spectrum of parent material and weathering events. Two of the most influential events on soil development resulted from the ash deposits of Mt. Mazama and Glacier peak, and post glacial wind deposits of loess from central Washington (Johnson and Clausnitzer 1992). A majority of the soils fall into one of three broad categories: Residual, Ash-loess, and Mixed. Soil taxa development was further stratified by moisture and temperature regimes and is concisely summarized by McNab and Avers (1994). Plant communities evolving with this environment also played a key role in influencing the future development of vegetation and soil assemblages.

The enormous variation in topography, geology, elevation, and climatic factors create a well distributed mosaic of plant communities. The primary habitats found in the BMP are, Western ponderosa forest, Douglas-fir forest, Western spruce-fir forest, Juniper steppe woodland, sagebrush steppe, Wheatgrass-bluegrass grasslands and alpine meadows and barrens (Thomas 1979). Dissection of these habitats by stream action modification processes (Kovalchik 1987) has lead to a large degree of riparian habitat diversification at a local scale. At a broader scale, these general habitat types were influenced differently by the climatic forces mentioned above.

For example, the northern Blue Mountain foothills, slopes and ridgetops developed grasslands and rhizomatous shrublands via the influences of a maritime climate and the vegetation of the Palouse country to the north (Columbia Basin Province). This climatic regime also perpetuates pockets of refugia for plant species most often associated with habitat found west of the Cascade crest. By contrast, in the southern Blue Mountains the continental climate facilitates the development of sagebrush and juniper as commonly found in the Great Basin (Johnson and Clausnitzer 1992) to the south (Basin and Range Province).

The vegetation of the BMP has been further influenced by the actions of disturbance forces such as erosion, livestock or insects herbivory, and or fire. From the late 1800s through the mid 1900s millions of domestic sheep caused considerable changes in the plant communities of the BMP. Subsequent cattle grazing continues to confound the recovery from these impacts in many portions of the province. Historically, abundant late summer/early autumn convectional lightning storms provided for cyclic annual fires (Johnson and Clausnitzer 1992). Prior to Euro-American settlement the BMP experienced low intensity surface fires in fire resistant seral habitats (i.e., ponderosa pine and grasslands) at intervals around 5 to 25 years. Stand replacement fires (in stands such as lodgepole and grand-fir stands) were as important but less frequent at 50 to 200 years (Arno 1992). Such fire events inspired the name Blue Mountains because of the smoky haze enveloping the region each summer.

These characteristics are responsible for the high level of floristic diversity, and the large number of local endemic plant species. The numerous designated sensitive plant species found in the BMP are also partly a result of this unique habitat. However, human activities have contributed to the rareness of many of these species.

Columbia River Basin

The Columbia Basin encompasses about two-thirds of the area east of the Cascade Mountains in Washington. Topography includes gently undulating to moderately hilly slopes with isolated basaltic buttes and river cut canyons. Elevations range from about 400 ft. in elevation adjacent the Columbia River to about 1700 ft. Lava poured over most of the area during the Miocene epoch laying down a basalt layer. The channeled scablands is a unique geologic feature, comprising a series of dry deeply cut channels in the Columbia River basalt, forming a complex drainage network.

During the Pleistocene epoch, Palouse loess was deposited over much of the Province. The Palouse area is characterized by rolling hills and very fertile soils, which is now agricultural land. Most of the soils in this Province were formed under grassland or shrub-grassland vegetation. Precipitation is heaviest along the edge of the basin and decreases towards the center.

East Cascades North

The Cascade Mountains are mostly comprised of ancient sedimentary rocks, which were folded, partially metamorphosed and intruded by large granitic batholiths. Valleys are deep and steep sided. The mountain crest is relatively uniform in elevation (5000-7300 ft.) with two dormant volcanoes (Mt. Baker) dominating the skyline. Extensive glaciation sculptured the features of the Province from the Canadian border south to Snoqualmie Pass. Soils to the east of the crest show the drier conditions under which they formed and are influenced by volcanic ash and loess.

The topography from Snoqualmie Pass south to the Columbia River is less rugged Andesite and basalt flows are the dominate features on the landscape, which is a series of ridge crests separated by steep, deeply dissected valleys. Elevations of the crest are lower, from 3300-5600 ft. with three dormant volcanoes dotting the ridgelines (Mt. Rainier at over 12,200 ft., Mt. St. Helens and Mt. Adams). East of the crest soils are derived from andesite, sandstone or glacial till with textures of silt loams and loams.

East Cascades South

The East Cascades physiographic province consists of scattered volcanic peaks, smaller cinder cones and gently sloping, high pumice plateau. A mantle of pumice and ash from numerous volcanic eruptions, notably Mount Mazama, blankets bedrock and influences the ecology of the area. The province is occupied by coniferous forests interrupted by mosaics of shrub-steppe, subalpine and alpine meadows, and barrens. Shasta red fir and mountain hemlock are found in the high elevation forests in the southern portion, and Oregon white oak is found in lower elevations along the Columbia River and Klamath River Drainage. Elevations range from near sea level on the Columbia River to over 10,000 feet at the summit of the major volcanic peaks.

High Lava Plains

The High Lava Plains physiographic province consists of lava buttes, cinder cones and basaltic flows scattered across the region. Rhyolitic pumice from Newberry Crater (6400-1400 yrs bp) and Mount Mazama (7000-10,000 yrs bp) mantle much of the area. Paulina Peak, a shield volcano, is the largest volcanic peak. Fort Rock Valley, Christmas Lake and Fossil Lake held extensive bodies of water during the Pleistocene era. Today, playa lakes and basins with fluctuating water levels are common. *Artemisia* shrub-steppe and *Juniper-us occidentalis* woodlands, tolerant of hot dry summers and cold winters, comprise the major vegetation types.

Idaho North

The Northern Idaho Ecoregion includes both central and northern Idaho. This area includes the northern Rocky Mountains and the eastern margin of the Columbia Basin.

The Rocky Mountain province in Idaho is usually divided into northern and central Idaho subunits. The geology of the northern subunit is highly mixed with belts of Precambrian and Cambrian igneous, sedimentary and metasedimentary rocks, Tertiary volcanics, and Quaternary depositional features. The vegetation of this area is dominated by moist mixed-coniferous forests. Dominant overstory species include western white pine, western red cedar, western hemlock, Douglas fir, and true firs. Floristically, this area is relatively rich. This is especially true of the "maritime refugium", an area that harbors many species that are more typical of western Cascade forests. Central Idaho geology is dominated by the Idaho batholith (Cretaceous in age) with lesser amounts of Tertiary volcanics and Quaternary depositional features. The vegetation of the Idaho batholith is dominated by coniferous forest, especially ponderosa pine, lodgepole pine, and Douglas-fir with lesser amounts of true firs. Central Idaho lacks the species diversity of the northern portion of the state but has a greater range of habitat types due to a broad range of shrublands, grasslands, and high mountain (alpine and subalpine) meadows. Central Idaho is also rich with geothermally influenced plant communities.

The Columbia Basin margin in Idaho includes the Palouse, the Seven Devils, and Columbia Uplands (also known as the Breaks). The Palouse region is predominantly rolling hills of Pleistocene loess that can be as much as 150 feet deep. This region was once an expansive fescue/wheatgrass grassland with a rich component of herbaceous perennial forbs. The vast majority of this area has been converted to agriculture in the last century and several of the species that were formerly common there are now restricted to tiny remnants of intact habitat. The Seven Devils area is a fault blocked series of Miocene and Jurassic volcanics with significant areas of marine metasedimentary and metavolcanic rocks. The Seven Devils is primarily a shrubland (sagebrush) and grassland with minor intrusions of ponderosa pine and Douglas-fir. The Columbia Uplands are between the Seven Devils and the Palouse and consequently are dominated by mixtures of Pleistocene loess, Miocene basalts, some Tertiary age sedimentary rocks and minor areas of metamorphics. This area is dominated by floristically diverse grasslands that are rich in herbaceous perennial forbs with ponderosa pine occurring on higher mountain slopes. The grassland and shrublands at the margin of the Columbia Basin all share the problem of significant habitat degradation from introduced plant species.

Idaho South

The southern Idaho Ecoregion includes the portions of the Owyhee uplift, the Snake River Plains, the Lemhi Range and Valley, the Lost River Range and Valleys, and the a portion of the Basin and Range province.

The Owyhee Uplift is a complex geological assemblage of Cretaceous granites (probably related

to the Idaho Batholith), Miocene rhyolites (from both magma and ash sources), Miocene and Pliocene basalts, a variety of metamorphic rock (gneiss and cherts and limestones of Permian age), and Quaternary alluvium and colluvium. The vegetation of the Owyhee Uplift is a diverse mixture of arid woodlands *(Juniper-us* spp.), mixed shrublands, and coniferous forests (Douglas-fir). The flora of this area is very rich in endemic species, a reflection of its isolation and azonal geology.

The geology of the Snake River Plains are dominated by igneous features. The western Snake River Plains are comprised of late Miocene and Pliocene olivine basalts mixed with welded ash and overlain by Pleistocene basalt flows. The eastern Snake River Plains generally lack the older olive basalts and has some more recent volcanic features (e.g., cinder cones). Both areas have a variety of Quaternary alluvial, colluvial, and lacustrine deposits and some active sand dunes. The Snake River Plains were once dominated by perennial grasses and shrubs with a rich ephemeral flora of herbaceous perennial. Much of this area has been converted to agricultural use or has been degraded from livestock grazing, exotic plant species, and an increased fire frequency. In areas of more recent volcanism on the eastern Snake River Plain there are large areas totally devoid of vegetation. The Snake River Plain is significantly more arid in its western reaches and in that area salt scrub type vegetation is commonly encountered.
The Lemhi and Lost River Ranges and there valleys a Basin and Range fault blocks that were isolated from the rest of the rest of the Basin and Range during the Pliocene.

The Basin and Range region of southeastern Idaho is an area of high topographic relief that is a result of extensive fault blocking during the Pliocene. The geology of the area is mixed and include a variety of Quaternary depositional features, Pliocene volcanics (ejecta, welded tuff, ash and flow rocks), Eocene granitic plutons, and marine sediments of much greater age. The Basin and Range regions of Idaho are dominated by sagebrush/bunchgrass habitats. There are however significant areas of pinyon/juniper woodlands and dry forests at higher elevations (Douglas-fir, lodgepole pine, and subalpine fir). The Basin and Range is also notable for its extensive aspen forests. This area is relatively rich floristically, a result of a diverse geologic history, steep gradients in topography and the isolating effects of remote mountain ranges inbedded in a sea of arid lowlands.

Northern Nevada

The Nevada portion of the Columbia River Basin is usually considered as a portion of the Owhyee Uplands (see Southern Idaho report). This area is a complex geological assemblage of Cretaceous granites, Miocene rhyolites (both from magma and ash sources), Miocene and Pliocene basalts, a variety of metamorphic rock (gneiss and cherts and limestones of Permian age), and Quaternary alluvium and colluvium. The vegetation of the Nevada portion of the assessment area is a diverse mixture of arid shrublands and grasslands, Juniper and Pinyon-Juniper woodlands, coniferous forests (Douglas-fir), and high elevation forb-graminoid meadows and open subalpine fir forests (often with scattered whitebark pine). Riparian areas in

this area are important sources of habitat diversity throughout this portion of Nevada but have been very heavily impacted by livestock grazing.

Northern Utah

The Raft River and Goose Creek mountains were formed in post-Cretaceous times by an intrusive upheaval. The Raft River Mountains (trending east-west) and the Goose Creek Mountains (trending north-south) are located in the northwestern part of Box Elder County, Utah covering an area 45 miles by 10 miles. They rise from 6000 feet on the north and 5000 feet on the south, to nearly 10,000 feet at the highest point. Northern slope streams of the Raft River and Goose Creek mountains drain into the Raft River and Goose Creek respectively and then empty into the Snake River near Burley, Idaho. Together these ranges form part of the northern boundary of the Great Basin.

These isolated desert ranges are an important floristic element of the southern portion of the Upper Columbia River Basin (UCRB). Thirty-two rare, disjunct or edge-of-range species are located in this part of Utah. Most of these species are at the south edge of their range and a few are at the north edge of their range, making this a unique merging area. The complex mix of climate, isolation, topography, geology and biotic factors are important in the make up of the plant communities and floristic richness. Primary habitat types for the Raft River sub-unit are pygmy forest, riparian, coniferous forest and alpine tundra. The Goose Creek area lacks the coniferous and alpine community types. Very little is known about the vegetation types in the Goose Creek area. Storm patterns in this region are from the north, and since the mountain range lies primarily east-west, most of the precipitation of the area is dropped on the north slope. North to south winds have had significant influence on seed dispersal from northern communities into this area. The conifer community is primarily on the north slope due to cooler temperatures and higher precipitation. Riparian vegetation has been significantly altered by livestock grazing. The mountain meadows of higher elevations have dense stands of poisonous sneeze weed and false hellebore. It appears that livestock and deer grazing may have resulted in changes of grasslands and forb communities to sage brush which is being converted to juniper stands on the lower south slopes. The general contour of the Raft River section is rounded and gentle sloping except in canyons, small draws and pockets. These offer little opportunity for the existence of microclimates required for more mesophytic vegetation communities. Limestone parent materials are lacking which reduces the potential for a higher degree of endemism.

Because the Goose Creek/Raft River area is on the southern edge of the UCRB, the plant species occurring in the area are probably under stronger selection pressure than they are towards the center of their range. These pressures may have led to unique genetic adaptations. Four new species have been described in the area in the last decade and these are based on limited field work. Insufficient data are available on these rare species to address specific biological factors to determine their requirement and contribution to the habitat they occupy.

Okanogan Highlands

The Okanogan Highlands Province is characterized by upland areas separated by a series of broad north-south valleys. Slopes are moderate with broad, rounded summits. Most of the area is over 3300 ft. in elevation, although the main river valleys are lower and a handful of peaks reach to 7000 ft. The entire Province was covered by glacial ice during the Pleistocene epoch, resulting in deposits of glacial drift. Numerous rock types form a complex pattern of substrates ranging in age from Precambrian to late Tertiary.

In this Province soil pattern is tied to elevation. Soils in mountainous areas are derived from granitic parent materials, while those from glacial materials often have volcanic ash. Surface layers generally have silt loam texture and subsoils are gravelly loam. Lower in elevation, along river valleys and the southern border of the Province, soils formed under a drier climate with transitional forest-grassland vegetation with soil textures of sandy loam to loam. At the lowest elevations, along major river terraces and floodplains, soils are coarse textured and well drained with parent materials of glacial outwash sands and gravels.

Oregon Basin and Range, Owyhee Uplands

The Basin and Range Province consists of fault-block mountains and intervening basins characterized by internal drainage (Franklin and Dyrness 1973) and often containing shallow, saline lakes. Principal mountain ranges include Winter Rim, Abert Rim, the Pueblo and Trout Creek Mountains, Hart Mountain and Steens Mountain. Steens Mountain (elevation 9500 feet), a major northeast striking and gently west-northwest dipping fault block, encompasses the greatest contiguous area of high elevation lands within the province. The landform consists of rhyolitic extrusions, subordinate tuffs, and sedimentary rocks overlain by Steens Basalt (15.5-Ma), breccias and pyroclastics (Minor et al. 1988). Deep U-shaped canyons on the west slope are the result of Pleistocene glaciation. The Owyhee Uplands Province is characterized by less frequent faulting and generally less topographic relief than the Basin and Range province. It is principally drained by the Owyhee River which flows north into the Snake River. The geology of both provinces is comprised predominately of Miocene and Quaternary volcanics, and the diversity of substrates found within the region accounts for much of the habitat diversity. The ash beds of the Leslie Gulch and Succor Creek area (Owyhee Uplands), for example, support a number of local endemics. Elevations within the provinces range from 1,200 to 2930 meters (3900 to 9610 feet).

Low precipitation in the provinces (mean annual ppt. 180 to 300 mm (7 to 12 inches)) supports little more than dry shrubland, as forests are rare outside of riparian areas. The principle vegetative formation is big sagebrush *(Artemisia tridentata)* shrub-steppe (Franklin and Dyrness *1973). Juniper-us occidentalis* and bunchgrasses, including *Festuca idahoensis, Agropyron spicatum,* and *Elymus cinereus*, are common associates. *Artemisia arbuscula* and *A. rigida* communities are found on shallow, stony soils, while *A. cana* communities are found in moister bottomlands. Salt desert shrub communities are common in the alkaline soils of basins and lake

margins and are generally dominated by *Atriplex confertifolia* and *Sarcobatus vermiculatus.* Higher order riparian areas commonly support gallery forests dominated by *Populus tremuloides* and/or *Populus trichocarpa. Salix* spp., may occur in similar habitat, or within wet meadows dominated by species of *Carex.*

Western Montana

The Montana ecoregion of the upper Columbia River Basin is typified by great variation in topography, vegetation types, geological characteristics and history, and climate. This highly varied environment, typical of the northern Rocky Mountains, creates a mosaic of forest, shrubland and grassland vegetation. In addition, wetland and alpine habitats, while occupying less landscape area than the latter vegetation types in many areas, contribute substantially to floristic and plant community diversity in western Montana. Species composition and productivity differ greatly within and among these major vegetation types (Mueggler and Stewart 1980).

The distribution of forest tree species and associated habitats in southwestern Montana, arranged by increasing altitude, is as follows: grassland (valley bottoms)/*Pinus flexilis* (limber pine)/*Pseudotsuga menziesii* (Douglas-fir)/*Pinus contorta* (lodgepole pine)/*Picea engelmannii* (Engelmann spruce)/*Abies lasiocarpa* (subalpine fir)/*Pinus albicaulis* (whitebark pine)/alpine tundra. In northwestern Montana, this elevational series is as follows: grassland (valley bottoms)/*Pinus ponderosa/Pseudotsuga menziesii/Picea engelmannii/Abies grandis/Thuja plicata/Tsuga heterophylla/Abies lasiocarpa* (*Tsuga mertensiana*)/*Pinus albicaulis/Larix lyallii*/alpine tundra (Pfister et al. 1977).

Grassland and shrubland habitats of western Montana have been classified into 13 and 16 habitat types, respectively, within 13 climax series (Mueggler and Stewart 1980). The five climax series for grasslands include the *Agropyron spicatum, Deschampsia caespitosa, Festuca idahoensis, Festuca scabrella* and *Stipa comata* series. The eight shrubland climax series include *Artemisia arbuscula, Artemisia tridentata, Artemisia tripartita, Cercocarpus ledifolius, Potentilla fruticosa, Purshia tridentata, Rhus trilobata* and *Sarcobatus vermiculatus* series (Mueggler and Stewart 1980).

General wetland habitats represented in western Montana include peatlands, riparian habitats, aquatic habitats, forested wetlands, and emergent wetlands. Alpine habitats occupy the least amount of acreage, on a landscape scale, but numerous rare species and uncommon vegetation types are entirely confined to these harsh environments (Lackschewitz 1991).

The Montana portion of the analysis area is prominently mountainous with intervening valleys. In northwestern and west-central Montana, valley base elevations range between 2,000 and 4,000 feet, and support either forests or grasslands. The major mountain ranges rise *to* elevations of 7,000 to 9,000 feet. These mountains support extensive forests up to subalpine levels, with a

small amount of landscape area above the alpine timberline. In the southwestern portion of the state the grassy intermountain valleys are higher, generally 4,500 to 6,500 feet, and the major mountain ranges usually rise to 10,000 feet or higher (Pfister et al. 1977).

The surface geologic formation prevalent throughout most of northwestern Montana is the Precambrian Belt Series, consisting primarily of quartzites and argillites. The Idaho and Boulder Batholiths comprise the Bitterroot Range west of the Bitterroot Valley and much of the southern Sapphire and Anaconda-Pintlar ranges, as well as the mountains along the Continental Divide from Butte to Helena; their composition is predominantly granitic with inclusions of gneiss and schist. Volcanic and sedimentary rocks (both limestone and non-limestone) constitute most of the remainder of the Montana Rocky Mountains (Pfister et al. 1977). Many of the mountain areas near or east of the Continental Divide are geologically complex in contrast to areas farther west (Perry 1962).

Most of the prominent valleys in the Montana Rocky Mountains contain a layer of alluvium deposited by streams and glacial action. The majority of these areas support grassland, riparian, or cultivated vegetation, although substantial areas in northwestern Montana valleys support forests (Pfister et al. 1977).

Forest soils in western Montana are typically quite rocky, reflecting their mountainous setting. Because steep topography and rocky soils are so prevalent, sites capable of supporting a climatic climax are scarce over much of the forested landscape (Pfister et al. 1977).

The Continental Divide exerts a marked influence on the climate of Montana. West of the Continental Divide, the area has an inland climate strongly modified by moisture-laden air masses from the Pacific Ocean; precipitation is rather evenly distributed throughout the year, except for a dry period in July and August. East of the Continental Divide, the climate is decidedly continental. It is characterized by warm summers, with a high proportion of the precipitation falling between May and September and winter conditions consisting of invasions of subzero air followed by warm dry Chinook winds. Elevation also has a major effect on climate and thus on vegetation patterns. Except in extreme northwestern Montana, lowlands are semiarid and support either grassland or very dry forest types. Mountains are much cooler and often receive two to three times as much annual precipitation, most of it as snow. Above 8,000 feet in northern Montana and 9,500 feet in southern Montana, forests give way to alpine tundra. About 25 mountain ranges in the state support some tundra, which develops on sites having mean July temperatures of less than 50 degrees F (Arno 1970). Thus, the lower elevational limits of coniferous forests are controlled primarily by moisture, while the upper elevational limits are controlled primarily by temperature.

Western Wyoming

The Wyoming portion of the Columbia River Basin includes the west slope of the Teton Range, and portions of the Yellowstone Plateau.

The Tetons are a tilted Tertiary high angle fault block range that reaches elevations in excess of 13,000 ft.. The geology is a complex of Precambrian igneous and metamorphic rocks (gneisses and schists). The lowlands on the west slope of the range (the Columbia River Basin side) are overlain with mostly Tertiary volcanics. The east slope of the Tetons are heavily altered by Pleistocene glaciation. The vegetation of the Tetons is dominated by coniferous forests, primarily Doug-fir, lodgepole pine, and subalpine fir. At higher elevations, mixed forb and graminoid meadows are common. Talus and snowbank communities comprised mostly of perennial forbs are also common though usually small in extent.

The Yellowstone region of the assessment area is a heavily forested volcanic plateau surrounded on three sides by high relief mountain ranges and to the west by the Snake River High Plains. Yellowstone Lake occupies a small portion of the much larger Yellowstone caldera in the east central portion of the plateau. The volcanic geomorphology of the area is largely the result of two periods of activity, one in the late Cretaceous-early Tertiary and the other in middle to Late Tertiary times. Material from the former event is predominantly breccias, agglomerates, and flow basalts. The latter period produced extensive areas of rhyolite and welded tuff. A third period of volcanism that has left more recent marks on the surface geology of the Yellowstone landscape. Quaternary eruptions that formed the Yellowstone caldera (600,000 years ago) subsequently produced extensive rhyolite flows (2,000 feet thick in places). The volcanism and geothermal activity of Yellowstone is the result of tectonic migration of the underlying plate over a stationary mantle convection plume. The geothermal features of Yellowstone Park are largely located above zones of ring fractures within the Yellowstone caldera. Portions of the Yellowstone Plateau were glaciated in at least three distinct events during the Pleistocene.

The vegetation of the Yellowstone area is dominated by lodgepole pine and Doug-fir forests. There are however extensive graminoid meadow lands throughout the area with mixed forb-graminoid meadows being less common yet still frequent. In close proximity to many of the hydrogeothermal features there are barren communities made up of a small number of vascular plants (often grasses), algae, and cyanobacteria.

VASCULAR PLANT EXPERT PANEL PROCESS

The vascular plant expert panels included plant taxonomists and plant ecologists, from academia, federal and state government agencies and the private sector, who are familiar with the flora and vegetation in each analysis area. A large percentage of the professional botanical community in the ICBEMP assessment area was involved in the project via these panels. The intent of the

expert panel process was to compile biological information and key environmental factors that affect the distribution, viability, health, fitness, abundance and trends of plant taxa or species groups in the ICBEMP assessment area. The panel process provided a means to compile "key environmental correlates" that affect populations or habitats of plant species, and that are not always available via extensive literature searches. Especially important information can reside in personal experience and observations, unpublished data and reports, and other "grey literature." Utilizing discussion and professional interaction, the panel process was designed to precipitate this information from the panel experts. Four separate analyses (the methods used for each are described below) were conducted by each panel; they included:

- Evaluation of vascular plant taxa of rangewide conservation concern.
- Analysis of habitat groups for other rare taxa.
- Delineation and status review of rare plant communities.
- Identification and description of areas of endemism and high floristic diversity.

The Science Integration Team constructed a species information form for use in capturing the panelists' knowledge and information, and to convert those data into a database. A scribe also recorded data and information that evolved out of discussions, and that were not readily captured on the form.

INFORMATION REQUEST AND RESULTANT CONTRACTS

Information regarding the abundance, trend, and viability assessments needed for sensitive plant species was requested from botanists on National Forests and BLM districts throughout the ICBEMP analysis area. This survey also included an inventory of existing conservation strategies, management guides, or similar plans for these taxa. Based on the results of this survey, assessments of species and habitat groups in five taxonomically complex genera were completed as separate contracts by individual experts; these genera included *Allium* (McNeal 1995), *Botrychium* (Zika 1995), *Carex* (Brainerd et al. 1995), *Mimulus* (Meinke 1995a), and *Penstemon* (Meinke 1995b). These assessments were subsequently peer-reviewed by members of the professional botanical community prior to incorporation into the ICBEMP vascular plant databases.

ANALYSIS COMPONENTS

The analysis for vascular plants consisted of eleven primary components. The first four analysis components were completed by the vascular plant expert panels, as outlined above; the remainder were accomplished by members of the Vascular Plant Task Group, ICBEMP Terrestrial staff members, or by independent contractors. Brief descriptions of each of the eleven components, including the methods for each, are as follows:

Vascular Plant Taxa of Rangewide Conservation Concern

As required by the charter for the ICBEMP, a primary focus of the vascular plant analysis was on taxa of conservation concern across their entire geographic ranges. These taxa include those currently listed as threatened or endangered under the federal Endangered Species Act, those that are candidates (Category 1 or 2) or officially proposed for such listing, and those with no current status that were recommended by the vascular plant expert panels for federal listing or candidate status. In some cases, species that were formerly Category 1 or 2 candidates, but are now in Category 3 (no longer being considered for federal listing), were also evaluated. Recent changes (Federal Register, vol 61, no. 40, 7596) were made to the list of species of plants and animals that are regarded as candidates for possible addition to the List of Endangered and Threatened Wildlife and Plants under the Endangered Species Act. These changes dropped the classifications of Category 1, Category 2, and category 3c in favor of simply listing species as candidates for listing. Most of the species that were classified as Category 1, 2, and 3c taxa are no longer included in the list of candidate species. These changes are not reflected in the references made to candidate species in this document.

Specific objectives for this analysis included the assignment of these taxa to five geographic distribution categories (local endemic, regional endemic, scattered, disjunct, and peripheral; defined below); delineation of critical environmental correlates, associated cover types (including climax and seral cover types), and threats for each taxon; assessment of species viability by analysis of the distribution of habitat, trends, threats, and number of occurrences for each; identification of primary threats to each taxon; and development of mitigation and management recommendations for the taxa where needed or appropriate.

Definitions for the geographic distribution categories are as follows:

- **local endemic** - populations are restricted to a very small geographic area (i.e., one portion of a mountain range, one canyon, etc.); these taxa are often also restricted to highly specialized habitats, and their range may lie either entirely within, or on, the ICBEMP Assessment Area boundary.

- **regional endemic** - populations inhabit a larger geographic area than that of a local endemic (i.e., southeast WA, northern ID, and northwest MT for a palouse endemic); these taxa may also be closely associated with certain habitats, and their range may lie either entirely within, or on, the ICBEMP Assessment Area boundary.

- **scattered** - populations are sparsely distributed within and outside the ICBEMP Assessment Area; the overall geographic range of these taxa is wide (i.e., they may be found in many western states), but they are nowhere common on the landscape.

- **disjunct** - populations within, or straddling, the ICBEMP Assessment Area boundary are substantially separated geographically from the remainder of the taxon's range.

- **peripheral** - populations within, or straddling, the ICBEMP Assessment Area boundary lie on the margin of the taxon's range, and are geographically contiguous with that range.

These species evaluations are a critical aspect of addressing the viability requirements included in the National Forest Management Act and the Federal Land Policy and Management Act. Due to the vast size of the analysis area (144 million acres), varying degrees of appropriateness of "fit" to the scale of analysis used in the ICBEMP were realized in analyzing the viability of plant taxa. Two broad categories emerged during the analysis: those plant species that could be modelled within the ICBEMP cover type and structural stage hierarchies using known environmental correlates, and those that could not be modelled owing to a lack of species-specific information and/or because of a "lack of fit" with the broad and mid-scale analysis levels. The latter case usually involved plant taxa that are tightly confined to highly specialized habitats that occupy very small ($< 1\ km^2$) patches on the landscape, and which could thus not be resolved at the broader analysis scales.

Utilizing a variety of federal, state, and private data sources, the ICBEMP database manager compiled a list of all federal threatened, endangered, and proposed plant taxa, as well as those taxa designated as sensitive or otherwise of conservation concern by the U.S. Forest Service or the Bureau of Land Management. This list was then subdivided into 13 lists, each specific to one of the panel analysis areas. Taxa not currently listed, proposed or designated as candidates were also added to the panel lists, as deemed necessary by the panel members. Biological, ecological and status information for a total of 168 taxa were evaluated in this analysis. This analysis included the preparation of range maps for each taxon; these are presented in Appendix 1.

To initiate the expert panel process, all panel members completed an environmental correlate form as a group for the first taxon on their analysis area list. This was done to ensure that all members were interpreting and completing the forms consistently. Subsequently, the panelists then independently filled out forms for individual taxa on the analysis area list according to their knowledge of each one. After all forms were completed, each panelist verbally recounted the information he or she had recorded. A discussion about each species ensued for the purpose of information-sharing and to stimulate each panelist to add or elaborate on data or key environmental correlates. The content of these discussions was captured by the panel scribe. If, as a result of the discussion, any of the experts thought of needed additions to their forms, they took a brief time to edit them. However, they were instructed not to reach consensus if disagreements appeared, nor to write down what other experts were saying if it was not also part of their own experience with that taxon. When all forms were completed they were collected for subsequent entry into the ICBEMP vascular plant database.

Figure 2 is a map of the ICBEMP assessment area with information on the number of element occurrences over the number of taxa by county (Figure 2) which provides some information on areas of high concentrations of species that are tracked by heritage programs. Many of the

species of conservation concern from this project were local endemics, this map reflects many of these species that have highly localized distributions.

Table 2 is a summary of the best available data at the time this report was prepared for each of the species of conservation concern. It presents a summary of species by geographic distribution. The table is followed by narratives for each species.

TABLE 2. List of Species of Conservation Concern by geographic distribution.

Locally Endemic Species

Abronia ammophila
Agrostis rossiae
Allium aaseae
Allium dictuon
Amsinckia carinata
Arabis suffrutescens var. horizontalis
Artemisia ludoviciana ssp. *estesii*
Astragalus anserinus
Astragalus applegatei
Astragalus atratus var. inseptus
Astragalus collinus var. laurentii
Astragalus columbianus
Astragalus howellii
Astragalus sinuatus
Astragalus tyghensis
Astragalus vexilliflexus var. *nubilus*
Balsamorhiza rosea
Botrychium pumicola
Calochortus longebarbatus var. peckii
Calochortus macrocarpus var. *maculosus*
Castilleja christii
Cas tilleja cryp tan tha
Castilleja pilosa var. steenensis
Castilleja rubida
Chrysothamnus parryi ssp. *montanus*
Claytonia lanceolata var. flava
Cymopterus davisii
D e l p h i n i u m viridescens
Draba trichocarpa
Erigeron basalticus
Erigeron lackschewitzii
Erigeron salmonensis
Eriogonum chrysops
Eriogonum meledonum
Erythronium grandiflorum var. *nudipetalum*
Hackelia venusta
Haplopappus insecticruris
Ivesia rhypara var. shellyi
Lathyrus grimesii
Leptodactylon glabrum
Leptodactylon pungens ssp. *hazeliae*
Lesquerella carinata var. languida
Lesquerella humilis
Lomatium erythrocarpum
Lomatium greenmanii
Lomatium ochocense
Lomatium tuberosum
Luina serpentina
Lupinus cusickii
Mimulus hymenophyllus
Mimulus patulus
Mirabilis macfarlanei
Oenothera psammophila
Oxytropis campestris var. *wanapum*
Penstemon compactus
Penstemon idahoensis
Penstemon peckii
Petrophytum cinerascens
Phacelia lenta
Phacelia lutea var. calva
Phlox idahonis
Physaria didymocarpa var. lyrata
Primula alcalina
Ranunculus reconditus
Rubus bartonianus
Rubus nigerrimus
Saxifraga bryophora var. tobiasiae
Senecio ertterae

Sidalcea oregana var. *calva*
Silene seelyi
Stephanomeria malheurensis
Tauschia hooverii
Thelpodium howellii ssp. spectablilis
Thelypodium repandum
Trifolium leibergii
Trifolium thompsonii

Regionally Endemic Species

Arabis falcifructa
Arabis fecunda
Artemisia campestris var. *wormskioldii*
Aster jessicae
Aster mollis
Astragalus cusickii var. sterilis
Astragalus diaphanus var. diurnus
Astragalus mulfordiae
Astragalus onciformis
Astragalus paysonii
Astragalus peckii
Astragalus scaphoides
Astragalus solitarius
Astragalus tegetariodes
Astragalus yoder-williamsii
Calochortus longebarbatus var. *longebarbatus*
Calochortus nitidus
Camissonia pygmaea
Carex parryana ssp. idahoa
Castilleja chlorotica
Chaenactis cusickii
Claytonia umbellata
Collomia mazama
Cymopterus douglassii
Descurainia torulosa
Douglasia idahoensis
Erigeron latus
Erigeron salmonensis
Eriogonum crosbyae
Eriogonum cusickii
Eriogonum lewisii
Eriogonum prociduum
Grindelia howellii
Hackelia cronquistii
Haplopappus liatriformis
Haplopappus radiatus
Iliamna longisepala
Ivesia rhypara var. rhypara
Lepidium davisii
Lepidium papilliferum
Lesquerella carinata var. *carinata*
Lesquerella paysonii
Lesquerella pulchella
Limnathes floccosa var. bellingeriana
Lomatium suksdorfii
Lupinus biddlei
Mentzelia mollis
Mentzelia packardiae
Mimulus ampliatus
Mimulus clivicola
Mimulus evanescens
Mimulus jungermannioides
Mimulus pygmaeus
Mimulus washingtonensis var. washingtonensis
Oryzopsis hendersonii
Oryzopsis wallensis
Oxytropis campestris var. columbiana
Papaver pygmaeum
Penstemon barrettiae
Penstemon glaucinus
Penstemon lemhiensis
Phacelia minutissima
Physaria integrifolia var. monticola
Pleuropogon oregonus
Polemonium pectinatum
Potentilla cottamii
Silene spaldingii
Stanleya confertifolia
Thelypodium eucosmum
Trifolium douglasii
Trifolium owyheense

Scattered Species

Antennaria arcuata
Botrychium ascendens
Botrychium crenulatum
Bottychium paradoxum
Botrychium pedunculosum
Collomia renacta
Cymopterus nivalis
Cypripedium fasciculatum
Howellia aquatilis
Meconella oregana
Oryzopsis contracta
Phacelia inconspicua
Rorippa columbiae
Thelypodium howellii var. *howellii*

Disjunct Species

Astragalus pulsiferae var. *suksdorfii*
Musineon lineare
Parnassia kotzebui var. *pumila*
Perideridis erythrorhiza
Sullivantia hapemanii var. hapemanii
Tofeldia glutinosa ssp. absona

Peripheral Species

Carex lenticularis var. dolia
Sisyrinchium sarmentosum

Number of Occurrences / Number of Taxa

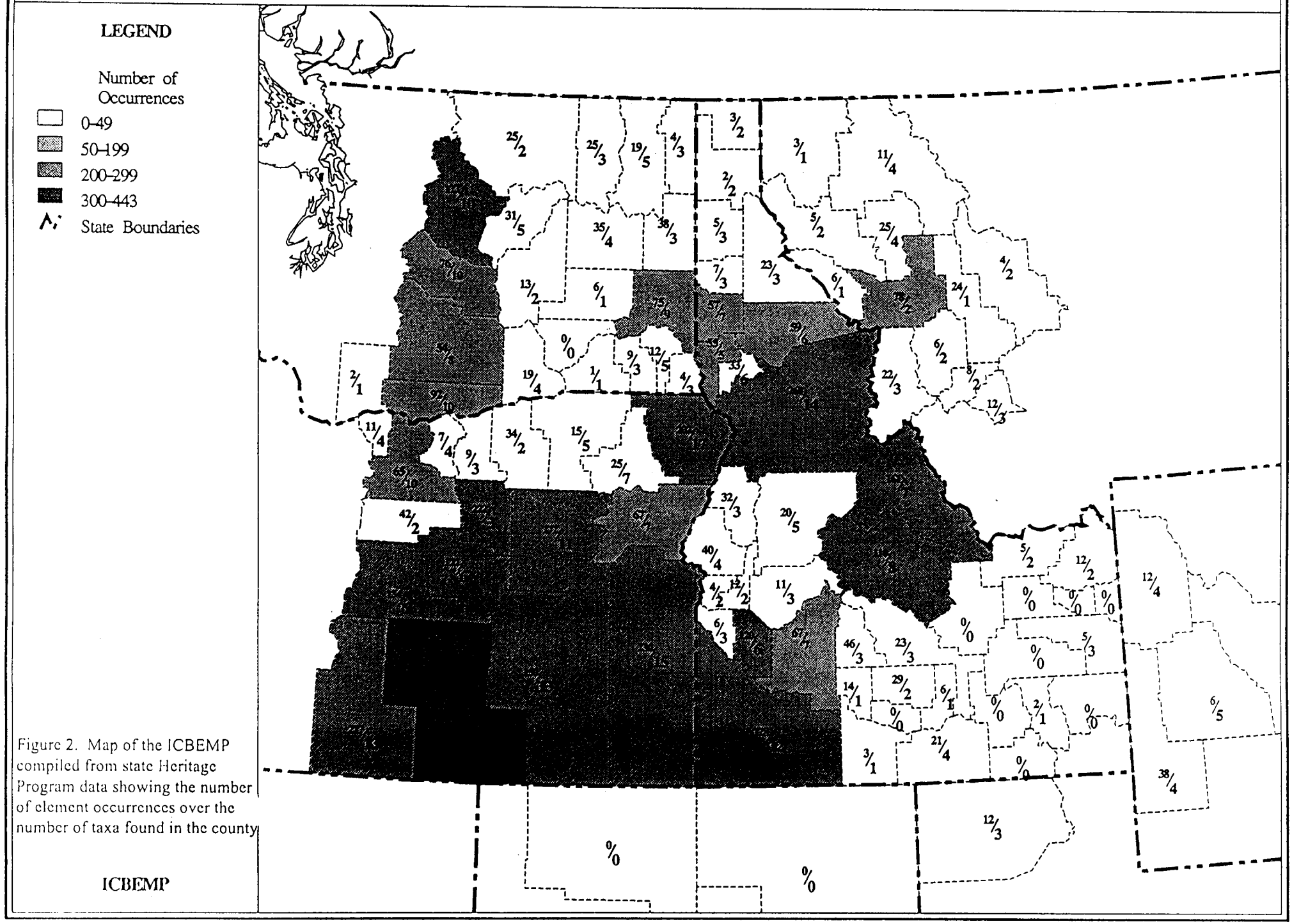


Figure 2. Map of the ICBEMP compiled from state Heritage Program data showing the number of element occurrences over the number of taxa found in the county.

Number of Taxa / Number of Occurrences

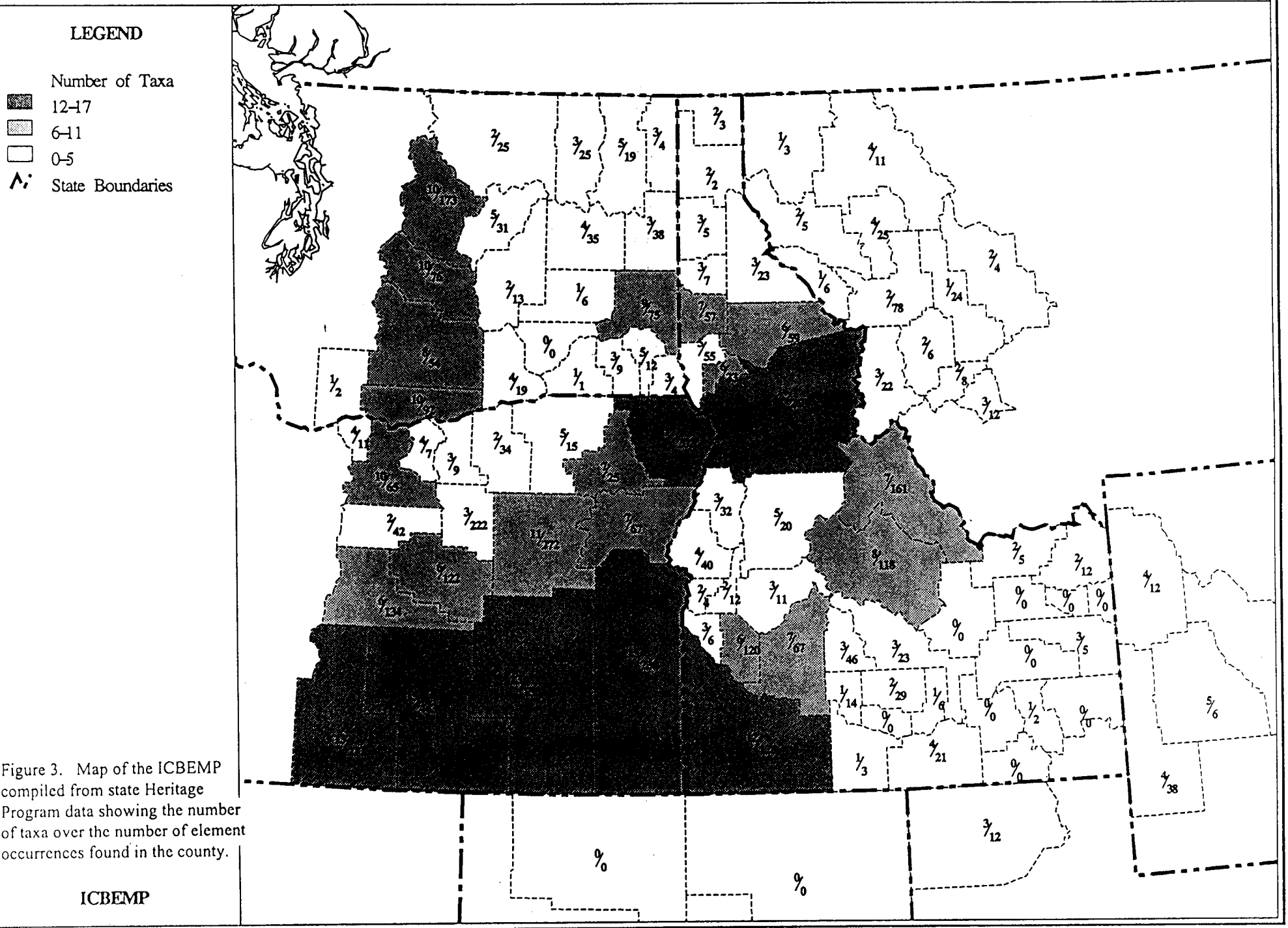


Figure 3. Map of the ICBEMP compiled from state Heritage Program data showing the number of taxa over the number of element occurrences found in the county.

Species Narratives

This information represents what was known about these taxa at the time the panels were conducted in 1994-1995. This information has not been updated to reflect the data collected in recent field seasons. The only updates have occurred for those species listed as Threatened or Endangered. Though dated, this information represents a starting point for analysis for these taxa across their range.

Abronia ammophilla **Greene** is a local endemic found only on sand dunes and beaches around Yellowstone Lake, all in Yellowstone National Park, Wyoming. This species is unique because it occurs at elevations higher that other members of its genus (7,700 feet). Road building and trampling (mostly by humans) seem to have affected the greatest impacts to this species, causing the extirpation of at least one site. The population is estimated to be no more than 1,000 individuals. Demographic uncertainty related to a highly restricted distribution and small population size is also a significant threat to this species. *A. ammophilla* is currently in decline.

Agrostis rossiae **Vassey** is a locally endemic annual grass found exclusively on hydrothermally warmed siliceous sinter in the Yellowstone, Wyoming region. It occurs at elevations between 7,250 and 7,400 feet. There are three primary occurrences in Yellowstone National Park divided into numerous local colonies. These colonies may fluctuate in size reflecting changes in thermal intensity and may become locally extirpated. This species is an important source of winter forage for wildlife, especially native ungulates. It is currently threatened by the invasion of exotic plant species and the development of thermal resources adjacent to Yellowstone National Park.

Allium aaseae **Ownbey** is a local endemic restricted to Glenns Ferry sands between the Boise Front and Weiser, Idaho. The majority of *A. aaseae* populations are found in a narrow elevational band between 2,100 and 2,800 feet. This species prefers southerly aspects and may be found on sites with slopes of 15-80%. Typical *A. aaseae* sites have very low (<20%) vegetative cover. This species flowers in the very early spring and is thought to contribute significantly to the support of a diverse spring insect fauna. The primary threats to this species include land development, sand mining, and exotic plant species. Timber harvest, road building, and off-road vehicles (especially motorcycles) are also seen as significant threats to some populations. This onion is sensitive to any disturbance that disrupts the soil profile as it appears to require the coarse , sandy substrate, overlaying a clay layer. This species is frequently associate with two other rare taxa, *Astragalus mulfordiae* and *Lepidium papilliferum*. The threats from livestock grazing have been decreasing over recent years. Dr. D. McNeal of the University of the Pacific recently completed a taxonomic treatment of *A. aaseae* (McNeal 1993) and Dr. J. Smith of Boise State University is currently engaged in DNA research concerning the origins and evolution of *A. aaseae*. The Boise District BLM botanist (A. DeBolt) located several large populations of this species in the spring of 1995.

Allium dictuon **St John** is *a* local endemic, known from four occurrences, in a one to two square mile area to the north and west of Weller Butte, on the Umatilla National Forest in Columbia

County, Washington. Sites range from 4,900 and 5,200 feet in elevation, on open, sparsely vegetated, shallow soils along the lower margins of basalt outcrops in weathered basalt scablands among *Festuca idahoensis* and *Poa sandbergii*. *Pinus ponderosa* in mixed stands of *Pseudotsuga menzesii* occurs at the margins. This bulb forming species tolerates fire and in general, its habitat doesn't burn intensely because of low fuel loading. Thus, around Weller Butte, scablands are often chosen for fire line location during fire suppression activities. Being very geographically restricted, ***Allium dictuon*** could be threatened by this kind of ground disturbance. Mc Neal (1995) speculates that solitary and social bees *(Apis **mellifera***) and other insects may be responsible for pollination. Overall, little is known about the biology of this species. More species-specific survey and monitoring work is needed to assess the viability of this species.

Amsinckia carinata Nels.* & Macbr.** is a local endemic known from six occurrences in northern Malheur Co., Oregon, covering a total area of less than 15 acres, with a majority of the populations on federal land. A facultatively autogamous annual, *A. carinata occurs* in xeric, relatively barren sites. Substrates derived from ash and welded tuffs are high in sodium, yellow to reddish in color, and gravelly to cobbly in texture. Soil development is poor, and harsh substrate conditions result in low vegetative cover. *Amsinckia **tessellata and ***Atriplex** spinosa are* nearby associates. Grazing is currently the most serious threat to the species. Cattle trails occur throughout the populations and grazing has enabled exotics, including Russian thistle (***Salsola kali***) and cheatgrass (***Bromus** tectorum),* to invade sites that might otherwise support *A. carinata.* Off-road vehicle (ORV) traffic is also a potential threat and is heavy at some sites. Many areas have been closed to ORV traffic, and a BLM Conservation Agreement has been signed with the USFWS. Population trends for the species are unknown.

Antennaria arcuata **Cronquist** is a scattered endemic found in scattered locations in Idaho, Nevada, and Wyoming though it is nowhere common. It is found at elevations between 4,950 and 8,000 feet on bare calcareous, alluvial soils. *A. arcuata* appears to be able to take advantage of periodic small disturbances for regeneration sites, though heavy disturbance is not well tolerated. The introduction of exotic species and activities that alter the hydrology (especially the water table) of its mountain meadow habitats are the greatest threats to the viability of *A. arcuata* populations. Land development and herbicide spray and drift are seen as significant but less immediate threats. Other identified threats to this species include trampling and haying. There is disagreement as to whether livestock grazing is a threat or not. Sexual reproduction is not known in this species. A DNA analysis of Idaho and Nevada populations (Bayer 1992) found that most of the genetic variation in this species is found within rather than among populations.

Antennaria aromatica **Evert** is a scattered endemic species. It is found in portions of the Rocky Mountains from Colorado, Montana, and Wyoming, and one occurrence in the Wallowa Mountains of Wallowa County, Oregon. Here this species is found on Martin-Bridge limestone formations between 8,000 and 10,100 feet in elevation. This plant displays a distinguishing citronella-like odor (Evert 1984). It is often found with *Trisetum spicatum* on alpine scree, bare limestone ridgetops, cirque basins, alpine turf and xeric upper slopes. Though scattered across several states, it is not abundant at any location (Evert 1984). As an alpine species, it could be

threatened by global warming, as its refugia would be limited. If populations of mountain goats in the Wallowa Mountains increase dramatically their foraging could impact *Antennaria aromatica.*

Arabis falcifructa **Rollins** is a regional endemic known from two drainage systems in northeastern Nevada, Northwestern Utah, and adjacent Idaho. Its preferred habitat correlates are north aspect slopes between 5,300 and 6,500 feet on soils with a high cover of cryptobiotic crust (>60%). *A. falcifructa* occurs on soils dominated by either sand or silt that usually have a significant fraction of volcanic ash or (in Utah) on metamorphic and quartzite rock outcrops. Livestock grazing and the invasion of exotic plant species are the greatest threats to populations of this rare mustard. Fire suppression, highway and road maintenance, and mining are also important threats to the continued viability of this species. The trend of this species is unknown throughout its range.

Arabis fecunda **Rollins** is a regional endemic, restricted to three counties in southwest Montana (Deerlodge, Ravalli, and Silver Bow counties). It is currently known from 20 occurrences within this geographic area, and occurs in or adjacent to the Highland, Pioneer, and Sapphire mountain ranges. The species is edaphically restricted as well, being wholly confined to alkaline soils derived from calcareous bedrock (typically limestone) that has been metamorphosed by batholithic intrusions (Lesica 1993a). These outcrops typically support sparse vegetation, which includes *Cercocarpus ledifolius* shrub stands, as well as other azonal stands of various bunchgrasses and perennial forbs. Known occurrences range from 4000 to 8000 feet elevation. Invasion of the habitat by exotic plants, especially *Centaurea maculosa* (spotted knapweed), is a serious threat to the populations in Ravalli County, and reduces recruitment rates (Lesica and Shelly 1990). The species is also frequently associated with cryptogamic crusts, and older, established plants show increased survival where intact crusts are present (Lesica and Shelly 1992). Enzyme electrophoretic studies of plants from five populations revealed a very small amount of interpopulation genetic variation; all plants sampled were monomorphic for 11 of 12 proteins. These data suggest that the species is highly inbred (Leeper et al. 1992). However, there is great variation in demographic and life history traits among populations; the variation in life history strategies is achieved through different proportions of plants that are iteroparous (repeatedly reproductive) or semelparous (having a single reproductive bout followed by death) (Lesica and Shelly 1995). Four years of intensive demographic monitoring at three sites has revealed that *A. fecunda* is a short-lived perennial with significant variation in recruitment rate, survivorship, age at maturity and fecundity among sites. Populations in the southern portion of the range appear to be stable, and will be most sensitive to changes that cause a reduction in recruitment, while northern populations may be declining and should be most sensitive to declines in adult survivorship (Lesica and Shelly 1994). Walsh (1992) found that the characters that most influenced survival and reproduction were size of the basal rosette (positive effect) and bolting (negative effect). A rangewide conservation strategy is needed for this species.

Arabis suffrutescens **Wats. var.** ***horizontalis*** **(Greene) Roll.** is a local endemic, known from six occurrences in the southern East Cascades province, Klamath Co., Oregon, with fewer than fifty individuals in each. It is found in the alpine zone of Crater Lake National Park at sites above 6500 feet. The perennial cruciferae is located on steep, barren slopes on light-colored,

coarse-textured pumice soils. Associated species include *Arabis platycaule*, *Carex breweri*, *Erigeron peregrinus* and *Raillardella argentea*. Surrounding forested sites include *Pinus albicaulis*. Some trampling occurs by recreational hikers at Crater Lake caldera and Mt. Scott. Population trends are currently considered stable.

***Artemisia campestris* L. ssp. *borealis* Hall & Ciem. var. *wormskioldii* (Bess.) Cronq.** is a regional endemic known from the Columbia River Gorge. There are two occurrences in Klickitat County, Washington with one on federal land and although once known from two locations in Sherman County, Oregon, these are extirpated. The plant is restricted to a 300 ft. shoreline corridor along the river and range from 300 to 500 ft. in elevation. At one site several plants grow on a compacted river cobble terrace degraded from recreation users. There are scattered low shrubs with at least 50% bare ground. At the other sit, plants grow from crevices in basalt outcrops with less than 100 plants spread over a 30 by 100 ft. area. This biennial or perennial plant is susceptible to damage from raising the Priest Rapids Reservoir. Populations are small and isolated, which leads to the fragmentation of taxa. Historic sites are underwater in reservoirs. Significant threats include raising water levels of dams, ORVs, orchard development, and exotic plants.

***Arfemisia Zudoviciana* Nutt. ssp. *estesii* Chamb.** is a local endemic of the Deschutes River, Oregon. A clonal perennial shrub, it grows immediately adjacent to the river on coarse, gravelly banks and exposed bedrock soils of *Salix*-dominated floodplains. Habitat is inundated during winter and early spring months, but is generally dry by *summer*. Thirteen occurrences are reported from three counties (Crook, Deschutes, Jefferson), with sites ranging from the Little Deschutes River near La Pine (Deschutes NF), to the Deschutes River, and from Benham Falls downstream to Lake Billy Chinook. Habitat is primarily on private land, but approximately fifty percent of sightings have been on BLM land. One population occurs on state land at Cline Falls. Pollination in *A. Zudoviciana* ssp. *'estesii'* is anemophilous. Seeds mature in late summer and are dispersed primarily by water, and secondarily by wind. The species' occurrence along perennial riverine habitats makes it locally important as an anchor to stabilize stream banks and provide limited shade. Trampling by cattle and recreationists, and changes in hydrologic regime, especially a lowering of the water table, are considered threats. Potential displacement by exotic species is also a threat. Population trends are currently considered stable.

***Aster jessicae* Piper** is a regional endemic currently restricted to tiny remnants of its former range in the Palouse of the Idaho panhandle, where most populations occur on private lands, and in adjacent southeastern Washington. In Washington, there are nine *occurrences.* in Whitman County, all on private land. The populations are small in size and area. In northern Idaho, *A. jessicae* is restricted to silty loam soils or deep loess soils, where it may act as a soil stabilizer and occurs with other rare Palouse endemics such *as Haplopappus Zaitriformis* and *Silene spaldingii*. This species depends of periodic fires to maintain its habitat; however, such events are rare today. The greatest threats to *A. jessicae* stem directly from agricultural activities. In the past century, approximately *98%* of *A. jessicae* populations and habitat have been lost to agricultural conversion. This species was once found primarily in *Festuca idahoensis* and *S'mphoricarpus albus* plant communities with roughly 95% cover. Today, remnant populations are found with a variety of introduced and annual grasses and forbs and continue to be lost to

housing developments and continuing agricultural conversion, though habitat management of relict populations may need to be complimented by restoration, as many of the sites have several exotic species. All populations occur in remnant habitats, especially eyebrows, the area between roads and fences, railroad right-of-ways, roadsides, and creeksides. Other ongoing threats include the elimination of the natural fire regime, livestock grazing, herbicide spray and drift, and the invasion of exotic species. The most recent status report on this species was done in 1991 (Lorain 1991a).

Aster mollis* Rydberg** is a regional endemic known primarily from the Bighorn Mountains, Wyoming with a single disjunct population within the assessment area (south of Yellowstone National Park) in Hoback Canyon that has not been relocated since 1922. It occurs in mountain meadows, forest edges, sagebrush grasslands, and open aspen stands. It prefers mesic sites on deep, alkaline or limestone derived soils. *A. **mollis could serve as a sensitive indicator species of good (or better) range conditions. Threats to this species are infrequent with the exception of livestock grazing which impacts populations directly by consumption and trampling and indirectly by facilitating the introduction of exotic plant species. Road construction associated with timber sales has been documented as a localized threat.

***Astragalus anserinus* Atwood, Goodrich, & Welsh** is a regional endemic found on the tuffaceous ashes of the Goose Creek drainage of southern Idaho, Northwestern Utah, and northeastern Nevada at elevations between 4,500 and 6,000 feet. This nitrogen fixing species prefers sites with a southerly aspect and cover values of less than 20% (usually dominated by mountain big sage and juniper). Threats to this species stem largely from livestock grazing and the invasion of exotic plant species though fire suppression activities, mining, road maintenance, and herbicide spray drift are also seen as important challenges to local viability. The current trend for this species is downward.

Astragalus applegatei* Peck** is a federally listed endangered species. It is a local endemic known historically from seven populations, two of which are extant in Klamath Co., Oregon, near Klamath Falls. The species is limited to two narrow areas of occurrence within the southern portion of the East Cascades physiographic province, comprising a metapopulation of fewer than 20,000 individuals spread over a total area of less than ten acres. Of the two populations, one is on state land, but the largest occurs on private land leased by the Nature Conservancy. The species is a long-lived, deeply taprooted legume found in flat, open, seasonally moist remnants of floodplains characterized by *Poa **nevadensis-Puccinella** Zemmonii* grasslands and salt desert shrub flats of the Klamath Basin. Sites range in elevation from 4000 to 4200 feet. *A. applegatei* is associated with *Sarcobatus, **Distichlis, and ***Castilleja*** species. Seasonal flooding at these sites may limit the dominance of other species and create favorable openings, and it is thought that historic drawdown of the water table may have eliminated some sites. Historically, agriculture conversion in the Klamath Valley was a major factor in the reduction of habitat. Today both agriculture and urban development may still impact small undetected relict sites on private land. Habitat conversion at the site of the principal population to exotic species, including quackgrass, cheatgrass, and *Melilotus* appears to be a significant cause of population decline. *A. applegatei* hosts an unknown species of beetle larvae and the adult stage of a number of genera of blue butterflies (Family Lycaenidae). Ground disturbance poses threats to pollinators, notably

ground-nesting bees. With the loss of pollinators, gene flow and seed set are inhibited, and loss of fruits to predators may also result in significant losses. The endangerment of *A. applegatei* is considered very high and it is considered one of the most imperiled plants in Oregon as populations are on a decreasing trend.

***Astragalus atratus* Wats. var. *inseptus* Barneby** is a local endemic native to the shallow basalt soils of the northern Snake River Plains in southern Idaho between Blaine and Elmore Counties. Populations of this nitrogen fixing forb are usually found between 2,900 and 5,600 feet in cool, clay rich soils. Vegetative cover of typical *A. atratus inseptus* sites range between 10-40%. This species is in decline as a result of several serious threats, most prominent being road building, land conversion, livestock grazing (especially trampling), the change in historic fire regimes, and the invasion of exotic plant species. Less immediate but still important threats stem from range improvements (especially seeding) and the use of herbicides. A 1991 (Smithman) status survey is available for this species.

***Astragalus collinus* var. *laurentii* Barneby** is a local endemic in Oregon. In the Columbia River Basin Province, there are 3 1 locations in Gilliam, Morrow, Sherman and Umatilla Counties. All populations are fragmented, relictual occurrences mostly on road shoulders. None are in federal ownership. It occurs on fractured basaltic outcroppings from 1970 to 2700 ft. in elevation. Significant threats are exotic plants and development. Two populations have been destroyed in the city of Pendleton since 1972. It is a nitrogen fixer and contributes to soil stabilization.

***Astragalus columbianus* Barneby** is a local endemic of south-central Washington. In the Columbia River Basin Province, it occurs in Yakima, Cadets and Benton Counties. Of the 32 occurrences, 24 are on federal land. Populations of this perennial usually consist of several hundred plants. This nitrogen fixer, is only found along the banks and hills of the Columbia River on compacted river cobble, loam, sandy loam, and basalt scablands with shallow basic soil. The plant ranges from 420 to 2500 ft. in elevation in big *Artemisia tridentata* and *A. rigida* plant communities where rainfall is 7 to 12 in. per year. Although very limited in range, populations may be large with hundreds of plants, even in disturbed areas. It shows an initial positive response to fire, but decreases in number as the cover of big sagebrush increases. Palatable to sheep and cows, grazing is a significant threat. This plant produces large fruit, which may provide food for other mammals also. Additional threats include military exercises and developments for orchards and recreation.

***Astragalus diaphanus* Dougl. ex Hook. var. *diurnus* (Wats.) Barn.** is a regional edaphic endemic of the South Fork of the John Day and Columbia Rivers in Klickitat County Washington and Grant County, Oregon. There are no extant sites in Washington. This nitrogen fixing, annual species *grows* in *Juniperus occidentalis* woodland openings (<5% cover) with *Cercocarpus, Lewisia,* and *Eriogonum* species on thin well drained volcanic substrates suspected to be naturally low in available nitrogen. Site elevations range from 1,650 to 4,000 feet. Adequate winter and spring precipitation is required for seed production and germination. It has been removed from the Oregon Sensitive List because of its abundance and apparent positive response to perturbations as disturbance of seedbeds by animal trails and rill erosion is needed.

It is found on sandy soils derived from John Day volcanic ash. It provides soil stabilization for highly eroded soils. A change in fire regime is a significant threat. Pollination is by small bees or autogamy. Mature fruits are dispersed by wind, gravity, and overland water flow. Predation on fruits and minor herbivory by small mammals and insects also occurs.

Astragalus diaphanus var. *diurnus* sites overlay a significant source of cinders used in the maintenance of nearby roads, and a primary threat to this species is the potential excavation and subsequent invasion of these sites by exotic species. Changes in the historic fire regime and off-road vehicle use threaten this species.

Astragalus howellii **Gray** is a local endemic of the lower Deschutes River watershed. It has a relatively broad ecological amplitude, occurring on sites ranging from lower and upper slopes, to ridges, on shallow gravelly lithosols. Ten occurrences are reported from the southern East Cascades and High Lava Plains provinces, Wasco Co., Oregon. Associated communities include, but are not limited to, *Pinus ponderosa* and *Quercus garryana* forested communities and *Artemisia tridentata-Agropyron spicatum* communities. The species is known to populate road banks and disturbed substrates, and its invasive habit contributes to a locally common distribution. *Astragalus* ***howellii*** habitats are often grazed, and the species itself is palatable to livestock. However, grazing does not appear to significantly impact species viability, and population trends are considered stable. Due to its pioneering characteristics, this species may flourish following wild or prescribed fires.

Astragafus mulfordiae **M.E. Jones** is a regional endemic restricted to course, deep, and usually sandy soils in southwestern Idaho and adjacent Oregon (primarily the Glenns Ferry sands and related formations). Vegetative cover at typical *A. mulfordiae* sites is usually low (less than 20%) and is often dominated by bitterbrush *(Purshia tridentata)* with an occasional significant component of *Stipa comata.* Other common associates include ***Balsamorhiza*** *sagittata, Chrysothamnus* ***viscidiflorus,*** *Oryzopsis hymenoides* and *Penstemon* ***acuminatus.*** *A. mulfordiae* is found only on sites with a minimal slope of 10%. Populations being monitored in Idaho and Oregon both show distinct population declines in recent years (90% in some areas). Major threats to the viability of *A. mulfordiae* populations include mining, land development, changes in the historic fire regime, range seedings (especially with crested wheatgrass), and the invasion of exotic plant species. Livestock grazing and road building are problems in certain areas. One population has declined by over 90 percent within the last six years as a result of sheep and cattle grazing, and small mammal herbivory. Smithman (1993) completed a field survey of the eastern edge of this species range in Idaho and a conservation agreement for this species exists between the US Fish and Wildlife Service and the BLM. Owen, et al. (1994) found that all (or most) populations of *A. mulfordiae* are infected with a rust. The pathological impact of this fungus is unknown.

Astragalus oniciformis **Barneby** is a regional endemic restricted to shady soils north of the Snake River between Picabo and Craters of the Moon National Monument in southern Idaho. It is immediately threatened by land development, road building, and the invasion of exotic species. Livestock grazing and the historic change in fire regimes are also threats. Current population levels of *A. oniciformis* are projected to be decreasing.

***Astragalus paysonii* (Rydb.) Barneby** is a regional endemic restricted to three eastern Idaho counties and western Wyoming. *A. paysonii* is found in early seral forests (especially lodgepole pine) at moderate elevations (4,000 to 9,600 feet). It seems to tolerate moderate levels of disturbance (consistent with its early seral habit), prefers sites with low relief, and grows best on well drained soils where canopy closure is between 15-45%. The factors that determine this species' distribution are poorly understood and there appears to be much unoccupied suitable habitat. Some authors have suggested that the species may be short lived and restricted to early successional environments (Fertig pers comm). In Wyoming, 15 of the 34 known occurrences are found within the ICBEMP assessment boundary, where the mean population size is 225 plants and all sites are on federal land. Data from Lorain (1990) for Idaho suggests an even smaller total population in Idaho. The greatest threats to the viability of *A. paysonii* populations include changes in the native fire regime and resultant alteration of in the historic distribution and size of forest structural stage patches. The invasion of exotic plant species and road building are also considered to be important threats to this species viability. A limited survey report for this species was completed in 1990 (Lorain).

Astragafuspeckii* Piper** is a regional endemic known from a total of thirty-eight occurrences reported from Klamath and Deschutes Counties, Oregon. In 1995 several new occurrence were discovered on the Chiloquin Ranger District of the Winema National Forest. The species is found on nearly level sites characterized by deep, dry, loose Mazama pumice or ash soils at elevations between 3,000 and *5,000* feet. ***Astragalus peckii is an early seral, perennial legume that occupies open, sunny sites in the coniferous or shrub canopy. Habitat is characterized primarily by *Juniper-us occidentalis/Purshia tridentata/*bunchgrass, *Pinusponderosa,* and *Artemisia tridentata* communities. It is also found in association with topographic climax ***Pinus contorta*** stands with *Purshia tridentata* understory. Its flowers appear to be pollinated by small bees, and seeds are dispersed by gravity and wind. As with other members of the genus, *A. peckii* fixes atmospheric nitrogen, although its contribution to the nitrogen budget in a *Purshia tridentata* community may be minimal. Populations of high density are known from recently disturbed habitats, and populations are stable to decreasing in trend. Threats to habitat are primarily associated with urbanization in central Oregon. Silviculture and fuels prescriptions to decrease canopy cover and diminish fuel loads while protecting the soil and seed bank could benefit the species.

***Astragalus pulsiferae* Gray var. *suksdorfii* (Howell) Barneby** is a disjunct perennial species in Washington with the rest of its range in the Sierra Nevada and Cascade Mountains of California. In the East Cascades North Province, it is known from three occurrences in Klickitat County, two of which are on federal land. Populations range from 35 to 600 plants and are found on volcanic soils. Its habitat includes, *Pinusponderosa* woodlands on flat areas of sand and gravel, as well as disturbed roadsides and old roadbeds. Significant threats to this nitrogen fixer include changes in fire regimes, the invasion of exotic plants, and timber harvest.

***Astragalus scaphoides* (Jones) Rydb.** is a regional endemic restricted to talus slopes derived from Challis volcanics. This nitrogen fixing species is immediately threatened by livestock grazing, changes in the historic fire regimes, land development, and the invasion of exotic plant species. Current populations are projected to be stable.

***Astragalus sinuatus* Piper** is a local endemic to southern Chelan County, Washington. The plant is known from nine occurrences in the East Cascades North Province. Five of these are on private land. Populations of this perennial may include several hundred plants scattered over tens of acres. It inhabits light porous, well-drained and relatively deep loam and basalt soils on southeastern to southwestern aspects on lower slopes, toe slopes, and mid-slopes. It ranges from 400 to 2000 ft. in elevation in the *Artemisia tridentata* and *Agropyron spicatum* plant community. Monitoring data for this nitrogen fixer shows that invasion by exotic plants is the major threat. Grazing has caused an increase in fuel for fires, where establishment after fire is poor for this species.

Astragafus solitarius* Peck** is a regional endemic of the Great Basin and Owyhee Uplands physiographic provinces, and adjacent Nevada. It is known in Oregon from seventy-five occurrences in Harney and Malheur Cos., many of which have been recently reported. The species is found on flat to rolling topography within *Artemisia tridentata* and pristine *Artemisia tridentata* ssp. *wyomingensis/Agropyron spicatum* communities, and occasionally in association with *Purshia tridentata* or ***Atriplex spinosa communities. Individuals frequently establish near the crown of *Artemisia,* and where solitary, away from the protective environment of the nurse plant, individuals are stunted. Collectively, *A. **solitarius*** populations are considered stable, although most sites are degraded as a result of grazing. Fire and livestock are considered threats where they lead to a loss of the shrub component and to increased competition from exotics, especially cheatgrass and crested wheatgrass. Mining claims are present at many sites, and the potential impacts of mining on the species requires monitoring.

Astragalus sterilis* Barneby *(= A. cusickii* var. *sterilis) is a regional endemic restricted to a variety of ash deposits in the northern Owyhee desert in Idaho into the Succor Creek and Leslie Gulch areas of adjacent Malheur *County,* Oregon. *A. sterilis* is found between 2,800 and 4,600 feet on steep slopes that are essentially devoid of vegetation. Populations are small, ranging from 11 to 50 individuals per site, and the species' entire range encompasses an area 30 by 15 miles. *Astragalus **sterilis*** is an early successional species, and while it colonizes newly exposed ash outcrops, it has not been found colonizing recently disturbed areas such as roadsides. This nitrogen fixing forb is subject to many threats, most significantly mining (especially zeolite and bentonite but also gold), the invasion of exotic plant species, and road building. Lesser yet still important threats stem from changes in the historic fire regime, livestock grazing (especially from trampling), land development (including seeding), and OHV's. A 1990 (Smithman) status survey is available for this species.

***Astragalus tegetarioides* M.E. Jones** is a regional endemic found in the Basin and Range and Blue Mountains physiographic provinces. It is known in Oregon from at least fifty occurrences in Harney Co., only one of which occurs within the Basin and Range Province. Many new populations have been located recently (A. Kratz & N. Taylor, *pers. comm.*). Populations are distributed from near U.S. Highway 395 west to the Dry Mountain area near Riley, at elevations between 4800 and 5220 feet. All known populations are under public ownership (Meinke & Kaye 1992), and most recent sightings have been from the Snow Mountain RD, Ochoco NF, and secondarily from the northern end of the Burns and Lakeview Districts, BLM. *Astragalus tegetarioides* develops a deep taproot capable of exploiting late-season moisture, and individuals

occupy cracks in tuffaceous and basalt outcrops, sites on poorly developed soils derived from pink welded tuffs, and occasionally on deeper soils in big sagebrush-dominated swales and in openings within ponderosa pine forest. Soils are generally shallow and stony, however, poorly to moderately drained, and comprised of ashy clays overlying heavily fissured bedrock (Meinke & Kaye 1992). Sage-scab flats supporting the species often interfinger up into ponderosa forest, and have likely been maintained historically by fire. The species has also been identified at a borrow pit on the Ochoco National Forest, and on abandoned skid roads, gravel roadbeds, and in roadside ditches. As the species is found on three diverse substrate types (bedrock, shallow gravelly soils, and deeper soils within swales), habitat relations and possible taxonomic differences require further attention. The species appears to be a poor competitor, and a thick litter layer or dense shrub overstory may inhibit its establishment. Within the ponderosa sites, associated species include *Artemisia* ***arbuscula***, *A. tridentata, Purshia tridentata,* ***Allium*** *acuminatum, Calochortus macrocarpus, Ipomopsis* ***aggregata***, ***Mimulus nanus*** and other annual forbs. Associated species at a disjunct rimrock-scrub site near Little Juniper Mountain include *Juniperus occidentalis, Artemisia* ***rigida,*** *A.* ***arbuscula, Chrysothamnus nauseosus***, *C.* ***viscidiflorus***, *Astragalus purshii, Lomatium* ***nevadense***, *Lewisia rediviva, Agropyron spicatum,* and *Poa sandbergii.* The species appears to be insect pollinated, and habitat destruction leading to a reduction of ground-nesting pollinators could severely impact seed set. A monitoring study to assess impacts of timber harvest activities on *A. tegetarioides* was initiated on the Snow Mountain District, Ochoco NF, in 1991. Livestock grazing and invasion by exotics may also pose a threat. Future management of the species may require prescribed fire to maintain overstory openings in associated ponderosa pine communities.

Astragalus tyghensis **Peck** is a local endemic known from twenty-four occurrences in Tygh Valley in eastern Wasco Co., Oregon. It occurs on deep, well-drained soils of the Bakeoven-Watama and Bakeoven-Maupin soil *series* in *Artemisia* ***tridentata-Agropyron*** *spicatum* communities along the edge of *Pinusponderosa,* ***Quercus garryana***, and *Juniperus occidentalis* mixed forest. Habitat is characterized by a mounded prairie topography. A deeply-taprooted perennial legume, its flowers provide nectar and pollen to native bees. Exotic annual grasses, including *Bromus tectorum* and *Taeniatherum* ***caput-medusae,*** *are* common on some sites. Agricultural conversion of habitats has caused fragmentation of populations and concurrent reduction or loss of gene flow. Removal of encroaching vegetation by prescribed fire may prove beneficial. Early demographic studies by the Oregon Department of Agriculture suggest that populations are stable, but many additional years of data are required to confirm an increasing trend.

Astragalus vexilliflexus **Sheld. var.** ***nubilus*** **Barneby** is a local endemic known only from the White Cloud Peaks of Custer County, Idaho. It occurs on ridgecrests and upper slopes to an approximate elevation of 9,000 feet. Fewer than ten populations of this low-growing *Astragalus* are known though there is much unsurveyed habitat on the east side of the White Clouds. Current threats have been documented from recreation (especially off-road vehicle use on trails), mining, and grazing (though the impact of grazing is variable among sites). A survey report for this species was compiled in 1990 (Mancuso and Moseley) and a related report concerning *A. vexilliflexus* was prepared in 1994 (Moseley).

***Astragalus yoder-wilfiamsii* Barneby** is a regional endemic found in southwestern Idaho and adjacent Nevada at elevations between 4,560 and 6,000 feet on shallow to moderately deep, cool soils. This sparsely distributed, nitrogen fixing forb is threatened by historic changes in the native fire regime, road construction, mining, grazing (as a result of trampling), and range improvements (especially seeding, water developments, and juniper burning). The introduction of exotic species has threatened *A. yoder-williamsii* more by increasing fire frequency than through obvious direct competition. A recent status survey for this species is available (Mancuso and Moseley 1993a).

***Balsamorhiza rosea* Nels. & Macbr.** is a local endemic in southern Washington and adjacent Oregon. In the Washington portion of the Columbia River Basin Province, this species is more abundant than previously thought. The single occurrence in Umatilla County, Oregon has been extirpated. It grows on fractured basaltic crevices, rocky ridgecrests, and butte summits from 1000 to 3500 ft. in elevation. Important threats include development of television, wind turbine and microwave tower sites; mining, and exotic weed invasion.

***Botrychium ascendens* W.H. Wagner** has a scattered distribution within its' geographic range of Alberta, British Columbia, Ontario and Yukon in Canada, and Alaska, California, Montana, Nevada, Oregon and Wyoming in the United States. It is rare throughout its range (Wagner and Wagner 1986, 1993). In Idaho, this species has been found in and near riparian areas within late seral, moist forests (western red-cedar with grand fir) that have greater than three inches of accumulated duff; this species is often found with other *Botrychium* species, especially *B. minganense.* In the Okanogan Highlands Province, this short-lived perennial is only known from one confirmed location, which is on National Forest Service land. This site in Ferry County is on the moist floodplain of a perennial stream in a late seral *Thuja plicata* and *Clintonia uniflora* forest. Canopy cover is 100% with a cedar duff layer. Elevation ranges from 3980 to 4120 ft. Three other species of *Botrychiums* occur with it, forming a "genus community." Sightings should be verified for correct identification, as this species is easily confused with others. *Botrychium ascendens* is currently verified from only one location in Montana, this based on a specimen collected by C.L. Hitchcock in 1948. This collection was made near the Chinese Wall, in the Bob Marshall Wilderness Area in northwest Montana. Another population may be located in the Little Belt Mountains of central Montana, but its identification has not been verified (W. Phillips, pers. comm.). Mycorrhizal fungi are required for spore germination and gametophyte development of *Botrychiums.* The major threats to *Botrychiums* in general are timber harvest (due to overstory removal), riparian disturbances, stand replacement fires.

***Botrychium crenulatum* Wagner** is a species of scattered geographic distribution in the western United States, known to occur sporadically in the states of Arizona, California, Idaho, Montana, Oregon, Nevada, Utah, Washington and Wyoming (Flora of North America Association 1993). It is currently known from one verified occurrence in Montana, that having been last observed in 1984 in Lake County (Montana Natural Heritage Program database records, Helena), and three likely occurrences on the Kootenai National Forest in Lincoln County (L. Ferguson, pers. comm.). The species occurs in moist forests at lower elevations, typically in association with mature or old growth *Thuja plicata* (western red cedar) groves; the Lake County record was found at an elevation of 3,100 feet (Lesica and Shelly 1991). It is also described as occurring in

"marshy and springy areas" (Flora of North America Association 1993). One of the Lincoln County populations was found in a highly disturbed roadside ditch, but this ditch does not have noxious weeds present, and is moist for most of the year (L. Ferguson, pers. comm.).

In the Okanogan Highlands Province, it occurs in 42 sites in Okanogan, Ferry, Stevens and Pend Oreille Counties, all on National Forest Service land. Although a few sites have over 100 plants, most populations have under 20. This species grows in moist areas, such as moist meadows, perennial or intermittent streams, and seeps in mid- to late seral forests of *Thuja plicata, Tsuga heterophylla* and *Picea engelmannii* with over 70% canopy cover. Sites range from 2030-5200 ft. in elevation and are on floodplains, in draws, ravines, and on lower slopes. It often occurs in "genus communities" with other species of *Botrychiums.*

In the East Cascades province of Washington, these short-lived perennial plants occur in moist openings and seeps, as well as near intermittent and perennial *streams* in *Thuja plicata* and *Tsuga heterophylla* forests over 100 years of age. Habitat characteristics include high organic matter, mafic soils with a high soil moisture, and a needle duff layer from 2 to 6 in. deep. Landforms encompass floodplains, draws, basins and midslopes from 3000 to 5500 ft. in elevation with over 20% canopy cover on northerly slopes of five to 30%. There are six occurrences that mostly consist of small (less than 50 individuals) populations.

In the Blue Mountain Province this *Botrychium* was known from eight occurrences in Union and Wallowa counties of Oregon. Recently, a single plant occurrence was confirmed from Grant County Oregon (Urban 1995), and an additional 15 occurrences have been reported from Crook and Harney Counties, in Oregon (Streier 1995). It is frequently misidentified, leading to occasional unverified reports in other areas (Zika 1992). In the Blue Mountain Province it has been reported growing in partially shady habitat between 4,800 and 6,000 feet in elevation. It is affiliated with year-round mesic, and semi permanently flooded marshy meadows and openings adjacent to Englemen's spruce, lodgepole pine, or grand fir stands. The soils at known sites are influenced by Quaternary surficial deposits or Hurwall Formation (Zika 1992) sedimentary, bedrock.

This species can be found in the same forest types *as B. ascendens* but usually prefers wetter, more mesic, sites. As with many *Botrychium* species, focused field surveys are needed in order to better understand the distribution, abundance and habitat relationships of *B. crenulatum.* Known threats derive from activities that alter canopy closure or drain its habitat (i.e., timber harvests and some livestock grazing activities) as this species is sensitive to changes in soil moisture levels . Other significant threats include fires that remove the canopy cover and change species composition, trampling from grazing, timber harvest (clearcuts), and road construction. *B. crenulatum* may tolerate low intensity fire if burning happens after sporulation in late summer or early fall; spring and summer burning is adverse. Although apparently tolerant of some ground disturbance, the level of such disturbance has not been quantified. It is threatened at many known locations by excessive trampling by campers and recreational livestock grazing.

***Botrychium lunaria* (L.) Swartz** is a peripheral species in Washington, but is the most widespread of the moonworts ranging from Alaska over most of Canada to the northeastern and western U. S. In the Okanogan Highlands Province, it is known from 14 occurrences in Okanogan, Ferry and Stevens Counties. Most are on federal or state land with less than 10 plants at a site. It ranges in elevation from 3000 to 7400 ft. This species grows in late seral forests of *Thuja plicata* and *Tsuga heterophylla* with over 70% canopy cover in moist areas on floodplains, lower slopes, and midslopes on well-developed duff layers. In Okanogan County, it occurs in subalpine meadows with 0 to 30% canopy cover often on deer or sheep dung, in grassy openings, or near perennial streams. It often occurs in "genus communities" with other species of *Botrychiums*. Stand replacement fires and clearcuting are the biggest threats.

***Botrychium paradoxum* Wagner** is a rare species of scattered geographic distribution, with occurrences known in Alberta, British Columbia and Saskatchewan in Canada, and Montana and Utah in the United States (Flora of North America Association 1993) but more sparsely distributed than *B. crenulatum*. In the Okanogan Highlands Province, there are four sightings in Ferry and Stevens Counties, each has fewer than 10 individuals and all are on National Forest Service land. This short-lived perennial inhabits late seral *Thuja plicata* forests on floodplains, stream terraces near perennial and intermittent streams, lower and midslopes, and compacted old roadbeds. It also is found in early seral *Pinus contorta* plant associations in moist grazed old homestead meadows. It ranges in elevation from 2480 to 3520 ft. and occurs in areas disturbed by campers and cattle.

Seven occurrences have been documented in Montana (Vanderhorst 1993), from Deer Lodge, Glacier, Granite and Pondera counties (Lesica and Shelly 1991; Vanderhorst 1993). One population was not relocated, despite surveys in 1986. In most of these locations *B. paradoxum* is found in "genus communities" (mixed populations that include other species of *Botrychium;* Wagner and Wagner 1983). Habitats include mesic grasslands, meadows adjacent to lakes, and openings in forests dominated by herbaceous species. The largest population documented rangewide, on the Deerlodge National Forest, occurs in near-pristine native montane *Festuca scabrella* grassland. Another site on the Deerlodge National Forest is highly disturbed by rodents and big game; this habitat supports many fewer, typically small and chlorotic, plants. A third location is threatened by off-road vehicle use, recreational impacts and, possibly, a mining claim (Vanderhorst 1993). Many members of the Ophioglossaceae, including species of *Botrychium,* have no root hairs and are considered to be dependent upon associated endophytic fungi for mineral absorption as well as, presumably, carbohydrate nutrition (Gifford and Foster 1989; Lellinger 1985; Wagner and Wagner 1981). This mycorrhizal relationship, found in both the subterranean gametophyte and the terrestrial sporophyte, is apparently responsible for allowing the evolution of partially achlorophyllous species such as *B. paradoxum* (Wagner and Wagner 1981). The species of symbiotic fungi are not known. Because of this obligatory symbiosis, which is poorly understood, species of *Botrychium* cannot be propagated and studied apart from the wild (Vanderhorst 1993).

In the Blue Mountain Province this species was known from two occurrences in the Wallowa Mountains of Wallowa County Oregon. A single plant occurrence was recently confirmed for Grant County Oregon (Urban 1995). In the Blue Mountain Province it grows between 5,000 and

5,500 feet in elevation, on soils influenced by Quaternary surficial deposits or Hurwall Formation sedimentary, (limy) bedrock (Zika 1992). It is most often associated with open mesic meadows of Tufted Hairgrass-sedge assemblages and alluvial fans. Sites in the Lostine and Hurricane drainages of the Wallowa Mountains are in full sun with partial afternoon shade (Zika 1992). Other occurrences in Washington and Oregon have not yet been confirmed, thus it remains one of the rarest botrychiums in this genus (Zika 1992).

Focused field surveys, especially in geographic areas adjacent to known populations, are needed for this, and many other, rare species of *Botrychiums.* The plants are often difficult to detect, given that they usually occur in the dense understory of the associated herbaceous vegetation. *B. paradoxum* may tolerate fire if low intensity burning occurs after sporulation in late summer or early fall; spring and summer burning is detrimental, though no monitoring has been conducted. Populations in the Wallowa mountains are at risk from hiker trampling and camping. Recreational packstock also pose a threat via grazing and trampling impacts.

***Botrychium pedunculosum* W.H. Wagner** is a species with a scattered distribution in Washington and Oregon. It is also found in a handful of locations in Alberta, British Columbia, and Saskatchewan. In the Okanogan Highlands Province, it is known from seven occurrences in Stevens and Pend Oreille Counties, all on National Forest land. There is also an herbarium collection from Ferry County, Washington. The type location is from the Lostine River, Wallowa County, Wallowa-Whitman National Forest, and from the literature from Union County, Oregon. In Washington, most populations are under 40 individuals, although one meadow site has over 1,000 plants. It grows in late seral *Thuja plicata* forests on lower slopes and in early seral *Pinus contorta* plant associations on the drier edge of grassy swales and moist grazed old homestead meadows. It is known from 2460 to 3350 ft. in elevation. It often occurs in "genus communities" with other species of *Botrychiums.* Exotic plants are a significant threat.

***Botrychium pumicola* Cov.** is a local endemic that occupies alpine pumice barrens of the SE Cascade Range and coniferous forests of the southern pumice plateau. One hundred thirteen occurrences are reported from three Oregon counties (Deschutes, Klamath, Lake), ninety-three of which are from the East Cascades South, and twenty from the High Lava Plains physiographic provinces. Alpine populations are found on broad ridge tops ranging in elevation from 6500 to 8500 feet, while pumice plateau populations are generally found on planar or concave topographic surfaces between 4200 and 5150 feet. Sites are characterized by a *Pinus contorta, Purshia tridentata* and *Festuca idahoensis* or *Stipa occidentalis community. Pinus ponderosa* dominates some sites. Overstory canopy cover is relatively low, ranging from zero to 30 percent, with light shrub cover and only a trace of herbaceous cover. The litter layer is poorly developed. The species is edaphically restricted to loose, unweathered Mazama pumice and individuals are inconspicuous, owing to their small stature and pale foliage. Spores are wind dispersed and likely washed deep into the substrate pending germination. Whittier (1973, *in* Vrilakas, 1984) reports that *Botrychiums* may require a endophytic mycorrhizal symbiont for survival of both the sporophyte and subterranean gametophytic phase. The ability or inability of the mycorrhizal fungus to migrate may limit the distribution of the fern. Deer, elk and rodents lightly browse the plants, and it is thought that browsing pressure prior to sporulation may decrease fecundity. Population trends are considered stable, but *some* populations may be declining. Threats to *B.*

pumicola in the high desert are largely related to fire suppression. Mature *Pinus contorta* stands are subject to insect and disease outbreaks, and these stands have a significant build-up of natural fuels that, when ignited, may have the potential to superheat the soil and destroy the gametophyte. Vehicular traffic associated with wood cutting uproots plants in fragile pumice sites, and alpine sites are occasionally damaged by hikers.

Calochortus longebarbatus* Wats. var. *longebarbatus is a regional endemic with a broad but clustered distribution. The northern portion of its range extends from Yakima and Klickitat Cos., Washington, south to Wasco Co., Oregon. The southern portion falls within the southern East Cascades physiographic province and extends from Klamath and Lake Cos., Oregon, to the Modoc Plateau (Modoc, Shasta, Siskiyou Cos.) in northeastern California. Fifty-two occurrences are reported from Klamath and Lake Cos., and within this province, the Sycan district appears to have the greatest concentration of populations. In addition, there are two sites in Wasco County and four occurrences in Union County. The Wasco County sites have been reported to be similar to *Calochortus Zongebarbatus* var. *peckii* as some flowers appear to be sterile (R. Helliwell, pers. comm). In the Columbia River Basin Province, all four of the occurrences in Washington are on private land in Yakima, Klickitat, and Whitman Counties and there are 17 occurrences in Yakima and Klickitat Counties, mostly on private land. *Calochortus Zongebarbatus var. Zongebarbatus* is found on clay loams in vernally moist sites, notably within thin soiled swales and along stony drainages of open meadow habitats, riparian zones and floodplains. Typically these swales are distributed among a matrix of conifer stands, most often pine types. In this habitat it is most often found growing in a band along the most moist portions of dry meadows or the drier areas of wet meadows (Kaye 1991). Individuals are found on drier, higher ground within moist *Deschampsia cespitosa*-dominated meadows, in small forest openings, along intermittent or ephemeral stream courses and occasionally beneath *Pinus ponderosa* or *Pinus contorta* at the margins of open meadow and herbaceous vegetative cover is generally high (>75%). In Washington, *Calochortus Zongebarbatus var. Zongebarbatus* is found from 1800 to 3000 ft. in elevation and in Oregon, site elevations range from 4500 to 5500 feet.

Soil moisture appears to control the distribution and phenology of this perennial herb. The ephemeral moisture in *Calochortus* habitat is supplied either through precipitation or subsurface flow, but water does not collect at the site to create anaerobic soil conditions (Jokerst 1983). It appears that, winter and spring moisture levels determine the percentage of the population that will flower that season, with spring moisture being critical. *Calochortus Zongebarbatus var. Zongebarbatus,* a fertile diploid, reproduces from seed and vegetatively from a bulblet borne at the base of the plant. Significant variability in the expression of below-ground populations has made census and monitoring difficult. A major portion of the population resides in the below ground bulb bank. The bulb is embedded deep in the soil, and above ground structures may be absent in drier years. Ownbey (1940) suggests that modern populations are relicts of a distribution that was once more widespread. Alteration of the hydrologic regime due to many activities is a principle threat to this species. Channelization and construction of impoundments for livestock appear to have had a detrimental effect on populations. Herbivory, trampling, forage seeding, competition, and compaction of moist soils by livestock also create negative impacts. Sod forming exotic grasses also pose a major threat to this species. Many grazed meadow populations are still extant, although they may be of low quality; likewise, many

meadow habitats suitable for *C. Zongebarbatus* var. *longebarbatus* do not support the subspecies. Timing and duration of livestock vistitation will influence the capability of this plant to withstand grazing impact. While early-season grazing is clearly detrimental, low to moderate late summer-fall grazing may be acceptable. Changes in the historical fire regime (fire suppression) may have impacted this species by allowing the encroachment of trees and shrubs onto its meadow/meadow edge habitat. *C. Zongebarbatus var. longebarbatus* is sensitive to spring/early summer burning but tolerates low intensity fall burning. Timber harvest and road construction threatens this species through changes in hydrology from soil compaction and site conversion on adjacent timber stands. Dispersed campsites (e.g., hunting camps) may also have the same effect. Intensive grazing in meadows with *C. Zongebarbatus* var. *Zongebarbatus* has been correlated with population declines (Kaye 1991). The population trends of are unknown, and it is suspected that some populations may be in decline. A conservation strategy is in place on the Fremont NF (Kaye and Wooley 1994) and in preparation on the Winema NF (Goldenberg and Jean 1995).

***Calochortus fongebarbatus* Wats. var. *peckii* Ownb.** is a restricted local endemic. In the Blue Mountain Province it is known from 16 1 occurrences in Crook, Harney, and Wheeler counties, Oregon. It is found at sites ranging from 4300 to 5200 feet in elevation. Habitat is almost identical to that listed for *C. Zongebarbatus var. Zongebarbatus,* vernally moist, low gradient draws and streambeds, and in broad meadow basins where it is situated between the wettest parts of the meadow and the forested edge. Unlike its fertile diploid relative, *C. Zongebarbatus* var. *Zongebarbatus, C. Zongebarbatus var. peckii* is a sterile triploid (Fiedler and Zabell 1994), and reproduces vegetatively through the production of bulblets that form at the base of the plant and by bulbils that form in the flower axils (Kagan, pers. comm). Bulblet dispersal mechanisms are unclear, though rodents have been suspected. Genetic studies are currently underway to determine the phylogenetic affinities of *C. Zongebarbatus var. Zongebarbatus* and *C. Zongebarbatus* var. *peckii* (Fiedler and Zabell 1994). Monitoring studies were initiated in 1993 to assess the effects of fire and grazing on this species. Significant variability in the expression of below-ground populations has made census and monitoring difficult. A major portion of the population resides in the below ground bulb bank. The bulb is embedded deep in the soil, and above ground structures are absent in drier years. It appears that, winter and spring moisture levels determine the percentage of the population that will flower that season, with spring moisture being critical. While early-season grazing is clearly detrimental, low to moderate late summer-fall grazing may be acceptable. Changes in the historical fire regime (fire suppression) may have impacted this species by allowing the encroachment of trees and shrubs onto its meadow/meadow edge habitat. *C. Zongebarbatus var. peckii* is sensitive to spring/early summer burning but appears to tolerate low intensity fall burning. This species faces the same threats as reported above for *C. Zongebarbatus* var. *longebarbatus* in the Blue Mountain Province. A conservation strategy is in preparation on the Ochoco National Forest.

***Calochortus nitidus* Dougl.** is a regional endemic currently known only from scattered, isolated populations in Idaho and (historically) southeastern Washington but was once widely distributed throughout the Palouse region of northern Idaho and adjacent Washington from three sites on private land in Garfield and Whitman Counties. This species can be found in a broad range of late seral habitat types from Palouse grasslands to mixed Doug-fir/ponderosa pine stands. Extant

populations are usually small and appear to be distributed along the margins of the species' former range. This very large flowered species can be difficult to survey for because flowering is precipitation dependent and consequently, population sizes appear to be highly variable between years. Though this species is highly palatable to cattle, grazing impacts vary among sites and the indirect impacts (soil compaction, facilitation of weed invasion, etc.) that contribute to habitat quality decline are a greater problem than simple consumption. The most recent status and survey report available for this species is Caicco 1992.

***Camissonia pygmae* (Douglas) Raven** is a regional endemic in Oregon and Washington, known only from historic locations in Wheeler, Crook, and Harney Counties in Oregon (though possibly rediscovered in Harney County by Holmgren in 1996) and is extant in Washington from Douglas, Grant and Franklin Counties. There were 10 occurrences recorded as of 1992, two historic, and eight recent. In 1992 BLM Botanist, Pam Camp tried to relocate these occurrences and was only able to find five (Camp 1992). The plant grows on ash soils derived from John Day volcanics and on the soil interface adjacent to basaltic cliffs on slopes of 30 to 60% from 1800 to 2000 ft. in elevation. Habitat has diminished from heavy trampling by cattle. Gravel operations, roadside spraying and drift, and exotic plant invasion are significant threats.

Carex Zenticularis* Michx. var. *dolia* (Jones) Standley** is a peripheral taxon in Montana, with the majority of its range extending northward through Alberta, British Columbia and Yukon in western Canada, to Alaska. Seven occurrences are currently documented for Montana, in Flathead and Glacier counties. These sites are all concentrated in two areas in Glacier National Park, and are the only occurrences known in the lower 48 United States (Lesica 1988). This variety occurs in shallow, wet, stony soil around streams and in seepage areas in the alpine zone, at elevations from 6,700 to 8,000 feet (Lesica and Shelly 1991; Standley 1985). Appropriate habitat appears to be limited in Glacier National Park, however; areas of gentle, perennially wet terrain over 7,000 feet are not common. Recreational impacts, and construction of recreational facilities such as boardwalk trails, have affected occurrences of this variety in the vicinity of Logan Pass, a heavily-used area of Glacier National Park. Invasion of occupied habitat by mosses, with resultant declines in numbers and flowering of *C. Zenticularis var. **dolia, also appears to be a factor influencing this taxon (Lesica 1988).

Carexparryana* Dewey ssp. *idahoa* (Bailey) Murray** is a regional endemic, restricted to southwest Montana and adjacent Idaho. Subspecies *idahoa* is very similar to ssp. ***hallii; Murray (1969) provides a key and discussion of this complex. Fourteen occurrences are currently documented in Montana, in Beaverhead, Madison, Powell and Silver Bow counties. It has recently been proposed for redesignation as a Category 2 candidate (it is currently in Category 3C) (B. Heidel, pers. comm.). The habitat for this taxon consists of wet meadows and minerotrophic fens in regions of calcareous parent material, at elevations of 6,500 to 8,500 feet; the sites are located in flat, depositional land form areas (Lesica and Shelly 1991; Montana VP panel notes). Most of the populations in Montana are small in size, and the habitat at many sites is in poor condition from heavy livestock grazing. In addition, one site has been modified by ditch diversions and irrigation, resulting in artificial flooding. A conservation strategy is needed for this taxon.

***Castilleja chlorotica* Piper** is a regional endemic known from eighty-seven occurrences in Deschutes, Lake and Klamath Counties, Oregon. Holmgren (1971, *in* Wooley and Phillips, 1994) suggests that the present distribution is discontinuous and may be relictual from a formerly more widespread distribution. A "perennial forb that generally grows in shrub-graminoid openings on exposed, well-drained slopes and summits at mid to high elevations" (Wooley and Phillips, 1994), it also occurs at low to mid-elevation sites that are entirely shrub-dominated. *Castilleja chlorotica* is a hemi-parasite, most often on *Artemisia tridentata,* but is also found in association with *Purshia tridentata* in *Pinusponderosa* or *Pinus contorta* communities. Flowers are pollinated by members of the genera *Bombus* and *Osmia,* and seeds are wind and gravity dispersed. The host-parasite relationship is of great importance when assessing threats and management implications. Species occurrence is strongly associated with canopy gaps or open canopy conditions where understory light, water, and nutrient availability are high. Prescribed fire and silvilcultural treatments may enhance *C. chlorotica* habitat, but survival of mature *Artemisia tridentata* and *Purshia tridentata*, neither of which are fire resistant, requires appropriate timing and spatial arrangement of prescribed fire treatments for maintenance of the crucial hemi-parasitic relationship. An additional threat to these populations is the possibility that *C. chlorotica* may hybridize when other species of *Castilleja are* present. Populations are generally considered stable, although those located within *Pinus ponderosa* communities may be at risk due to fire suppression and high fuel loads. A species conservation strategy (Wooley and Phillips, 1994) is in place on the Fremont National Forest.

***Castilleja christii* N. Holmgren** is a very localized endemic native to high elevation meadows atop Mt. Harrison in the Albion Range in southern Idaho (Moseley 1993). Extensive searches of adjacent areas have failed to locate additional populations. The US Fish and Wildlife Service, Sawtooth National Forest, and the Idaho Department of Fish and Game Conservation Data Center are currently building a conservation agreement for this species. The population trend for this species appears stable. The only threats to this species are from road improvements and the increasing recreational use of the site.

***Castilleja cryptantha* Pennell & G. N. Jones** is a local endemic in Washington and only is known from the north side of Mt. Rainier. There are two occurrences, both on National Forest Service land in Yakima County. It is known from subalpine and alpine meadows on slopes of zero to 20%. It grows on pumice with organic debris, in well-developed deep soils, in areas with late snowpack and high soil moisture, and ranges from 4500 to 7000 ft. in elevation. This species is susceptible to changes in moisture regimes and needs a maritime climate. Seedling establishment for this perennial is thought to be infrequent in subalpine meadows. The biggest threats are human trampling and grazing by horses used for recreation. The invasion of conifers may also be a threat.

***Castilleja pilosa* (S. Wats.) Rydb. var. *steenensis* (Penn.) N. Holmg.** is a local endemic restricted to high elevation sites (>6500 feet) on Steens Mountain, Harney Co., Oregon. Thirty-five occurrences have been reported, with some contiguous, where suitable habitat exists. Morphological and geographical characteristics manifest in the three varieties of *C. pilosa* suggest that the complex has recently evolved. *Castilleja pilosa* var. *steenensis* combines characters of both varieties *pilosa* and *longispica* (Cronquist *et al.* 1984). No overlap in

occurrence of *C. pilosa* var. *steenensis* and *C. pilosa* var. *pilosa has been observed,* however. Variety *steenensis* generally occurs on exposed summit ridges and cirque rims, but is also found on northern aspects at lower elevations on the west side of Steens Mountain. It is found in forb-dominated communities, rather than in shrubland or grassland types. Sites are generally rocky and exposed, and total vegetative cover ranges from 5 to 30 percent. Grazing pressure is low in occupied communities, but the species has withstood historic overgrazing. Closely monitored, low-intensity grazing may favor *Castilleja* by reducing grass cover, as var. *steenensis* has been observed to decrease with an increase in bunchgrass. Fire suppression may have led to increased shrub cover and habitat loss. Recreation is a possible threat, where trampling becomes severe. Populations appear to be stable.

Castilleja rubida **Piper** is a restricted local endemic, known from seven occurrences narrowly distributed in the Wallowa Mountains of Wallowa County in Northeast Oregon. It grows on substrates derived from Hurwal sedimentary soils or Martin-Bridge formation limestone. Its habitat is alpine scree, bare cliffs, alpine plateaus and ridgetops, cirque basins, alpine turf and upper slopes. This species is found between 7,500 and 10,100 feet in elevation, on all aspects, often with *Trisetum spicatum , Erigeron chrysopsidis* var. ***brevifolius*** and *Ivesia gormanii. Castilleja rubida* appears to be a partial parasite on these species as well as other native alpine grasses (Kagan 1987). Growing on cool mountain tops, this geographically restricted alpine species could be threatened by global warming as its refugia would be limited. Mountain goats in the area of *Castilleja* ***rubida*** do not appear to feed on this species (Kagan 1978)

Chaenactis cusickii **Gray** is a regional ash endemic from the Owyhee River region of Oregon and adjacent Idaho. It is found at elevations between approximately 2000 and 4200 feet, on ash outcrops weathered to clay with low percolation rates. It is often associated with *Allium* spp. and a variety of annuals, including the rare *Mentzelia mollis*. Reactivation of bentonite and zeolite mining in the area poses a threat, and some sites have already been disturbed by such activity. Gold mining developments are proposed at one site. During high moisture years, invasion of *C. cusickii* habitat by exotics, notably *Lepidium perfoliatum* and *Centaurea solstitialis*, is also a threat. Livestock grazing and off-road vehicle (ORV) use are identified as moderate threats. This species is decreasing rapidly. A recent status report is available for this species (Moseley 1994).

Chrysothamnus parryi **(Gray) Greene ssp.** ***montanus*** **L. Anderson** is locally endemic to a very small area in the Red Conglomerate Peaks of the Beaverhead Range, in Beaverhead County, Montana and adjacent Clark County, Idaho; the area occupied is less than 2,000 acres (Lesica 1992). It is currently known from four occurrences in this limited area, one of which extends into Montana. The taxon occurs near timberline on stony, poorly developed soils derived from calcareous parent material of the Beaverhead Conglomerate formation (Mancuso and Moseley 1990). Specifically, it occurs on slopes or windswept ridge crests with southerly exposure, between 8,000 and 10,000 feet (Mancuso and Moseley 1990). Most of the Montana portion of the Red Conglomerate Peaks area consists of north-facing slopes; thus, there is little available habitat in the state. The Montana site is at 9,300 feet on a 50% slope with a 170 degree aspect. The sites are sparsely vegetated; in Montana, total shrub, graminoid and forb cover were estimated to be 1%, 10% and 10% respectively. The total number of plants globally is estimated

to be approximately 3,600 (Lesica 1992). This species is an important source of cover for wildlife in its windswept habitat. The habitat is remote, and there are no apparent threats at this time. However, small population sizes and local distribution make the taxon vulnerable to any disturbances in the area. The plant should be given consideration in all management decisions related to the Red Conglomerate Peaks area, and the condition of populations should be monitored (Lesica 1992).

Claytonia lanceolata **Pursh var.** ***flava*** **(A. Nels.) C.L. Hitchcock** is a local endemic that occurs at the ecotone of *Artemisia cana*/forb/grass community and ephemerally wet meadows between 6,450 and 6,500 feet around Henry's Lake in southeastern Idaho. All populations of this taxon are on private land. Population trends are currently stable however threats due to introduced plant species and land conversion are seen as significant. This taxon is being reclassified as *Claytonia rosea* ssp. ***multiscapa***.

Claytonia umbellata **Wats.** is a regional endemic of Oregon. It is known from Wasco, Harney, and Crook Counties and California and Nevada. It grows on basaltic dry rock channels from 4000 to 4800 ft. in elevation, in biscuit scablands. Populations are small and the range of the plant has decreased. Significant threats include gravel pits and exotic weed invasion. Currently this species is on the "watch-list" for Oregon Heritage.

Collomia mazama **Coville** is a regional endemic of the southern Cascade Range known from fourteen occurrences in the southern East Cascades province, Klamath Co., Oregon. A slender taprooted perennial, it occurs in open, mesic forest environments at elevations ranging from 4700 to 6500 feet. Soils include glacial tills and those of volcanic origin. Lower elevation sites are generally riparian. *Collomia mazama* is associated with young and multi-strata *stands* in *Abies magnifica* var. *shastensis, A. concolor* and *Tsuga mertensiana* forests. In *Pinus contorta* forests, *C. mazama* occupies stands where understory reinitiation is occurring. Fruits ripen in mid-to late summer, at which time seeds are ballistically expelled from the capsule. Recruitment appears highest on substrates where duff has been removed. Threats are low and are limited primarily to trampling by recreational hikers at Crater Lake National Park and along developed trails on the Klamath RD, Winema NF. The species is absent from clearcuts, but appears to persist in stands characterized by partially open canopies. Population trends are unknown at this time. A conservation strategy is being developed on the Winema NF, and genetic studies are being conducted in cooperation with the University of Idaho.

Collomia renacta **Joyal** is a newly described scattered endemic known from three occurrences in south central Malheur Co., Oregon, including one site near Star Mountain, mainly in federal ownership and one occurrence in Nevada. *Collomia renacta* is an annual, believed to be autogamous, and is found on poorly developed, basalt-derived soils on southern aspects between 5200 and 5700 feet in elevation. Mature fruits are released *in situ,* and may be dispersed by passing animals. Grazing and road construction are possible threats, as is invasion of sites by exotics. If increased fire frequencies were to convert the native vegetation to communities dominated by exotic annuals, *C. renacta* would be unable to compete. Little is known about population trends at this time.

Cymopterus acaulis (Pursh) Raf. var. *greeleyorum* Grimes & Packard is a local endemic known from Malheur Co., Oregon, and from additional sites in Idaho. Occurrence data for Oregon is unavailable at this time. The species is found on Succor Creek Formation ash weathered to montmorillonite, and early spring precipitation is essential to successful reproduction and growth on these xeric sites. As with other ash endemics of the Owyhee Uplands, it is potentially threatened by mining, off-road vehicle (ORV) traffic, and other ground disturbing activities. Invasion of sites by exotic species may also be a threat. Population trends are unknown.

Cymopterus davisii R.L. Hartman is a local endemic occurring at high elevations on Mt. Harrison and Cache Peak in the Albion Range in southern Idaho. Little is known of this species other than that it occurs in subalpine grassy slopes and rock outcrops (Moseley 1993). This taxa occurs on relatively deep gravelly soils derived from quartzite, disturbed by pocket gophers, frost heaving or a similar type of disturbance. It generally occurs on north facing aspects, although there are south facing sites occurring in depressions where snow lies late into the summer. It does not occur on wind swept ridgelines where soils are shallow. Population vigor appears to be excellent. Threats appear to be minimal with exception of the influence of a radio transmission site on Mt. Harrison.

Cymopterus douglassii R.L. Hartman & L. Constance is a regional endemic found at high elevations on all aspects from flat ridgelines to relatively steep scree slopes in the Lost River and Lemhi Ranges in eastern Idaho. This species is usually found on carbonate substrates in subalpine basins, open subalpine woodlands and grasslands. The occurrences are limited in size but appear to be in otherwise good condition, with the populations dense and vigorous. Little is known about the biology or ecology of this species and no threats were identified during the panel process. The Idaho Conservation Data Center is currently preparing a status survey for this species.

Cymopterus nivalis Hartman & Kirkpatrick is a scattered endemic known from Idaho, Nevada, Utah, Montana, and Wyoming. The Oregon Basin and Range populations, including sites at Steens Mountain and Table Rock, represent the western most extent of the species. The dry, rocky sites on which it is found, notably volcanic tuffs and bald areas with less than 30% vegetation cover and at elevations between *4200* to *8900* feet. *Artemisia* ***arbuscula*** is a common associate. *Cymopterus* ***nivalis*** exploits early spring moisture provided by rainfall and snowmelt. A deeply-taprooted perennial, it aids in soil stabilization and nutrient cycling on otherwise sterile mineral substrates. Potential threats to the species include early season grazing and vehicle traffic. Road and area closures designed to protect two sites in Lake Co. have resulted in a significant increase in the number of individuals present at those sites. Population trends appear to be stable at this time.

Cypripedium fasciculatum Kell. is an orchid with a widely scattered distribution in the western United States; it is known to occur from southern British Columbia, Oregon, Washington, to southern California, east to Colorado, Idaho, Montana, Utah, and Wyoming (Brownell and Catling 1987). In Montana, 17 occurrences of the species have been documented in the northwest and west-central portions of the state, in Lake, Mineral and Sanders counties. The

species occupies a variety of coniferous forest cover types, but in Montana it does not typically occur in stands that have a closed canopy; it prefers more open, mid-seral stand conditions. Associated cover types include Douglas-fir/ninebark, ponderosa pine, and western red cedar mixed conifer stands, usually in warmer microhabitats. In the Blue Mountains, one occurrence in Baker County, Oregon, has not been relocated since reported. In this province it is found between 2,500 and 6,500 feet in elevation under the filtered sunlight of open parkland-like conifer stands or deep shade of old growth conifers. It is also reported to be associated with *Holodiscus discolor* or *Pachistima myrsinites* on basalt derived soils. In Idaho, it is found on the river breaks of central and northern Idaho in low elevation (1,000 to 3,000 feet) forests with greater than 50% canopy closure, an area concurrent with the maritime refugium (sensu lato). In Washington, most of the 50 locations in Chelan, Kittitas, Klickitat and Yakima Counties are on federal and state land, yet it is known from only one occurrence each in Columbia and Garfield Counties, Washington. There are also two occurrences, both on public land in Whitman and Kittitas Counties, Washington. One isolated population is surrounded by wheat fields, so a significant threat is the isolation of populations as have under a dozen plants. It grows under mid- to late seral *Pseudotsuga menziesii/Pinus ponderosa* overstories with a closed herbaceous layer and variable shrub layer, mostly on northerly aspects about 4500 ft. in elevation. It can also be found in *Abies grandis* forests with Swauk sandstone, thick duff or sandy loam soils. Slopes range from 5 to 75% and canopy cover varies from 25 to 80%. Populations are on upper, mid- or lower slopes, as well as ridgetops. It ranges from 700 to 5300 ft. in elevation. It is limited to well-drained sites. Most populations are small and reproduction is low. At all sites in the ICBEMP the scattered, generally small, character of most of the populations seems to be contributing to poor reproductive success.

The pollination and reproductive biology of this mycotrophic species is poorly understood and apparently complex. The seed requires a mycorrhizal fungal associate to germinate and survive. Fruit set may be limited by pollinator availability. Also, pollinator success seems to be dependent on climatic conditions, a phenomenon that has been observed for other orchid species (Montana VP panel notes). Demographic monitoring studies have indicated that the plants may not be present above ground every year, which is also typical of many orchid species. Insect and ungulate herbivory threaten some populations. In fragmented forests, the thermal cover provided by overstory species frequently leads to livestock and wildlife trampling of *C. fasciculatum* in the understory. Spring burns, and severe stand replacement fires are harmful, but mild fall underburns may benefit *Cypripedium fasciculatum.* Historic changes in the native fire regime are considered a threat as is canopy removal; yet fire suppression, and resultant canopy closure, also do not appear to be suitable to the species. The effects of selective logging are not well understood. The mechanical impact and resulting increase in solar radiation from clear-cutting is detrimental to population viability. Recreation, road building, development , and off-road vehicles are also threats. The most recent status survey for this species is Moseley, 1992 (for the Caribou NF) and a species management guide was prepared for it in 1990. A conservation strategy is needed for this species in Montana and Idaho, as the occupied habitats are frequently targeted for timber harvesting.

Delphinium uiridescens **Leiberg** is a local endemic to the Wenatchee Mountains of Washington. In the East Cascades North Province, 24 locations are known in Chelan and Kittitas Counties,

fourteen are on National Forest Service land. Populations range from 13 to several hundred plants along 300 ft. of a riparian area. This perennial plant occurs in moist openings in *Pseudotsuga menziesii* and *Pinusponderosa* forests from 1500 to 4050 ft. in elevation. It is also found in openings in aspen groves and along the edges of shrub thickets, such as *Crateagus douglasii.* Other habitats include wet meadows, seeps, and roadsides. This plant tends to grow in poorly drained microsites, which dry out in the summer. Changes in hydrological regimes , grazing, timber harvest, and developments are major threats.

Descurainia torulosa **Rollins** is a regional endemic of Wyoming, that occurs in the Absorka Mountains and the Rocksprings Uplift on sparsely vegetated sandy slopes at the base of cliffs and boulders of volcanic conglomerate or sandstone at elevations of greater than 8,300 feet. Populations of this alpine mustard are typically small, with the total population in this area of less than 200 plants, with a mean population size of 25 plants and some disappear for one or more years at a time. Populations seem to be decreasing though there is much interannual variation in numbers of individuals. On sites within the ICBEMP area, threats are considered low due to the inaccessibility and ruggedness of the sites. All *known D. torulosa* sites are on federal lands.

Douglasia idahoensis **D. Henderson** is a regionally endemic primrose found on scattered north (NW-ENE) facing ridge systems on the Idaho Batholith. It is known only from Forest Service lands (Boise and Nez Perce NFs). The high elevation slopes (6,000-9,500 feet) that *D. idahoensis* inhabits typically have very low vegetation cover (typically 10-15% but ranging from 5-50%), and are very steep (slopes 4-100%). The majority of *D. idahoensis* populations occur on granite but one or two are known from quartzite. In all cases, the substrate is poorly differentiated, generally coarsely decomposed bedrock (residuum) with poor to high stability. This species is pollinated by a diverse assemblage of small bees and flies. A graduate student at the University of Idaho (Angela Sondenaa) is currently researching the reproductive ecology of this species. Changes in the fire regime seem to be a problem for this species. The large fires of 1994 burned over some populations on the Boise National Forest killing many individuals. Grazing (sheep) is a potential threat that is easy to mitigate with proper (effective) controls. Many populations of *D. idahoensis* occur near popular recreation sites and some human trampling and habitat disruption has been observed. Mining is a potential threat in some locations. Timber harvest is not viewed as a threat because it occurs in the whitebark pine and subalpine fir zones, species with little commercial value. The Boise National Forest, in conjunction with the US Fish and Wildlife Service is currently conducting a long-term monitoring study to assess the viability of the species at the southern margin of its range.

Draba trichocarpa **Rollins** is locally endemic to the Stanely Basin of Idaho. It is restricted to southerly aspects with shallow gravely soils of decomposed granite at elevations of less than 7,500 feet. It is suspected that the specific microsites in which *D. trichocarpa occurs* are blown free of snow in winter. This species is found in approximately twenty small populations, some of which it shares with the rare *Eriogonum* ***meledonum.*** Current threats to *D. trichocarpa* population viability are seen as low but increasing development in the Stanley Basin has the potential to become a significant problem in the future (both through land alteration and associated increases in human activities such as recreation and road construction). Though seed

viability of this species is known to be high, a three year monitoring study suggests that populations are in long-term decline (Moseley and Mancuso 1990,1991, and 1993). This taxa may occur with *D. trichocarpa* var. *treleasii* and the two varieties freely intergrade with one another.

***Erigeron basafticus* Hoover** is a local endemic to Yakima and Kittitas Counties in Washington. In the Columbia River Basin Province, there are nine occurrences, four of these are on federal land. It is known from basalt outcrops, cliffs, and cracks. Soils include colluvial and aeolian deposits. It ranges from 1300 to 1700 ft. in elevation on aspects from northwest to southeast, preferring the more northerly and generally not on direct south-facing sites. Lichens are often noticeable on the basalt. This perennial species provides showy flowers (food) within an area somewhat devoid of other showy species and blooms in the spring and fall. Plants trap wind-blown material for soil build-up in cracks. Construction of roads has probably meant the loss of habitat. Exotic plants are a significant threat.

***Erigeron lackschewitzii* Nesom & Weber** is a local endemic restricted to the Flathead and Rocky Mountain Front (Sawtooth) ranges in northwest Montana. The species is currently known from a total of 12 sites, in Flathead, Lewis and Clark, Pondera, and Teton counties, and an estimated total of approximately 1,800 individuals (Heidel 1993). It is confined to open, gravelly, calcareous soils and talus on ridge tops and in tundra in the alpine zone, and flowers in July and early August; this habitat serves as winter range for some big game species. The species is most frequently found on southwest aspects; it prefers midslopes between scree and toeslope turf, or gentle but highly exposed slope crests and ridgelines, at elevations from 6,400 to 8,200 feet. Most sites fall within the *Dryas octopetala/Carex* spp. plant association (Heidel 1993). Although the taxonomic recognition of this taxon has been questioned (i.e., Dorn 1984), recent systematic studies, employing morphological and molecular techniques, indicate that the species is sufficiently distinct from *E. ochroleucus var. scribneri*, its closest relative, to warrant species status (Kerstetter 1994). A persistent lack of pollen, coupled with the presence of fully formed achenes at a very early state of floret development, suggest apomixis (asexual reproduction of seeds). Populations of *E. Zackschewitzii* most likely resulted from selection for traits often found in other polyploid derivatives that colonize areas left barren after glaciation, with maintenance of the adaptive genotype through apomixis (Kerstetter 1994). Nine of the 12 known occurrences are in or on the boundaries of two Wilderness Areas (Bob Marshall and Scapegoat wilderness areas). There has been little management activity in the occupied habitat apart from the construction of lookout towers, the latter having since been taking out of operation; proximity of hiking and pack trails near the populations also do not appear to pose potential threats, nor do disease, predation or grazing (Heidel 1993).

***Erigeron latus* (A. Nelson & J.F. Macbride) Cronquist** is a regional endemic native to rhyolitic gravels in southwestern Idaho and adjacent northern Nevada. It occurs on flats (slopes of less than 10%) at elevations ranging from 4,200 to 6,450 feet (Moseley and Mancuso 1993). The most serious threat to this species' viability is the invasion of exotic plants (especially from the consequent increase in fire frequency), though conflicts also arise from juniper eradication programs and livestock grazing.

***Erigeron salmonensis* S.J. Brunsfeld & Nesom** is locally endemic to a 30 mile stretch of the Middle Fork Salmon River in Idaho, with a single disjunct population downstream from Shoup on the Salmon River. This species is restricted to north slopes and grows in cracks **and** ledges of massive cliffs and large rocky outcrops (primarily granite and metamorphics). The current population trend is assumed to be stable (though there is no monitoring data to support that supposition). Since most populations of *E. salmonensis* are in wilderness, the species is probably safe from most anthropogenic threats.

Eriogonum chrysops* Rydb.** is a very narrowly distributed local endemic of the Owyhee Uplands, with a range of 5 by 2 miles and total number of individuals less than 10,000. The species is known from five occurrences in Malheur Co., Oregon. Of the three main populations, one is on private land and the remainder are on BLM lands. The species is closely related to several other rare *Eriogonum* species in the *Eriogonum chrysops* complex, including: *E. crosbyae, E. prociduum, E. cusickii,* and *E. **ochrocephalum (Hitchcock *et al.* 1964). Habitat is scabland of shallow, rocky, basalt- and rhyolite-derived soils. Site topography ranges from nearly level areas to broad outcrops on ridges or hills. *Artemisia arbuscula* is a common associate. *E. chrysops* is a pioneer species, and vegetative cover at these sites is sparse, up to 2 percent cover. Individuals may aid in soil development by fracturing rocky substrates and contributing to litter accumulation. Threats are thought to be minimal, although trampling by livestock may be detrimental. Pedistled plants have been observed, indicating soil loss at least one site. Population trends are considered stable.

***Eriogonum crosbyae* Reveal** is a local endemic occurring at nine sites in southern Lake and Harney Cos., Oregon, and at five sites in Nevada. Extensive searches have been performed, and new populations are not expected in Oregon. The species grows on gently rounded ridge tops and upper slopes on light brown or tan volcanic tuffs at elevations between 5280 and 6600 feet. Communities are characteristically barren, with vegetative cover of less than five percent. Associated species include *Ivesia rhypara var. rhypara,* as well *as **Mentzelia albicaulis**, Cryptantha* sp., *Gilia congesta, Lygodesmia spinosa, **Atriplex** spinosa, **Astragalus** tetrapterus, A. purshii, Orobanche **fasciculata**,* and *Penstemon **speciosus**. The* pollinators for *this Eriogonum* complex are specific to the taxon and include flies and wasps. Once mature, achenes break easily for wind dispersal. *Eriogonum crosbyae* populations are in a declining trend, as a gradual decrease has been observed in numbers over the last ten years. Gold mining and off-road vehicle (ORV) use are threats in Nevada, but do not yet appear to be impacting Oregon populations. An Oregon conservation agreement between the BLM and USFWS is slated for completion in 1995.

***Eriogonum cusickii* M.E. Jones** is a regional endemic known from nine occurrences in northern Lake and Harney Counties, Oregon, in the Basin and Range physiographic province. Sites are located at elevations between 4400 and *5300* feet. *Eriogonum cusickii* is a pioneer species that grows on relatively flat, barren, welded tuff outcrops. Vegetative cover is sparse, rarely exceeding 5 percent. *Juniperus occidentalis* and *Artemisia arbuscula* are common associates, along with *Cymopterus **nivalis**, Lewisia rediviva, Gilia congesta, **Lesquerella** occidentalis,* and *Dimeresia **howellii**.* Population trends are considered stable, and monitoring has shown that some populations are increasing in size. Threats appear to be minimal, but invasion of roadside sites by exotics is a potential problem. Successful recovery of sites following an ORV closure

suggests that off-road vehicle traffic has also been detrimental. All Oregon populations will be covered by a conservation agreement to be completed in 1995.

Eriogonum lewisii **Reveal** is a northern Nevada regional endemic that occurs at elevations between 7,300 and 9,600 feet on exposed ridgetops on poorly developed limestone or dolomite soils or residuum. Roads and mining are seen as significant threats to the viability of several populations. Fire suppression activities, exotic plant species, and livestock grazing are seen as important threats across the species' range. Population trends for this species appear to be downward.

Eriogonum meledonum **Reveal** is locally endemic to the Stanely Basin of central Idaho. It occurs at elevations below 7,500 feet on granite derived substrates (residuum) at sites with full exposure. Known populations appear to be stable but a preliminary monitoring study indicated that long-term viability may be in jeopardy (Moseley and Mancuso 1990, 199 1, and 1993a). The most consistent threat to *E. meledonum* populations stems from trampling by livestock. Additionally, development and road construction may become threats to some populations as the human population in the Stanley Basin increases.

Eriogonum novonudum **Peck** is a regional endemic of the Owyhee Uplands. It is known from Malheur Co., Oregon, where it is found on gravelly-textured Leslie Gulch ash. Occurrence data is unavailable at this time, and it appears to be common and is no longer tracked by the Oregon Natural Heritage Program. Within communities that support *E. novonudum, Agropyron spicatum* is generally dominant. As with other ash endemics, the species is potentially threatened by livestock activity, notably trampling, and by recreational use, invasion of sites by exotic species and subsequent changes in the fire regime. Population trends are unknown.

Eriogonum prociduum **Reveal** is a regional endemic found in Lake and Klamath Counties, Oregon, as well as in northeast California and northwest Nevada. It inhabits gentle slopes and level areas of barren, rocky or gravelly soils with minimal vegetative cover. *Artemisia* ***arbuscula*** and *Juniperus occidentalis* generally occur adjacent to sites. Substrates include basalt, ash outcrops, and other volcanic rocks. *E. prociduum* is a perennial pollinated by flies and wasps. Mature achenes dihesce easily and seeds are wind dispersed. A road was constructed at one site, but the population is recovering following road closure. In general, population trends are considered stable. Threats appear to be minimal with the exception of off-road vehicle activity, and the species is considered stable across its range.

Erythronium grandiflorum **Pursh var.** ***nudipetalum*** **(Applegate) Hitchcock** is locally endemic to the Bear Valley area of Valley County, Idaho. Though its distribution is highly restricted, it is very common within its range. This species occurs in more or less moist meadows and meadow ecotones between 5,600 and 7,00 feet and may be able to invade small disturbances in the graminoid-forb matrix (e.g., gopher mounds). Practices that alter meadow hydrology such as diversions, creek dredging, and excessive grazing pressure are the major threats to *E. grandijlorum nudipetalum.*