

Plant Species of Special Concern
and Plant Associations
of the
Copper Mountain Ecosystem
Fremont County, Wyoming

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Introduction

The Copper Mountain ecosystem is located at the south end of the Bridger Mountains in the transition zone between the Wind River and Bighorn basins and the Owl Creek and Bighorn mountains. This transition area is unusually rich in regionally endemic plant species and contains a mosaic of vegetation types of great importance for wildlife habitat. In addition, the rugged nature of the area and variety of geological formations has made the Copper Mountains a significant area for recreation and mineral exploration (USDI Bureau of Land Management 1989).

Under the Lander Resource Area Resource Management Plan (USDI Bureau of Land Management 1986), public lands administered by the Bureau of Land Management (BLM) in the Copper Mountain area are managed under the philosophy of multiple-use. Due to the high level of interest in this area and the potential for conflicts involving biological resources, the BLM Wyoming State Office in 1995 contracted on a cost-share basis with the Wyoming Natural Diversity Database (WYNDD) to inventory plant species of special concern and plant associations in the Copper Mountain ecosystem. The objectives of this project were to:

- * collect biological information and map populations of plant species of special concern identified by the US Fish and Wildlife Service, BLM, and WYNDD within the study area;
- * develop a list of vascular plants of the Copper Mountain ecosystem;
- * identify occurrences of plant associations of particular conservation value (i.e. occurrences of rare plant associations, and occurrences that represent unusually high-quality examples of common plant associations, particularly those associations unrepresented in existing special management areas).

Study Area

The Copper Mountain ecosystem, as defined in this report, consists of the summit and slopes of Copper Mountain, Lysite Mountain, and Cedar Ridge and the adjacent basins between the east side of Boysen Reservoir and the Nowood Road (Figure 1). The entire study area is contained within Fremont County, Wyoming. Most of the lands within the ecosystem are administered by the BLM Lander Resource Area, although scattered state and private lands are also present. The extreme western end of the Copper Mountain uplift has been managed as a Wilderness Study Area, although the site was not recommended for wilderness designation in the BLM's final wilderness Environmental Impact Statement for the Lander Resource Area (USDI Bureau of Land Management 1989).

Copper Mountain is located at the eastern end of the Owl Creek-Bridger Mountain uplift, one of only three major east-west oriented mountain ranges in the central Rocky Mountains (Lageson and Spearing 1988). Deep thrust faults have exposed a sequence of geologic strata on Copper Mountain that includes Precambrian granites, Cambrian sandstones, shales, and limestones (Flathead, Gros Ventre, and Gallatin formations), Ordovician dolomites (Bighorn Formation), Mississippian limestones (Madison Formation), and Pennsylvanian sandstone-limestones

Figure 1. Map of the Copper Mountain Ecosystem.

(Amsden and Tensleep formations) (Lageson and Spearing 1988; USDI Bureau of Land Management 1989). The basins and lower slopes surrounding Copper Mountain consist primarily of Tertiary tuffaceous sandstones, claystones, and conglomerates (Wagon Bed, Wind River, and White River formations) and Quaternary alluvium and colluvium (Love and Christiansen 1985; USDI Bureau of Land Management 1989).

Methods

Vascular Plant Checklist

Field sampling was conducted by the authors in June and July 1996. Species were identified in the field or collected for later determination and deposit at the Rocky Mountain Herbarium (RM). Additional species were added to the final checklist based on records of the RM and WYNDD.

Rare Plant Species

Surveys of plant species of special concern were conducted in the summer of 1996. Prior to conducting fieldwork, information on the habitat needs and known distribution of target species was obtained from secondary sources, including WYNDD files and computer databases, collections of the RM, pertinent literature, and knowledgeable individuals. USGS topographic maps, geologic maps, and BLM land status maps were used to identify areas of potential habitat for ground surveys.

In the field, data were collected on the biology, habitat, population size, and management needs of target species. Locations of plant populations were mapped on 7.5-minute USGS topographic maps. When populations were sufficiently large, voucher specimens were collected for deposit at the RM. Information gathered in the field was entered into the computerized Element Occurrence database of WYNDD.

Plant Associations

The landscape of the study area has already been classified into standard habitat sites (Greenquist 1982) based on species composition, topographic position, and geographic location, and complexes of those associations have been mapped at a scale of 1:24,000. Much of the work for the present project consisted of relating those habitat sites to the plant associations in the classification scheme of the network of state natural heritage programs and The Nature Conservancy (1997), of which WYNDD is a part. Each association in that classification has been assigned a rank that reflects its conservation status, as described in Appendix B.

Sampling sites were selected to represent the variation in the vegetation of the study area. At each sampling site, a survey was made on foot to identify the vegetation types present and, for each vegetation type, the topographic position, substrate, vegetation structure, and most common plant species were recorded. This information was sufficient to allow each of the vegetation types at each sampling point to be assigned to a plant association (The Nature Conservancy 1997). Each sampling point was mapped, and the mapped locations were compared with geologic maps of the study area (Tourtelot 1953; Hafen 1980a, 1980b, 1980c, 1980d) to confirm or correct the identity of the geologic substrates. The identity of the standard

habitat site at each sampling location was determined by comparison of the information from the field survey with the descriptions of the habitat sites.

At two sampling locations, plots were used to collect more detailed information about the composition and structure of two vegetation types rich in cushion-plant species.

Results

Vascular Plant Checklist

A preliminary checklist of the vascular flora of the Copper Mountain ecosystem is included in Table 1. For additional information on the flora of the Wind River Basin and the adjacent Owl Creek Mountains, consult Haines (1988) and Fertig (1992 b).

Table 1. Vascular Plants of the Copper Mountain Ecosystem

The following list is based on fieldwork conducted by the authors in the summer of 1996 and on records from the Rocky Mountain Herbarium, University of Wyoming. Nomenclature follows Dorn (1992) for scientific names and Hitchcock and Cronquist (1973) and Welsh et al. (1993) for common names. Family acronyms are based on Weber (1982).

Scientific Name	Common Name	Family
Trees		
<i>Pinus flexilis</i>	Limber pine	PIN
<i>Populus angustifolia</i>	Narrow-leaved cottonwood	SAL
<i>Populus deltoides var. occidentalis</i>	Great Plains cottonwood	SAL
<i>Ulmus pumila</i>	Siberian elm	ULM
Shrubs		
<i>Amelanchier utahensis</i>	Utah serviceberry	ROS
<i>Artemisia cana</i>	Silver sagebrush	AST
<i>Artemisia frigida</i>	Fringed sagebrush	AST
<i>Artemisia longifolia</i>	Long-leaved sagewort	AST
<i>Artemisia nova</i>	Black sagebrush	AST
<i>Artemisia pedatifida</i>	Birdfoot sagebrush	AST
<i>Artemisia porteri</i>	Porter's sagebrush	AST
<i>Artemisia tridentata var. tridentata</i>	Basin big sagebrush	AST
<i>Artemisia tridentata var. vaseyana</i>	Mountain big sagebrush	AST
<i>Artemisia tridentata var. wyomingensis</i>	Wyoming big sagebrush	AST
<i>Atriplex canescens var. canescens</i>	Fourwing saltbush	CHN
<i>Atriplex confertifolia</i>	Shadscale	CHN
<i>Atriplex gardneri var. gardneri</i>	Gardner's saltbush	CHN
<i>Chrysothamnus nauseosus var.</i>	Rubber rabbitbrush	AST

<i>nauseosus</i>			
<i>Chrysothamnus nauseosus var. oreophilus</i>	Rubber rabbitbrush		AST
<i>Chrysothamnus viscidiflorus</i>	Douglas rabbitbrush	AST	
<i>Gutierrezia sarothrae</i>	Broom snakeweed		AST
<i>Holodiscus dumosus</i>	Mountain-spray		ROS
<i>Juniperus osteosperma</i>	Utah juniper		CUP
<i>Juniperus scopulorum</i>	Rocky Mountain juniper		CUP
<i>Krascheninnikovia lanata</i>	Winterfat		CHN
[<i>Ceratoides lanata</i>]			
<i>Leptodactylon pungens</i>	Sharp prickly-phlox		PLM
<i>Prunus virginiana var. melanocarpa</i>	Common chokecherry	ROS	
<i>Rhus trilobata</i>	Skunkbush		ANA
<i>Ribes cereum var. pedicellare</i>	Wax currant		GRS
<i>Ribes oxycanthoides</i>	Northern gooseberry	GRS	
<i>Rosa woodsii</i>	Woods' rose		ROS
<i>Salix boothii</i>	Booth willow		SAL
<i>Salix eriocephala var. watsonii</i>	Yellow willow		SAL
[<i>S. lutea</i>]			
<i>Salix exigua</i>	Coyote willow		SAL
<i>Sarcobatus vermiculatus</i>	Greasewood		CHN
<i>Symphoricarpos oreophilus var. utahensis</i>	Mountain snowberry		CPR
<i>Tamarix chinensis</i>	Salt-cedar		TAM
<i>Tetradymia canescens</i>	Gray horsebrush		AST
<i>Yucca glauca</i>	Soapwell		AGA
	Forbs		
<i>Achillea millefolium var. lanulosa</i>	Common yarrow		AST
<i>Agoseris glauca</i>	Short-beaked agoseris		AST
<i>Allium textile</i>	Textile onion		LIL
<i>Alyssum desertorum</i>	Desert alyssum		BRA
<i>Amaranthus blitoides</i>	Prostrate pigweed		AMA
<i>Antennaria dimorpha</i>	Low pussytoes		AST
<i>Antennaria microphylla</i>	Small-leaved pussytoes		AST
<i>Antennaria umbrinella</i>	Umber pussytoes	AST	
<i>Arabis confinis</i>	Spreadingpod rockcress	BRA	
[<i>Arabis divaricarpa</i>]			
<i>Arabis demissa var. languida</i>	Daggett rockcress		BRA
<i>Arabis holboellii var. secunda</i>	Holboell's rockcress	BRA	
<i>Arenaria congesta</i>	Ballhead sandwort		CRY
<i>Arenaria hookeri</i>	Hooker's sandwort		CRY
<i>Arenaria nuttallii</i>	Nuttall's sandwort		CRY
[<i>Minuartia nuttallii</i>]			
<i>Artemisia biennis var. biennis</i>	Biennial wormwood	AST	
<i>Artemisia ludoviciana var. ludoviciana</i>	Louisiana sagewort		AST
<i>Asclepias speciosa</i>	Showy milkweed		ASC
<i>Aster ascendens</i>	Long-leaved aster		AST
<i>Aster occidentalis</i>	Western mountain aster		AST
<i>Astragalus agrestis</i>	Field milkvetch		FAB

<i>Astragalus bisulcatus</i> var. <i>bisulcatus</i>	Two-grooved milkvetch	FAB
<i>Astragalus chamaeleuce</i>	Cicada milkvetch	FAB
<i>Astragalus drummondii</i>	Drummond's milkvetch	FAB
<i>Astragalus gilviflorus</i> var. <i>gilviflorus</i>	Plains milkvetch	FAB
<i>Astragalus grayi</i>	Gray's milkvetch	FAB
<i>Astragalus purshii</i>	Woolly-pod milkvetch	FAB
<i>Astragalus sericoleucus</i> var. <i>aretioides</i>	Cushion milkvetch	FAB
<i>Astragalus simplicifolius</i>	Bun milkvetch	FAB
<i>Astragalus spatulatus</i>	Spoon-leaved milkvetch	FAB
<i>Balsamorhiza incana</i>	Hoary balsamroot	AST
<i>Balsamorhiza sagittata</i>	Arrowleaf balsamroot	AST
<i>Camelina microcarpa</i>	Littlepod falseflax	BRA
<i>Camissonia scapoidea</i>	Scapose evening primrose	ONA
<i>Cardaria draba</i>	Whitetop	BRA
<i>Castilleja angustifolia</i> var. <i>dubia</i>	Desert paintbrush	SCR
<i>Castilleja flava</i>	Yellow paintbrush	SCR
<i>Centaurea repens</i>	Russian knapweed	AST
<i>Chaenactis douglasii</i> var. <i>montana</i>	Douglas' dustymaiden	AST
<i>Chamaerhodos erecta</i> var. <i>parviflora</i>	American chamaerhodos	ROS
<i>Chenopodium atrovirens</i>	Mountain goosefoot	CHN
<i>Cirsium arvense</i>	Canada thistle	AST
<i>Cirsium canescens</i>	Platte thistle	AST
<i>Cirsium pulcherrimum</i>	Pretty thistle	AST
<i>Cirsium vulgare</i>	Bull thistle	AST
<i>Clematis ligusticifolia</i>	White virgin's bower	RAN
<i>Cleome lutea</i>	Yellow beeplant	CPP
<i>Collinsia parviflora</i>	Smallflowered blue-eyed Mary	SCR
<i>Collomia linearis</i>	Narrowleaf collomia	PLM
<i>Comandra umbellata</i> var. <i>pallida</i>	Pale bastard toadflax	SAN
<i>Conyza canadensis</i>	Horseweed	AST
<i>Crepis acuminata</i>	Mountain hawksbeard	AST
<i>Crepis modocensis</i>	Modoc hawksbeard	AST
<i>Cryptantha caespitosa</i>	Tufted cryptantha	BOR
<i>Cryptantha cana</i>	Silvery cryptantha	BOR
<i>Cryptantha celosioides</i>	Cockscomb cryptantha	BOR
<i>Cryptantha fendleri</i>	Fendler's cryptantha	BOR
<i>Cryptantha kelseyana</i>	Kelsey's cryptantha	BOR
<i>Cryptantha subcapitata</i>	Owl Creek miner's candle	BOR
<i>Cymopterus acaulis</i>	Plains spring-parsley	API
<i>Cymopterus longilobus</i>	Mountain rock-parsley	API
[<i>Cymopterus hendersonii</i>]		
<i>Cymopterus terebinthinus</i> var. <i>albiflorus</i>	Turpentine rock-parsley	API
<i>Delphinium bicolor</i>	Little larkspur	RAN
<i>Delphinium geyeri</i>	Geyer's larkspur	RAN
<i>Descurainia pinnata</i> var. <i>nelsonii</i>	Nelson's tansymustard	BRA
<i>Descurainia sophia</i>	Flixweed	BRA
<i>Dodecatheon conjugens</i>	Slimpod shooting-star	PRI
<i>Draba nemorosa</i>	Woods draba	BRA
<i>Draba oligosperma</i>	Few-seeded draba	BRA
<i>Epilobium ciliatum</i> var. <i>ciliatum</i>	Northern willowherb	ONA

<i>Erigeron compositus</i> var. <i>discoideus</i>	Cut-leaved daisy	AST
<i>Erigeron corymbosus</i>	Mountain daisy	AST
<i>Erigeron eatonii</i>	Eaton's daisy	AST
<i>Erigeron engelmannii</i>	Engelmann's daisy	AST
<i>Erigeron lonchophyllus</i>	Longleaf daisy	AST
<i>Erigeron pulcherrimus</i>	Basin daisy	AST
<i>Erigeron pumilus</i> var. <i>pumilus</i>	Vernal daisy	AST
<i>Eriogonum acaule</i>	Stemless buckwheat	PLG
<i>Eriogonum brevicaulis</i> var. <i>micranthum</i>	Shortstem buckwheat	PLG
<i>Eriogonum cernuum</i>	Nodding buckwheat	PLG
<i>Eriogonum flavum</i> var. <i>flavum</i>	Yellow buckwheat	PLG
<i>Eriogonum ovalifolium</i>	Cushion buckwheat	PLG
<i>Eriogonum pauciflorum</i>	Few-flowered buckwheat	PLG
<i>Eriogonum umbellatum</i>	Cream buckwheat	PLG
<i>Euphorbia</i> sp.	Spurge spp.	EUP
<i>Galium aparine</i>	Cleavers	RUB
<i>Gaura coccinea</i>	Scarlet gaura	ONA
<i>Geum macrophyllum</i> var. <i>perincisum</i>	Long-leaved avens	ROS
<i>Geum triflorum</i>	Prairie smoke	ROS
<i>Gilia leptomeria</i>	Common gilia	PLM
<i>Glycyrrhiza lepidota</i>	American licorice	FAB
<i>Grindelia squarrosa</i>	Curlycup gumweed	AST
<i>Halogeton glomeratus</i>	Halogeton	CHN
<i>Haplopappus acaulis</i>	Stemless goldenweed	AST
<i>Haplopappus armerioides</i>	Thrifty goldenweed	AST
<i>Haplopappus multicaulis</i>	Many-stemmed goldenweed	AST
<i>Haplopappus nuttallii</i>	Gumweed aster	AST
[<i>Machaeranthera grindelioides</i>]		
<i>Hedeoma drummondii</i>	Drummond's pennyroyal	LAM
<i>Helianthus annuus</i>	Common sunflower	AST
<i>Heterotheca fulcrata</i>	Golden-aster	AST
<i>Heterotheca villosa</i>	Hairy golden-aster	AST
<i>Heuchera parvifolia</i>	Littleleaf alumroot	SAX
<i>Hutchinsia procumbens</i>	Hutchinsia	BRA
<i>Hymenopappus filifolius</i> var. <i>luteus</i>	Columbia cutleaf	AST
<i>Hymenoxys acaulis</i>	Stemless hymenoxys	AST
<i>Ipomopsis pumila</i>	Dwarf gilia	PLM
<i>Ipomopsis spicata</i> var. <i>spicata</i>	Spike gilia	PLM
[<i>Gilia spicata</i> var. <i>spicata</i>]		
<i>Iva axillaris</i>	Poverty-weed	AST
<i>Iva xanthifolia</i>	Tall marsh-elder	AST
<i>Kochia scoparia</i>	Summer-cypress	CHN
<i>Lactuca serriola</i>	Prickly lettuce	AST
<i>Lappula redowskii</i> var. <i>redowskii</i>	Stickseed	BOR
<i>Lathyrus eucosmus</i>	Seemly sweetpea	FAB
<i>Leptodactylon caespitosum</i>	Clumped prickly-phlox	PLM
<i>Lesquerella alpina</i> var. <i>alpina</i>	Alpine bladderpod	BRA
<i>Lesquerella arenosa</i> var. <i>arenosa</i>	Great Plains bladderpod	BRA
<i>Lewisia rediviva</i>	Bitterroot	POR
<i>Linum lewisii</i>	Blue flax	LIN

<i>Lithophragma tenellum</i>	Slender fringecup		SAX
<i>Lithospermum ruderale</i>	Western gromwell		BOR
<i>Lomatium orientale</i>	White biscuitroot		API
<i>Lomatium triternatum</i> var. <i>platycarpum</i>	Ternate desert parsley		API
<i>Lupinus argenteus</i>	Silvery lupine		FAB
<i>Machaeranthera canescens</i>	Hoary aster		AST
<i>Maianthemum stellatum</i>	Starry false-Solomon's seal		LIL
<i>Malcolmia africana</i>	African mustard		BRA
<i>Melilotus officinalis</i>	Yellow sweetclover		FAB
<i>Mentha arvensis</i> var. <i>canadensis</i>	Field mint		LAM
<i>Mentzelia albicaulis</i>	Whitestem blazing-star		LOA
<i>Mentzelia pumila</i>	Wyoming stickleaf		LOA
<i>Mertensia oblongifolia</i>	Leafy bluebells	BOR	
<i>Mimulus guttatus</i>	Yellow monkeyflower		SCR
<i>Monolepis nuttalliana</i>	Povertyweed		CHN
<i>Musineon divaricatum</i>	Leafy musineon	API	
<i>Oenothera cespitosa</i>	Tufted evening primrose		ONA
<i>Oenothera coronopifolia</i>	Crown evening primrose		ONA
<i>Oenothera flava</i>	Yellow evening primrose		ONA
<i>Opuntia polyacantha</i> var. <i>polyacantha</i>	Plains prickly-pear		CAC
<i>Orthocarpus luteus</i>	Yellow owl-clover		SCR
<i>Oxytropis besseyi</i>	Bessey's locoweed		FAB
<i>Oxytropis sericea</i> var. <i>sericea</i>	Silky crazyweed		FAB
<i>Paronychia sessiliflora</i>	Stalkless nailwort		CRY
<i>Penstemon arenicola</i>	Wyoming basin beardtongue		SCR
<i>Penstemon eriantherus</i>	Fuzzytongue beardtongue		SCR
<i>Penstemon laricifolius</i>	Larch-leaved beardtongue	SCR	
<i>Penstemon nitidus</i>	Shining beardtongue		SCR
<i>Petrophyton caespitosum</i>	Rocky Mountain rockmat		ROS
<i>Phacelia glandulosa</i>	Glandular phacelia		HYD
<i>Phacelia ivesiana</i>	Ives' phacelia		HYD
<i>Phlox hoodii</i>	Hood's phlox		PLM
<i>Phlox multiflora</i>	Mountain phlox		PLM
<i>Phlox muscoides</i>	Moss phlox		PLM
<i>Physaria acutifolia</i>	Southern twinpod		BRA
<i>Picradeniopsis oppositifolia</i>	Opposite-leaf bahia		AST
<i>Plantago major</i>	Common plantain		PTG
<i>Plantago patagonica</i>	Indian-wheat		PTG
<i>Platyschkuhria integrifolia</i>	Nakedstem bahia		AST
<i>Polanisia trachysperma</i>	Clammyweed		CPP
<i>Polygonum aviculare</i>	Prostrate knotweed		PLG
<i>Potentilla biennis</i>	Biennial cinquefoil		ROS
<i>Potentilla fissa</i>	Bigflower cinquefoil	ROS	
<i>Potentilla gracilis</i> var. <i>nuttallii</i>	Nuttall's cinquefoil		ROS
<i>Potentilla hippiana</i> var. <i>effusa</i>	Woolly cinquefoil		ROS
<i>Potentilla ovina</i> var. <i>ovina</i>	Sheep cinquefoil		ROS
<i>Psoralidium lanceolatum</i>	Dune scurfpea		FAB
[<i>Psoralea lanceolata</i>]			
<i>Ranunculus cymbalaria</i>	Marsh buttercup		RAN
<i>Ranunculus gmelinii</i> var. <i>purshii</i>	Small yellow water buttercup		RAN

<i>Ranunculus scleratus</i>	Blister buttercup	RAN
<i>Rumex crispus</i>	Curly dock	PLG
<i>Rumex hymenosepalus</i>	Canaigre dock	PLG
<i>Rumex salicifolius</i> var. <i>triangulivalvis</i>	Narrowleaved dock	PLG
<i>Salsola australis</i>	Russian-thistle	CHN
[<i>Salsola kali</i> , <i>S. pestifer</i>]		
<i>Schoenocrambe linifolia</i>	Flax-leaved plainsmustard	BRA
<i>Sedum lanceolatum</i>	Lance-leaved stonecrop	CRS
<i>Senecio canus</i>	Woolly groundsel	AST
<i>Senecio integerrimus</i> var. <i>exaltatus</i>	Western groundsel	AST
<i>Sisymbrium altissimum</i>	Tumble mustard	BRA
<i>Solidago canadensis</i>	Canada goldenrod	AST
<i>Solidago sparsiflora</i>	Alcove goldenrod	AST
<i>Sphaeralcea coccinea</i>	Scarlet globemallow	MLV
<i>Sphaeromeria capitata</i>	Clusterheaded false sagebrush	AST
<i>Sphaerophysa salsula</i>	Sphaerophysa	FAB
<i>Stanleya pinnata</i>	Bushy prince's-plume	BRA
<i>Stanleya tomentosa</i>	Hairy prince's-plume	BRA
<i>Stenogonum salsuginosum</i>	Stenogonum	PLG
<i>Stephanomeria runcinata</i>	Desert wire-lettuce	AST
<i>Taraxacum laevigatum</i>	Red-seeded dandelion	AST
<i>Thelesperma marginatum</i>	Scapose greenthread	AST
<i>Thermopsis rhombifolia</i> var. <i>rhombifolia</i>	Round-leaved goldenpea	FAB
<i>Thlaspi arvense</i>	Field pennycress	BRA
<i>Townsendia hookeri</i>	Hooker's Easter-daisy	AST
<i>Townsendia incana</i>	Silvery Easter-daisy	AST
<i>Townsendia spathulata</i>	Sword-leaf Easter-daisy	AST
<i>Tragopogon dubius</i>	Yellow salsify	AST
<i>Trifolium gymnocarpon</i>	Hollyleaf clover	FAB
<i>Urtica dioica</i>	Stinging nettle	URT
<i>Verbena bracteata</i>	Prostrate vervain	VRB
<i>Veronica americana</i>	American brooklime	SCR
<i>Veronica anagallis-aquatica</i>	Water speedwell	SCR
<i>Vicia americana</i>	Plains vetch	FAB
<i>Viola</i> sp.	Violet	VIO
<i>Xanthium strumarium</i>	Common cocklebur	AST
<i>Wyethia scabra</i>	Rough mule's ears	AST
<i>Zigadenus venenosus</i> var. <i>gramineus</i>	Meadow death-camas	LIL

Graminoids

<i>Agropyron triticeum</i>	Annual wheatgrass		POA
<i>Agrostis stolonifera</i>	Redtop		POA
<i>Andropogon scoparius</i>	Little bluestem		POA
[<i>Schizachyrium scoparium</i>]			
<i>Aristida purpurea</i> var. <i>fendleriana</i>	Purple three-awn		POA
<i>Bouteloua gracilis</i>	Blue grama		POA
<i>Bromus inermis</i> var. <i>inermis</i>	Smooth brome		POA
<i>Bromus japonicus</i>	Japanese brome		POA
<i>Bromus tectorum</i>	Cheatgrass		POA
<i>Carex aquatilis</i>	Water sedge		CYP
<i>Carex douglasii</i>	Douglas sedge		CYP
<i>Carex filifolia</i>	Threadleaf sedge		CYP
<i>Carex hoodii</i>	Hood's sedge		CYP
<i>Carex rossii</i>	Ross' sedge		CYP
<i>Carex stenophylla</i>	Narrowleaf sedge		CYP
<i>Carex vallicola</i>	Valley sedge		CYP
<i>Catabrosa aquatica</i>	Brookgrass		POA
<i>Distichlis stricta</i>	Alkali saltgrass		POA
<i>Eleocharis palustris</i>	Common spikerush		CYP
<i>Elymus cinereus</i>	Great Basin wildrye		POA
<i>Elymus elymoides</i>	Squirreltail		POA
[<i>Sitanion hystrix</i>]			
<i>Elymus lanceolatus</i> var. <i>lanceolatus</i>	Thickspike wildrye		POA
[<i>Agropyron dasystachyum</i>]			
<i>Elymus repens</i>	Quackgrass		POA
[<i>Agropyron repens</i>]			
<i>Elymus smithii</i>	Western wheatgrass		POA
[<i>Agropyron smithii</i>]			
<i>Elymus spicatus</i>	Bluebunch wheatgrass		POA
[<i>Agropyron spicatum</i>]			
<i>Elymus trachycaulus</i> var. <i>trachycaulus</i>	Bearded wheatgrass		POA
[<i>Agropyron trachycaulum</i>]			
<i>Festuca idahoensis</i>	Idaho fescue		POA
<i>Festuca octoflora</i>	Sixweeks fescue		POA
[<i>Vulpia octoflora</i>]			
<i>Hordeum brachyantherum</i>	Meadow barley		POA
<i>Hordeum jubatum</i>	Foxtail barley		POA
<i>Juncus balticus</i> var. <i>montanus</i>	Baltic rush		JUN
<i>Juncus bufonius</i>	Toadrush		JUN
<i>Juncus interior</i>	Inland rush		JUN
<i>Juncus nodosus</i>	Tuberous rush		JUN
<i>Koeleria macrantha</i>	Junegrass		POA
<i>Leucopoa kingii</i>	Spike fescue		POA
<i>Monroa squarrosa</i>	False buffalograss		POA
<i>Oryzopsis contracta</i>	Contracted Indian ricegrass		POA
<i>Oryzopsis hymenoides</i>	Indian ricegrass		POA
<i>Poa cusickii</i> var. <i>cusickii</i>	Cusick's bluegrass		POA
<i>Poa pratensis</i>	Kentucky bluegrass		POA

<i>Poa secunda</i>	Sandberg bluegrass	POA
<i>Polypogon monspeliensis</i>	Rabbitfoot polypogon	POA
<i>Sporobolus airoides</i>	Alkali saccaton	POA
<i>Stipa comata</i>	Needle-and-thread	POA
<i>Stipa nelsonii</i>	Nelson's needlegrass	POA
<i>Stipa viridula</i>	Green needlegrass	POA

Ferns and Fern Allies

<i>Cystopteris fragilis</i>	Brittle bladder fern	ASL
<i>Equisetum laevigatum</i>	Smooth scouring rush	EQU
<i>Selaginella densa</i>	Compact spike-moss	SEL

Rare Plant Species

Surveys in 1996 targeted ten plant species considered to be of medium to high conservation concern by WYNDD (Fertig 1996). Five of these (*Arabis demissa* var. *languida*, *Artemisia porteri*, *Cryptantha subcapitata*, *Lathyrus eucosmus*, and *Stanleya tomentosa* var. *tomentosa*) were previously known to occur in the study area or were relocated during this project. Five other taxa (*Aster mollis*, *Cymopterus williamsii*, *Physaria eburniflora*, *Physaria saximontana* var. *saximontana*, and *Shoshonea pulvinata*) were thought to potentially occur within the ecosystem, but were not located during surveys in 1996. Although each of these species is known to occur in adjacent areas of the Bighorn or Owl Creek mountains and Bighorn or Wind River basins, suitable habitat appears to be lacking within the ecosystem's boundaries.

Four other regionally endemic plant species formerly tracked by WYNDD were located in the Copper Mountain ecosystem in 1996. The status of each of these is briefly summarized below:

* Bun milkvetch (*Astragalus simplicifolius*) was found to be locally abundant on barren ashy knolls in *Artemisia porteri*-*A. pedatifida* communities at the base of Cedar Ridge, sandstone-gravel *Sphaeromeria capitata*-cushion plant communities on the summit of Cedar Ridge, and wind-blasted, dolomite-limestone ridgetop cushion plant communities on Lysite Mountain. *A. simplicifolius* is endemic to the basins of central and northeastern Wyoming, where it is currently known from nearly 40 occurrences. Recent surveys have found this species to be more widespread and less threatened than previously suspected, prompting WYNDD to drop this species from its list of species of special concern in 1996.

* Tufted cryptantha (*Cryptantha caespitosa*) was observed in calcareous ridgetop cushion plant communities at the east end of Copper Mountain and on the summit of Lysite Mountain. This species is a regional endemic of central and southern Wyoming and adjacent Utah and Idaho. Within Wyoming it is known from 45-50 occurrences, most of which occur in sites with minimal threats. Tufted cryptantha is closely related to *C. subcapitata*, but can be distinguished by its more matted growth form, shorter styles (in fruit) and preference for limestone and dolomite habitats. *C. caespitosa* was dropped as a species of concern by WYNDD in 1994.

* Contracted Indian ricegrass (*Oryzopsis contracta*) was discovered on the summit of Cedar Ridge in 1996. This species is a regional endemic of the basins and mountain valleys of central Wyoming, southwest Montana, north-central Colorado, and northeast Utah. Until 1996 it was a Category 2 (C2) candidate for listing under the Endangered Species Act, but was dropped from consideration after rangewide surveys found the species to be much more widespread and abundant than previously suspected (Fertig 1994). *O. contracta* is no longer considered a high priority species by WYNDD and was not actively surveyed in 1996.

* Sword-leaf Easter-daisy (*Townsendia spathulata*) was found at several small locations in dolomite ridgecrest cushion plant communities at the eastern end of Copper Mountain and Lysite Mountain in 1996. This species is restricted to southern Montana and central Wyoming, where it is presently known from 30-40 occurrences. Although most populations are thought to be relatively small, the low threats to the species have prompted WYNDD to drop it as a high priority species of concern.

Species Summaries

Information on the biology and conservation status of the five plant species of special concern known from the Copper Mountain ecosystem is presented in the following species summaries. Element Occurrence Records (formatted database reports) and location maps for these species are included in Appendix C.

Arabis demissa Greene var. *languida* Rollins
Daggett rock cress
Brassicaceae or Cruciferae (Mustard Family)

Heritage Rank: G5T3/S2.

Legal Status: USFWS: former 3C.

Description: Daggett rockcress is a tufted, perennial herb with several hirsute or glabrous stems up to 3 dm tall from a simple or branched caudex (Figure 2). The outermost stems are often prostrate at their base, but erect above the middle. Basal leaves are oblanceolate, 5-35 mm long, entire, and have both simple and forked hairs on the leaf surface and ciliate hairs on the margins. The basal rosette of leaves is not notably elevated above the stem bases. Stem leaves are widely separated, sessile, and have ear-like lobes at the base. Flowers have 4 white to pink petals 4.5-6.5 mm long and are borne in a raceme. Fruitstalks are glabrous, 4-7 mm long, and arch downwards. Fruits are 2-4 cm long, 1.5-2 mm wide, and have seeds arranged in a single row (Rollins 1941, 1993; Dorn 1992).

Similar Species: *Arabis pendulina* var. *russeola* has more slender leaf blades with simple (unbranched) hairs. *A. fendleri* var. *spatifolia* has erect outer stems, basal leaves in a rosette elevated above the stem bases, and seeds arranged in 2 rows. *A. pusilla* has spreading stems with downward pointing fruits borne at a 90 degree angle to the ground (Dorn 1992; Rollins 1993; Fertig et al. 1994).

Geographic Distribution: Regional endemic of central and southern Wyoming, Colorado, Utah, and Nevada. In Wyoming, this species is known from the Green River, Laramie, and Wind River basins and the foothills of the Laramie and Wind River ranges in Albany, Fremont, Lincoln, Sublette, and Sweetwater counties.

Occurrences Within the Study Area: Daggett rockcress is known from a single herbarium collection from Cedar Ridge, along the southern boundary of the Copper Mountain ecosystem.

Habitat: *A. demissa* var. *languida* typically occurs on rocky, windswept, calcareous hillsides, benches, and ridges associated with juniper or sagebrush-grassland vegetation (Rollins 1982; Fertig 1992 a).

Flowering/Fruiting Period: Flowers from late April-June; fruits produced from June-July.

Population Size and Condition: No population estimates were made when the Cedar Ridge occurrence was discovered in 1989. This population was not relocated during surveys in 1996, although large areas of suitable habitat were observed. At other locations in the state, populations of this species have been observed to be sparse and consist of widely scattered individuals (Fertig 1992 a).

Existing and Potential Threats: May be threatened by surface disturbances associated with road construction, mineral location, or grazing. At Cedar Ridge, these threats appear to be relatively low due to the rugged nature of the site.

Notes: There is some controversy over the taxonomy of the *Arabis demissa*-*A. oxylobula*-*A. pendulina* complex in western North America. Rollins (1982) recognizes three taxa in this group from Wyoming (*A. demissa* var. *languida*, *A. pendulina* var. *russeola*, and *A. pusilla*), and acknowledges the similarity of a fourth, more distantly related species, *A. fendleri* var. *spatifolia*. Welsh et al. (1993) lump *A. pendulina* with *A. demissa*, noting that the characters used to separate the two taxa “fail singly and together, and there is no apparent geographic correlation”. In Wyoming, the morphological characters used to distinguish *A. demissa* from *A. fendleri* appear to be weak, and there is a possibility that only one of these species actually occurs in the state. These taxonomic problems have implications for the management of these species, since all are fairly rare when considered as separate taxa, but would be more common (and thus in less need of management attention) if viewed as a single species.

Figure 2. Line drawing of *Arabis demissa* var. *languida* by K. Thorne (Welsh and Thorne 1979).

Artemisia porteri Cronq.
Porter's sagebrush
Asteraceae or Compositae (Sunflower Family)

Heritage Rank: G2/S2.

Legal Status: None.

Description: Porter's sagebrush is a mat-forming perennial subshrub with numerous slender annual stems less than 15 cm tall (Figure 3). The leaves are silvery-pubescent and 2-5 cm long. Stem leaves are mostly entire, while the basal leaves may be entire or three-lobed. Flower heads are arranged in a long, narrow, leafy, spike-like inflorescence. Each head consists of 30-40 disk flowers (ray flowers are lacking) within a pubescent involucre 4.5-7 mm long. Flowers at the center of the head are staminate, while those on the margins produce fruit (Cronquist 1951; Clark and Dorn 1979; Fertig et al. 1994).

Similar Species: *Artemisia pedatifida* has shorter (6-20 mm long), mostly three-parted leaves and shorter involucre. *A. longifolia* usually has longer leaves (often over 6 cm) and a more elongate inflorescence (Fertig et al. 1994).

Geographic Distribution: Endemic to the Wind River Basin in northeastern and central Fremont County and western Natrona County, Wyoming.

Occurrences Within the Study Area: An extensive occurrence of Porter's sagebrush is found in the valley between Copper Mountain and Cedar Ridge, bordering Dry Creek and the Badwater Road. This population consists of at least 17 subpopulations within an area of 12 square miles. A second, smaller occurrence is also found at the eastern edge of the ecosystem along the Big Horn Trail. Additional populations are found to the east and south of the study area in the vicinity of Lysite, Lost Cabin, and Cedar Gap.

Habitat: Porter's sagebrush occurs in sparsely vegetated badlands of ashy or tuffaceous mudstones and clay slopes at elevations of 5300-6500 feet (Fertig et al. 1994). Within the study area, populations are found primarily in semi-barren, low desert shrub communities dominated by *Artemisia pedatifida*, *A. porteri*, or *A. longifolia* on dry, whitish ashy-clay hills, gravelly-clay flats, and shaley erosional gullies of the Wagon Bed Formation. Soils are usually poorly developed and appear to have a high gypsum content. Common associated species include *Penstemon arenicola*, *Lesquerella arenosa* var. *arenosa*, *Phlox muscoides*, *Haplopappus multicaulis*, *Erigeron pulcherrimus*, *Musineon divaricatum*, *Platyschuhria integrifolia*, *Oryzopsis hymenoides*, *Bouteloua gracilis*, and *Elymus lanceolatus* var. *lanceolatus*.

Flowering/Fruiting Period: Flowers from June-July, mature fruits present into August.

Population Size and Condition: The population on the north side of Cedar Ridge has been known since 1969, but was not intensively surveyed until 1979 when the area was being considered for large scale uranium development (Environmental Research and Technology, Inc. 1979). Surveys at that time resulted in the discovery of 16 subpopulations, each ranging in area from 0.5 acres to 0.5 square miles. A census was not taken, but densities were observed

to range from 3-23 stems per 10 square meters. In 1996, this population was relocated and some additional habitat was documented. The population was estimated at 5000-8000 plants in one of the larger colonies near the northeast end of Cedar Ridge. Based on this estimate, the entire occurrence probably numbers between 50,000-75,000 individuals in an area of about 500 acres. Plants were observed to be widely scattered or occasionally locally dominant.

Existing and Potential Threats: Loss of habitat from road construction or other surface disturbances associated with mineral exploration is a potential threat at this site. Areas of critical habitat can be easily avoided if development of minerals in the area proceeds. Observations of other populations in the state suggest that this plant is capable of recolonizing disturbed roadside areas if a seed bank is present and if additional disturbances are minimal (Environmental Research and Technology, Inc. 1979). This species does not appear to be grazed by livestock.

Notes: Porter's sagebrush is known from only six locations in the entire world, none of which currently receive special management attention. The habitat containing a large population west of Lysite was recommended as an Area of Critical Environmental Concern by Marriott (1986), but has not been officially designated. Due to its highly specialized habitat and limited range, Porter's sagebrush could be vulnerable to large-scale habitat disturbances and should be managed as a sensitive species by the BLM.

Figure 3. Line drawing of *Artemisia porteri* by Isobel Nichols (Fertig et al. 1994).

Cryptantha subcapitata Dorn and Lichvar
Owl Creek Miner's candle
Boraginaceae (Borage Family)

Heritage Rank: G1/S1.

Legal Status: USFWS: former C2.

Description: Owl Creek miner's candle is a mat-forming perennial herb with flowering stems less than 15 cm tall (Figure 4). The leaves are linear to oblanceolate, 1-3 mm wide, and densely pubescent with both appressed, short hairs and longer, spreading, bulbous-based hairs. The inflorescence is head-like, with white flowers 5-6 mm broad that barely exceed the calyx tube in length. The nutlets are wrinkled and bumpy on the back and are enclosed by the pubescent calyx lobes. The slender style persists in fruit and exceeds the nutlets by 1.5-2 mm (Dorn and Lichvar 1981; Dorn 1989, 1992; Fertig 1993; Fertig et al. 1994).

Similar Species: *Cryptantha caespitosa* has an elongate inflorescence and styles exceeding the nutlets by less than 0.5 mm. *C. spiculifera* has a longer inflorescence and closed nutlet scars (nutlet scars are the remnants of the common point of attachment of the 4 nutlets and are open in *C. subcapitata*). *C. cana* has longer and wider leaves with silvery appressed hairs (no coarse, bulbous-based spreading hairs) and shorter styles. *C. celosioides* has an elongate inflorescence, wider leaves, and single, unmatted stems. Other Wyoming species of *Cryptantha* are either annual, have smooth nutlets, or erect (non-matted) stems (Dorn 1992; Fertig et al. 1994).

Geographic Distribution: Endemic to the Owl Creek and Bridger Mountains in the vicinity of Boysen Reservoir and Copper Mountain in the northern Wind River Basin in Fremont County, Wyoming.

Occurrences Within the Study Area: This species is found in 2 main areas within the Copper Mountain ecosystem. The largest occurrence is on the north slopes and summit ridge of Cedar Ridge (and 2 smaller ridges immediately to the west along the West Fork of Dry Creek). A second population is found at the base of the ridge system on the west side of the Birdseye Pass Road in the Copper Mountain Wilderness Study Area. This second population is at the eastern end of a large, but discontinuous occurrence extending to the north and east sides of Boysen Reservoir.

Habitat: Occurs on sandy-gravelly slopes and desert ridges in sparsely vegetated cushion plant communities. This species appears to be restricted to sandstones and conglomerates derived from the Eocene Wind River Formation, although it has also been reported from limestones (Dorn 1989; Fertig et al. 1994). The Cedar Ridge population is found primarily on whitish sandy-silt ridgecrests and slopes in cushion plant-bunchgrass communities dominated by *Sphaeromeria capitata* or *Artemisia nova*. The Birdseye ridge population occurs on low, south-facing benches of whitish-tan, clay-sandy sandstone and conglomerate at the toe of a dry limestone ridge. *C. subcapitata* is typically replaced by *C. celosioides* on shale outcrops and by *C. cana* on limestone. Common associated species at both sites include *Astragalus*

simplicifolius, *A. sericoleucus*, *Phlox muscoides*, *P. hoodii*, *Hymenoxys acaulis*, *Arenaria hookeri*, *Eriogonum brevicaule*, *Haplopappus nuttallii*, *Elymus spicatus*, and *Poa secunda*.

Flowering/Fruiting Period: Flowers from late May-June. Mature fruits are present from mid-June to late-July.

Population Size and Condition: Dorn (1989) estimated the Cedar Ridge population to contain 15,000 plants. Based on the large size of the rosettes, Dorn suspected that most of the individuals in the population were relatively mature. This colony was resurveyed in 1996 and found to contain 10,000-15,000 individuals. No seedling plants were observed. Establishment of seedlings is probably low in most years due to the extremely dry environment. The Birdseye ridge population was estimated to contain 3000-5000 plants in about 20 acres of suitable habitat in 1996. This population is part of a larger occurrence that was previously estimated to contain 23,000 individuals (Dorn 1989).

Existing and Potential Threats: Both populations in the study area occur in areas that have numerous mineral claims, mostly for uranium, oil, and natural gas. Two-track roads are common in the Cedar Ridge area, with some passing through *C. subcapitata* habitat. Active development of mineral claims and associated surface disturbances are a potential threat to these populations, especially in areas where the terrain is less rugged.

Notes: About 40% of the entire global range of *Cryptantha subcapitata* is found within the Copper Mountain ecosystem. Dorn (1989) conducted a range-wide status survey for this species and recommended that it not be listed as Threatened or Endangered due to lack of threats and large population size. Nevertheless, the small geographic range and specialized habitat requirements of this species make it vulnerable to large scale surface disturbances. *C. subcapitata* should be managed as a Sensitive species by the BLM.

Figure 4. Line drawing of *Cryptantha subcapitata* by Jane Dorn (Fertig et al. 1984).

Lathyrus eucosmus Butters & St. John
Seemly Sweetpea
Fabaceae or Leguminosae (Pea Family)

Heritage Rank: G4G5/S1.

Legal Status: None.

Description: Seemly sweetpea is a perennial herb with leafy, glabrous, stems 1.5-4 dm tall (Figure 5). The leaves are 3-10 cm long and divided into 6-10 narrowly elliptic to lance-elliptic leaflets with thick, strongly-veined blades. Tendrils at the tips of the leaves are simple or branched and coiled at the tips. Stipules are 8-20 mm long and arrowhead-shaped. The inflorescence is a 2-5 flowered raceme on a stalk 3-12 cm long. The calyx is 8.5-12 mm long with a strongly 10-veined tube 5-7 mm long with unequal teeth. The petals are pink-purple, with the keel about equal in length to the wings and the banner 15-29 mm long. The fruit is a pale brown, veiny, flattened pod 3-4.5 cm long on a stalk 4-6 mm long (Barneby 1989; Welsh et al. 1993).

Similar Species: *Lathyrus lanszwertii* var. *lanszwertii* has smaller flowers, with banner petals under 15 mm long, and occurs in montane forest habitats. *L. lanszwertii* var. *leucanthus* has white flowers with a blush of pink or orange and also occurs in montane habitats. *Vicia americana* often has narrower leaflets and smaller flowers.

Geographic Distribution: Occurs from central Colorado to southeast Utah, New Mexico, Arizona, and Sonora, Mexico, with disjunct populations in central Wyoming. In Wyoming, this species is known only from the foothills of the Bridger and Wind River mountains in Fremont County (WYNDD records).

Occurrences Within the Study Area: A single occurrence is known from Cottonwood Creek (about 4.5 miles north of Lost Cabin), near the eastern boundary of the ecosystem.

Habitat: In Wyoming, this species is known from roadside areas and dry creek bottoms. Rangeland, it is reported from clay or gravelly washes, gullied banks of gulches, breaks, and roadcuts (Barneby 1989).

Flowering/Fruiting Period: Flowers in late May, fruits present June-July.

Population Size and Condition: The Cottonwood Creek population was discovered in 1985, but no population data were collected. This population was not resurveyed in 1996.

Existing and Potential Threats: Little information is available on the management needs of this species. Surface disturbances associated with road construction, mineral exploration, or grazing may be potential threats at this site.

Notes: Wyoming material of this species was originally determined as *Lathyrus lanszwertii* var. *lanszwertii* (Dorn 1992). In 1996, specimens of *L. lanszwertii* from Fremont County were annotated as *L. eucosmus* by Steve Broich for the treatment of the genus for the *Flora of North*

America project. *L. lanszwertii* var. *lanszwertii* is still known from the state, but is restricted to the Uinta Range in Uinta County.

Figure 5. Line drawing of *Lathyrus eucosmus* (Barneby 1989).

Stanleya tomentosa Parry var. *tomentosa*
Hairy prince's-plume
Brassicaceae or Cruciferae (Mustard Family)

Heritage Rank: G4T3/S2.

Legal Status: None.

Description: Hairy prince's-plume is a perennial herb with an unbranched caudex covered by persistent leaf bases (Figure 6). Stems are erect, single or branched above, 5-15 dm tall, leafy, and densely pubescent with short, tangled, woolly hairs. Basal leaves are 1-3 dm long, 2-6 cm wide, long-petioled, and have broadly lance-shaped, runcinate-pinnatifid blades (dissected like a dandelion leaf) covered with felt-like pubescence. Stem leaves are similar to the basal leaves, but become gradually smaller and more entire or arrowhead-shaped farther up the stem. The elongate, densely-congested inflorescence is 2-6 dm long and has hirsute branches. Flowers consist of 4 pale yellowish-green, pubescent, sepals and 4 glabrous, lemon yellow petals that are wider at the base than the tip. Fruits are slender, erect, glabrous, distinctly compressed siliques 4-7 cm long and about 2 mm wide. The base of the fruit narrows to a slender stalk-like structure (gynophore) borne above the true fruit stalk (pedicel). Seeds are brown, oblong, and lack wings (Rollins 1939, 1993; Hitchcock and Cronquist 1964; Dorn 1992).

Similar Species: *Stanleya viridiflora* has sessile stem leaves and glabrous stems. *S. pinnata* has glabrous or sparsely short-hairy leaves and stems and pubescent petals.

Geographic Distribution: Variety *tomentosa* is a regional endemic of north-central Wyoming and adjacent Montana (Lesica and Achuff 1992; Rollins 1993). In Wyoming, it is restricted to the Big Horn Basin and the foothills of the Big Horn, Bridger, Absaroka, and Owl Creek mountains in Big Horn, Fremont, Hot Springs, and Park counties (WYNDD records).

Occurrences Within the Study Area: *Stanleya tomentosa* was first documented in the study area by Aven Nelson near Birdseye Pass in 1910. This colony was relocated by Ron Hartman in 1991 and by W. Fertig in 1996. Two additional populations were discovered by Fertig at the east end of Copper Mountain and on the north side of Lysite Mountain during surveys for this project.

Habitat: Hairy prince's-plume occurs in dry sandy canyons, rocky hillsides and slopes, and canyon walls associated with juniper woodlands and cushion plant-grasslands (Lesica and Achuff 1992; Rollins 1993). In the Copper Mountain area it is found primarily at the base of dolomite cliffs and on dry limestone talus slopes. Common associated species include *Cryptantha celosioides*, *Artemisia frigida*, *Bromus tectorum*, *Haplopappus acaulis*, *Arenaria hookeri*, *Sphaeromeria capitata*, *Phlox muscoides*, *Eriogonum pauciflorum*, *Elymus spicatus*, *Poa secunda*, and *Koeleria macrantha*.

Flowering/Fruiting Period: June-July.

Population Size and Condition: Populations in WY are typically small in area and number, despite the presence of extensive areas of suitable habitat. Colonies found in 1996 were found

to contain 8-100 plants. The total population in the study area may be as low as 500-1000 individuals. Lesica and Achuff (1992) reported similar population densities in Montana.

Existing and Potential Threats: Heavy herbivory, presumably by deer, was observed at 2 of the 3 occurrences in the study area in 1996. Populations may also be threatened by quarrying for limestone or gravel and by surface disturbances associated with road construction. Many colonies may be secure, however, due to rugged terrain.

Notes: This taxon was formerly of concern in Montana, but was recently downlisted following the discovery of numerous small colonies in the northern Bighorn Basin (Lesica and Achuff 1992). The species may be equally abundant in Wyoming, but large areas of suitable habitat have yet to be completely surveyed. Information is needed rangewide on population size and management needs.

Figure 6. Line drawing of *Stanleya tomentosa* var. *tomentosa* (Hitchcock and Cronquist 1964).

Plant Associations

Seventeen plant associations were identified in the Copper Mountain study area (Tables 2, 3), most of which are common in the low mountains and basins of Wyoming (as indicated by the global heritage ranks of G3 to G5). The distribution and abundance of these vegetation types reflects an east-west precipitation gradient across the area (USDA Soil Conservation Service 1983), differences in geologic substrate throughout the area, and the influence of local topography.

The vegetation on the soft, sedimentary substrates in the low-elevation, southern part of the study area consists of a matrix of blue grama grassland. In the eastern part of the study area, scattered Wyoming big sagebrush plants usually are present in this grassland, but sagebrush is more restricted on the drier, western end of the area. Within the blue grama grassland matrix, stands of the Wyoming big sagebrush/blue grama association occur in draws (and are more common in the eastern part of the area than the western), and patches of blue grama-bluebunch wheatgrass grassland, Wyoming big sagebrush/bluebunch wheatgrass vegetation, and birdsfoot sagebrush/bluebunch wheatgrass vegetation occur on rocky slopes. Patches of very sparsely vegetated clay badlands, some with populations of Porter's sagebrush (*Artemisia proteri*) also occur throughout the southern part of the area. In terms of the standard habitat type classification (Greenquist 1982), this vegetation is primarily lowland short steppe with small areas of badland and big sagebrush-mixed grass steppe. Areas of black greasewood shrub vegetation (the greasewood steppe and greasewood-sagebrush steppe standard habitat types) occur in this part of the study area, but they are minor components of the vegetation and were not sampled in this study.

Farther north, on the resistant bedrock of the mountains, bluebunch wheatgrass-Sandberg bluegrass grasslands and Utah juniper/bluebunch wheatgrass woodlands are the major components of the vegetation, especially at the drier, western end of the area. Stands of black sagebrush/bluebunch wheatgrass sparse shrublands, Wyoming big sagebrush/bluebunch wheatgrass shrublands, and mountain big sagebrush/Idaho fescue shrublands become more common with increasing distance from the western end of the area, and they constitute a substantial part of the vegetation (in swales and draws where snow drifts) on Lysite Mountain at the study area's eastern end. Limber pine/Idaho fescue woodlands occur on the higher elevations of the mountains in the study area, generally on north- and east-facing slopes. The standard habitat types on the mountains are the lowland short steppe (comprising the bluebunch wheatgrass grasslands and the sparser of the black sagebrush shrub stands), the tall sagebrush steppe (including the Wyoming big sagebrush and mountain big sagebrush stands), the black sagebrush steppe (including the denser stands of the black sagebrush/bluebunch wheatgrass association), the Utah juniper woodland (equivalent to the Utah juniper/bluebunch wheatgrass woodlands), and the limber pine-Utah juniper woodland (including the limber pine/Idaho fescue woodlands).

Occurrences of two apparently widespread but poorly known plant associations rich in cushion plants were sampled in the study area. The first, the bluebunch wheatgrass-cushion plant association, was found on rims of the Flathead sandstone below Greer and Fuller Peaks, surrounded by bluebunch wheatgrass-Sandberg bluegrass herbaceous vegetation (location 6d), and on steep, north-facing limestone slopes in the western part of the area (location 3a). All of the stands include a substantial amount of bluebunch wheatgrass and contain several species of low-growing forbs: thrifty goldenweed, stemless hymenoxys, and cushion buckwheat (Appendix D, Table D1). In the two stands on the Flathead sandstone near Greer and Fuller

Peaks, compact spike-moss contributes most of the plant cover, and black sagebrush and Sandberg bluegrass are relatively important species. The vegetation in the stands on limestone in the western part of the area contains no spike-moss, and thrifty goldenweed and clusterheaded false-sagebrush are relatively important species. All four stands seem sufficiently similar in vegetation and habitat to the bluebunch wheatgrass-cushion plant association named from the Pryor Mountains (DeVelice and Lesica 1993) to be placed into that association. Further information from other areas may show that the two stands growing on the Flathead sandstone represent a different vegetation type.

The other cushion plant type is the moss phlox-stalkless nailwort cushion plant association, which occurs as an inclusion in the bluebunch wheatgrass-Sandberg bluegrass vegetation and black sagebrush/bluebunch wheatgrass vegetation on limestone rims on Lysite Mountain in the eastern part of the study area. This latter type was not observed in the western part of the study area, perhaps because that part of the area is too dry. In all three plots from this type (Appendix D, Table D2), forbs contributed at least as much canopy cover as did graminoids, and two of the major species were moss phlox and stalkless nailwort. Several other low-growing forbs were present. These stands resemble, in vegetation and habitat, occurrences of the moss phlox-stalkless nailwort association at Beaver Rim, ca. 50 miles south of the Copper Mountain study area (Jones 1989), although the Lysite Mountain stands contain substantially more grasses than do the Beaver Rim stands.

Three riparian vegetation types -- the yellow willow/Wood's rose shrubland, the basin big sagebrush/basin wildrye shrubland, and the narrowleaf cottonwood/skunkbush sumac forest -- were observed in the study area. As is the case with many riparian types, these three associations have relatively high conservation ranks (Table 2), suggesting that the occurrences of these types possess considerable conservation interest. But riparian plant associations typically receive their relatively high conservation ranks less because they are rare than because few outstanding examples of those associations exist; most have been substantially altered by livestock grazing, changes in hydrologic regimes, removal of beaver, and introduction of exotic plants. This appears to be the case with the stand of the basin big sagebrush/basin wildrye shrubland surveyed in this study: the basin wildrye is sparse and grows primarily under the sagebrush plants, and the understory in much of the stand is dominated by cheatgrass. The understory in the narrowleaf cottonwood stand surveyed in this project also is dominated by exotic grasses (cheatgrass and Kentucky bluegrass), and the shrub layer is sparse. The yellow willow shrub stand contains fewer exotic species, but it is so small that it cannot be considered a good representative of the type. Consequently, the information collected in this study suggests that public lands in the the Copper Mountain study area do not contain high-quality occurrences of riparian plant associations. The stands of narrowleaf cottonwood forest and willow shrubland in this arid area are small, and exotic plant species are now major components of the riparian vegetation. This is not to say that the riparian vegetation is unimportant; indeed, in this arid landscape, the small stands of riparian vegetation may be particularly important as habitat for the animals living in the area.

Table 2. Heritage Program/TNC Plant Associations in the Copper Mountain Ecosystem.

Ranks are assigned by the network of natural heritage programs to express the conservation status of a plant association, and are explained in Appendix B. Sample locations are described in Appendix A.

I. SPARSELY VEGETATED SOIL SLOPES (isolated plants; cover generally 1% - 10%).

1. Claystone badlands. Rank: unranked.
Standard habitat site: Badlands (Location 4a).
See photo 96GJ2.12.

II. HERBACEOUS VEGETATION

A. SHORT TEMPERATE GRASSLAND (shrub canopy cover <10%)

1. Blue grama (*Bouteloua gracilis*) herbaceous vegetation. Rank: G?S?.
Standard habitat site: Lowland short steppe (Locations 1b, 2a, 5).
2. Blue grama-bluebunch wheatgrass (*Bouteloua gracilis/Elymus spicatus*) herbaceous vegetation. Rank: G?S?.
Standard habitat site: Lowland short steppe (Location 4c).
3. Bluebunch wheatgrass-Sandberg bluegrass (*Elymus spicatus/Poa secunda*) herbaceous vegetation. Rank: G4S3S4.
Standard habitat sites: Badland (Location 4b), Lowland short steppe (Locations 4c, 6c, 7c).
4. Bluebunch wheatgrass-Cushion plant (*Elymus spicatus*-Cushion plant) herbaceous vegetation. Rank: G3S3?.
Standard habitat site: Lowland short steppe (Locations 3a, 6d).
See photos 96GJ2.16 and 2.18.

B. SHORT TEMPERATE GRASSLAND WITH A SPARSE, MICROPHYLLLOUS EVERGREEN SHRUB LAYER (shrub canopy cover 10%-25%).

1. Blue grama (*Bouteloua gracilis*) herbaceous vegetation. Rank: G?S?.
Standard habitat site: Big sagebrush-mixed grass steppe (Location 1a).
2. Birdsfoot sagebrush/bluebunch wheatgrass (*Artemisia pedatifida/Elymus spicatus*) sparse dwarf-shrubland. Rank: G3S3?.
Standard habitat site: Badland? (Location 2b).

Table 2 (continued). Heritage Program/TNC Plant Associations in the Copper Mountain Ecosystem.

3. Black sagebrush/bluebunch wheatgrass (*Artemisia nova/Elymus spicatus*) sparse dwarf-shrubland. Rank: G5S4.
Standard habitat sites: Lowland short steppe (Location 6e), Black sagebrush steppe (Location 7a).
4. Wyoming big sagebrush/bluebunch wheatgrass (*Artemisia tridentata* spp. *wyomingensis/Elymus spicatus*) sparse shrubland. Rank: G5S5.
Standard habitat site: Big sagebrush-mixed grass steppe (Location 6f).

C. TEMPERATE PERENNIAL FORB VEGETATION

1. Moss phlox-stalkless nailwort (*Phlox muscoides-Paronychia sessiliflora*) cushion plant vegetation. Rank: unranked.
Standard habitat site: Lowland short steppe (Location 7d).
See photos 96GJ2.08 and 2.11.

III. SHRUBLAND

A. MICROPHYLOUS EVERGREEN SHRUBLAND (shrub canopy cover $\geq 25\%$)

1. Wyoming big sagebrush/Blue grama (*Artemisia tridentata* ssp. *wyomingensis/Bouteloua gracilis*) shrubland. Rank: G5S5.
Standard habitat site: Big sagebrush-mixed grass steppe (Locations 1e, 2d).
2. Basin big sagebrush/basin wildrye (*Artemisia tridentata* ssp. *tridentata/Elymus cinereus*) shrubland. Rank: G2G3S?
Standard habitat site: Tall sagebrush steppe (Locations 6b, 7b).
3. Mountain big sagebrush/Idaho fescue (*Artemisia tridentata* ssp. *vaseyana/Festuca idahoensis*) shrubland. Rank: G5S5.
Standard habitat site: Big sagebrush-mixed grass steppe (Locations 6g, 7e).

B. COLD-DECIDUOUS SHRUBLAND

1. Yellow willow/Wood's rose (*Salix lutea/Rosa woodsii*) shrubland?. (Identification uncertain). Rank: G3S?
Standard habitat site: Willow floodplain (Location 6a).

Table 2 (continued). Heritage Program/TNC Plant Associations in the Copper Mountain Ecosystem.

IV. WOODLANDS AND FORESTS

A. TEMPERATE, NEEDLE-LEAVED, ROUNDED-CROWN EVERGREEN WOODLANDS.

1. Utah juniper/bluebunch wheatgrass (*Juniperus osteosperma/Elymus spicatus*) woodland. Rank: G4S3S4.
Standard habitat site: Utah juniper woodland (Locations 1d, 2c, 3b).
2. Limber pine/Idaho fescue (*Pinus flexilis/Festuca idahoensis*) woodland. Rank: G5S3.
Standard habitat site: Limber pine-Utah juniper woodland (Location 6h).

B. TEMPORARILY-FLOODED, COLD-DECIDUOUS FOREST.

1. Narrowleaf cottonwood/Skunkbush sumac (*Populus angustifolia/Rhus trilobata*) forest. Rank: G2G3S?
Standard habitat site: Cottonwood floodplain (Location 3c).
-

Table 3. Comparison of BLM Wildlife Standard Habitat Sites (Greenquist 1982) with Heritage Program/TNC Plant Associations in the Copper Mountain Ecosystem

1. Standard habitat site: Willow floodplain.
TNC association: Yellow willow/Wood's rose shrubland ? (Identification uncertain) (Location 6a).
2. Standard habitat site: Cottonwood floodplain.
TNC association: Narrowleaf cottonwood/skunkbush sumac forest (Location 3c).
3. Standard habitat site: Badland.
TNC associations:
Claystone badlands (Location 4a)
Bluebunch wheatgrass-Sandberg bluegrass herbaceous vegetation (Location 4b)
Birdsfoot sagebrush/bluebunch wheatgrass sparse dwarf-shrubland (Location 2b).
4. Standard habitat site: Lowland short steppe.
TNC associations:
Blue grama herbaceous vegetation (Locations 1b, 2a, 5)
Blue grama-bluebunch wheatgrass herbaceous vegetation (Location 4c)
Bluebunch wheatgrass-Sandberg bluegrass herbaceous vegetation (Locations 4c, 6c, 7c)
Bluebunch wheatgrass-cushion plant herbaceous vegetation (Locations, 3a, 6d)
Black sagebrush/bluebunch wheatgrass sparse dwarf shrubland (Location 6e)
Moss phlox-stalkless nailwort cushion plant vegetation (Location 7d).
5. Standard habitat site: Black sagebrush steppe.
TNC association: Black sagebrush/bluebunch wheatgrass sparse dwarf-shrubland (Location 7a).
6. Standard habitat site: Big sagebrush-mixed grass steppe.
TNC associations:
Blue grama herbaceous vegetation (Location 1a)
Wyoming big sagebrush/bluebunch wheatgrass sparse shrubland (Location 6f)
Wyoming big sagebrush/blue grama shrubland (Locations 1e, 2d)
Mountain big sagebrush/Idaho fescue shrubland (Locations 6g, 7e).
7. Standard habitat site: Tall sagebrush steppe.
TNC association: Basin big sagebrush/basin wildrye shrubland (Locations 6b, 7b).
8. Standard habitat site: Utah juniper woodland.
TNC association: Utah juniper/bluebunch wheatgrass woodland (Locations 1d, 2c, 3b).
9. Standard habitat site: Limber pine-Utah juniper woodland.
TNC association: Limber pine/Idaho fescue woodland (Location 6h).

Summary and Management Recommendations

Rare Plant Species

Of the five plant species of special concern known from the Copper Mountain ecosystem, *Artemisia porteri* and *Cryptantha subcapitata* are the highest priority for management attention. Both of these species have highly restricted geographic ranges and very specific habitat requirements, making them vulnerable to large scale habitat loss or disturbance. The main threats to these species are disturbance from road construction and vehicles associated with mineral exploration. Occupied habitat of both species can be easily avoided however, if development activity is carefully planned around the known habitat and locations of the plants. No-surface Occupancy stipulations in particularly sensitive areas would ensure that disturbances would be kept to a minimum while still allowing access to mineral resources. Designation of the summit and northern foothills of Cedar Ridge as an area of critical environmental concern (ACEC) should also be considered as a means of protecting adequate habitat for both of these species, as well as *Arabis demissa* var. *languida* and a variety of cushion plant and desert shrub communities.

Designation of the Copper Mountain Wilderness Area would have provided habitat protection for colonies of *Cryptantha subcapitata* and *Stanleya tomentosa*. Alternative special management designations, such as an ACEC or No-Surface Occupancy area, would accomplish similar, but less restrictive, habitat conservation objectives at this site.

Plant Associations

For this project, plant association occurrences of high conservation value are defined as all occurrences of rare plant associations and unusually high-quality occurrences of common plant associations, especially those unrepresented in special management areas such as areas of critical environmental concern. The Copper Mountain area apparently does not contain rare plant associations. Cushion plant vegetation types, such as the moss phlox-stalkless nailwort association on Lysite Mountain, are poorly known relative to the other vegetation types, but this paucity of information probably is due to a lack of study, rather than to the rarity of cushion plant vegetation. The riparian vegetation types in the area have relatively high conservation ranks, but the stands of these types are not particularly good representatives of the vegetation.

The Copper Mountain area apparently contains good representatives of Utah juniper/bluebunch wheatgrass woodlands growing in a vegetation mosaic with bluebunch wheatgrass grasslands, Wyoming big sagebrush/bluebunch wheatgrass shrublands, and black sagebrush/bluebunch wheatgrass shrublands. These plant associations also occur in the Beaver Rim Area of Critical Environmental Concern ca. 50 miles south of Copper Mountain (Jones 1989), and Utah juniper/bluebunch wheatgrass woodland occurs with bluebunch wheatgrass grasslands in the Spanish Point Karst ACEC ca. 65 miles north of Copper Mountain (Marriott and Jones 1989). The other major vegetation type in the Copper Mountain area, blue grama grassland, apparently is not represented in special management areas, but it is unclear whether the Copper Mountain area is a good place to represent this vegetation type.

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Appendix A

1996 Plant Association Sampling Locations in the Copper Mountain Ecosystem.

BLM types are taken from Greenquist (1982) and TNC types are taken from The Nature Conservancy (1997). Information on geologic substrates is from Tourtelot (1953) and Hafen (1980a, 1980b, 1980c, 1980d).

Location 1. T40N, R93W, Sec 32, NE1/4.; stream valley east of Tough Creek, at south foot of Copper Mountain.

Elevation: 5860 feet.

1a. Aspect : South. Substrate: Quaternary gravels
TNC type: Wyoming big sagebrush/blue grama (*Artemisia tridentata* spp. *wyomingensis*/*Bouteloua gracilis*) herbaceous vegetation.

BLM type: Big sagebrush-mixed grass steppe

General description: Blue grama dominates a grassland that contains low, moderately-dense Wyoming big sagebrush and black sagebrush. Draws contain taller Wyoming big sagebrush and bluebunch wheatgrass in the understory.

Common species:

TREES:

SHRUBS: Wyoming big sagebrush, black sagebrush

GRAMINOIDS: Bluebunch wheatgrass

FORBS:

1b. Aspect: West. Substrate: Quaternary gravels and Eocene-aged claystone (Wagon Bed Formation)

TNC type: Blue grama (*Bouteloua gracilis*) herbaceous vegetation

BLM type: Big sagebrush-mixed grass steppe

General description: Sparse grassland of blue grama, Hooker's sandwort, Hood's phlox, and prickly pear cactus. Cheatgrass is common in shallow draws

Common species:

TREES:

SHRUBS:

GRAMINOIDS: Blue grama, cheatgrass

FORBS: Hooker's sandwort, Hood's phlox, prickly pear cactus

1c. Aspect: Southwest. Substrate: Quaternary alluvium

TNC type: Narrowleaf cottonwood/Skunkbush sumac (*Populus angustifolia*/*Rhus trilobata*) forest?

BLM type: Cottonwood floodplains

General description: Woodland of narrowleaf cottonwood groves and scattered trees, growing in the stream channel

Common species:

TREES: Narrowleaf cottonwood

SHRUBS: Scattered skunkbush sumac

GRAMINOIDS: Cheatgrass, Douglas sedge, sedge spp., Kentucky bluegrass, small amounts of western wheatgrass and basin wildrye.

FORBS:

1d. Aspect: East. Substrate: Sandstone (Wagon Bed Formation)
TNC type: Utah juniper/Bluebunch wheatgrass (*Juniperus osteosperma*/*Elymus spicatus*) woodland.
BLM type: Utah juniper woodland.
General description: Juniper woodland on east-facing slope, surrounded by blue grama grassland.
Common species:
TREES: Utah juniper
SHRUBS: Scattered Wyoming big sagebrush and black sagebrush.
GRAMINOIDS: Blue grama, bluebunch wheatgrass, purple three-awn.
FORBS: Dune scurfpea

1e. Aspect: Variable. Substrate: Sandstone and claystone (Wagon Bed Formation)
TNC type: Wyoming big sagebrush/Blue grama shrubland
BLM type: Big sagebrush-mixed grass steppe
General description: Low grassland with sagebrush (patchy cover) and a few greasewood, growing in the bottom of a draw. Area is south-facing slopes and valleys with intermittent streams flowing south from Copper Mountain.
Common species:
TREES:
SHRUBS: Wyoming big sagebrush, black greasewood
GRAMINOIDS: Blue grama, alkali sacaton
FORBS:

Location 2. T39N, R94W, Sec 2 NW1/4 and Sec 3 NE1/4; and T40N, R93W, Sec 34 SE1/4 and Sec 35 SW1/4; South side of foothills of Copper Mountain immediately west of Birdseye Pass Road.
Elevation: 5200-5300 feet.

2a. Aspect: South Substrate: Quaternary gravel
TNC type: Blue grama herbaceous vegetation
BLM type: Lowland short steppe
General description: Short, sparse herbaceous vegetation on nearly flat, gently sloping surfaces at the south side of Copper Mountain.
Common species: (See plot 96GJ03.01)
TREES:
SHRUBS: Scattered Wyoming big sagebrush
GRAMINOIDS: Blue grama dominates, purple three-awn secondary, needle-and-thread, and alkali sacaton present
FORBS: Numerous; cockscomb cryptantha most common

2b. Aspect: North Substrate: Siltstone with cobble and gravel lag pavement (Wind River Formation)
TNC type: Birdsfoot sagebrush/Bluebunch wheatgrass (Plot 96GJ03.02)
BLM: Badland?
General description: Low herbaceous vegetation with birdsfoot sagebrush and a few low Wyoming big sagebrush, black sagebrush, and Utah juniper, growing on north-facing slopes of siltstone (Wind River Formation).
Common species.

TREES:

SHRUBS: Birdsfoot sagebrush

GRAMINOIDS: Bluebunch wheatgrass, blue grama

FORBS: Hood's phlox, basin daisy, Hooker's sandwort

2c. Aspect: South Substrate: Conglomerate (Wind River Formation)

TNC type: Utah juniper/bluebunch wheatgrass (Plot 96GJ03.03)

BLM type: Utah juniper woodland

General description: Patches of open juniper woodland in draws on south facing slopes, in a matrix of low grassland on the interfluves. Juniper patches cover about 15% of the landscape.

Common species:

TREES: Utah juniper

SHRUBS: Black sagebrush

GRAMINOIDS: Bluebunch wheatgrass, blue grama

FORBS: Dune scurfpea; many other species present, but all minor

2d. Aspect: South Substrate: Conglomerate (Wind River Formation)

TNC type: Wyoming big sagebrush/blue grama (Plot 96GJ03.04)

BLM type: Big sagebrush-mixed grass steppe?

General description: Low, sparse vegetation on south-facing dip slopes; includes patches of Utah juniper woodland in draws.

Common species:

TREES:

SHRUBS: Wyoming big sagebrush

GRAMINOIDS: Blue grama, alkali sacaton

FORBS: Many species present, but all minor.

Location 3. T40N, R94W, Sec 15, S1/2; middle elevations in the western part of the area, south of Birdseye Mountain and west of the Birdseye Pass Road.

Elevation: 6150 to 6350 feet.

3a. Aspect: North Substrate: Limestone (Gallatin Formation)

TNC type: Bluebunch wheatgrass-Cushion plant herbaceous vegetation (Plots 96GJ03.05 and 06)

BLM type: Lowland short steppe

General description: Moderately dense, herbaceous vegetation growing on north-facing slopes, mixed with Utah juniper woodland on southerly slopes.

Common species:

TREES:

SHRUBS:

GRAMINOIDS: Bluebunch wheatgrass, Sandberg bluegrass

FORBS: Thrifty goldenweed, clusterhead false sagebrush, Hood's phlox, few-flowered buckwheat

3b. Aspect: South. Substrate: Limestone (Gallatin Formation)
TNC type: Utah juniper/bluebunch wheatgrass woodland (Plots 96GJ03.06 and 07).
BLM type: Utah juniper woodland.
General description: Patches of woodland, each from several acres to several hundred acres, growing on southerly slopes, interspersed with bluebunch wheatgrass-cushion plant herbaceous vegetation on northerly slopes.
Common species:
TREES: Utah juniper
SHRUBS: Black sagebrush (very sparse)
GRAMINOIDS: Bluebunch wheatgrass, prairie junegrass, Sandberg bluegrass, Ross's sedge,
FORBS: Thrifty goldenweed, many additional minor species.

Location 4. T39N, R92W, Sec 15, 16, 21, 22; north side of Cedar Ridge.
Elevation: 5500 - 6000 feet.

4a. Aspect: North.
Substrate: Claystone (Wagon Bed Formation)
TNC type: Claystone badlands
BLM type: Badland
General description: Very sparse vegetation growing on gentle slopes and colluvial fans and in draws.
Common species:
TREES:
SHRUBS: Porter's sagebrush
GRAMINOIDS: Indian ricegrass
FORBS: Nakedstem bahia, gumweed aster, many-stemmed goldenweed

4b. Aspect: North.
Substrate: Sandstone and conglomerate (Wind River Formation)
TNC type: Bluebunch wheatgrass-Sandberg bluegrass herbaceous vegetation
BLM type: Badland.
General description: Sparse vegetation of grasses and forbs, with few Utah junipers, growing on slopes and bottoms of draws on the north face of Cedar Ridge.
Common species:
TREES: Scattered Utah juniper
SHRUBS: Scattered Wyoming big sagebrush
GRAMINOIDS: Bluebunch wheatgrass, Sandberg bluegrass, threadleaf sedge, prairie junegrass
FORBS: bun milkvetch, gumweed aster

4c. Aspect: North. Substrate: Quaternary alluvium from sandstone and conglomerate.
TNC type: Blue grama-bluebunch wheatgrass.
BLM type: Lowland short steppe.
General description: Low, sparse grassland with scattered shrubs in draws flowing north out of Cedar Ridge.
Common species:
TREES:
SHRUBS: Wyoming big sagebrush
GRAMINOIDS: Blue grama, bluebunch wheatgrass

FORBS:

Location 5. T39N, R89W, Sec 6; T39N, R90W, Sec 1; T40N, R89W, Sec 31; T40N, R90W, Sec 36.

Elevation: 5890 feet. Aspect: Mostly south.

Substrate: Siltstone? (Lysite Member, Wind River Formation)

TNC type: Blue grama herbaceous vegetation.

BLM type: Lowland short steppe

General description: Low grassland with scattered shrubs, growing on flats and gentle slope south of Lysite Mountain.

Common species:

TREES:

SHRUBS: Scattered Wyoming big sagebrush

GRAMINOIDS: Blue grama, threadleaf sedge, western wheatgrass

FORBS:

Location 6. T39N, R91W, Sec 6; T39N, R92W, Sec 1; T40N, R92W, Sec 23, 24, 25, 26, 35, 36; T40N, R91W, Sec 29, 30, 31, 32.. Greer Peak and Fuller Peak and foothills to south.

Elevation: 5700 feet. Aspect: South

Substrate: Quaternary alluvium.

6a. TNC type: Yellow willow shrubland

BLM type: Willow floodplain

General description: Small stand (several hundred sq m) along small stream channel, immediately downstream from springs.

Common species:

TREES:

SHRUBS: Yellow willow, coyote willow, northern gooseberry

GRAMINOIDS: Water sedge, common spikerush

FORBS:

6b. TNC type: Basin big sagebrush/basin wildrye shrubland

BLM type: Tall sagebrush steppe?

General description: Stand of moderately dense basin big sagebrush growing on floodplain and first terrace in bottom of narrow valley.

Common species.

TREES:

SHRUBS: Basin big sagebrush

GRAMINOIDS: Cheatgrass, western wheatgrass, inland saltgrass, basin wildrye

FORBS:

6c. Aspect: Mainly south.

Substrate: Granite (Precambrian), conglomerate and sandstone (Wagon Bed Formation)

TNC type: Bluebunch wheatgrass-Sandberg bluegrass herbaceous vegetation

BLM type: Lowland short steppe

General description: Low grassland that forms the matrix for patches of black sagebrush/bluebunch wheatgrass association and Wyoming big sagebrush/bluebunch wheatgrass association.

Common species.

TREES:

SHRUBS:

GRAMINOIDS: Bluebunch wheatgrass, Sandberg and Cusick bluegrasses, needle-and-thread, cheatgrass

FORBS: Thrifty goldenweed, stemless hymenoxys

6d. Aspect: Northeast.

Substrate: Sandstone (Flathead Formation)

TNC type: Bluebunch wheatgrass-cushion plant herbaceous vegetation (Plots 96GJ04.04 and 04.14)

BLM type: Lowland short steppe

General description: Low, sparse vegetation with scattered low shrubs and scattered limber pines and an understory of spike-moss, growing along the edge of the Flathead sandstone rim below Greer and Fuller Peaks. Matrix vegetation is bluebunch wheatgrass-Sandberg bluegrass association. See photos 96GJ2.16 and 2.18.

Common species.

TREES: Scattered Limber pine

SHRUBS: Black sagebrush, Wyoming big sagebrush

GRAMINOIDS: Bluebunch wheatgrass, Sandberg bluegrass, prairie junegrass

FORBS: Hooker's sandwort, stemless nailwort, bun milkvetch

FERN ALLIES: Spike-moss (*Selaginella densa*)

6e. Aspect: Mainly south.

Substrate: Granite (Precambrian), conglomerate and sandstone (Wagon Bed Formation)

TNC type: Black sagebrush/bluebunch wheatgrass sparse dwarf-shrubland

BLM type: Lowland short steppe

General description: Patches of low shrubland mixed with low grassland (bluebunch wheatgrass-Sandberg bluegrass association), on granite of lower mountains and on foothills south of granite.

TREES:

SHRUBS: Black sagebrush

GRAMINOIDS: Bluebunch wheatgrass, threadleaf sedge, cheatgrass, Sandberg and Cusick bluegrasses, needle-and-thread.

FORBS: Thrifty goldenweed, stemless hymenoxys

6f. Aspect: South

Substrate: Granite

TNC type: Wyoming big sagebrush/bluebunch wheatgrass sparse shrubland

BLM type: Big sagebrush-mixed grass steppe

General description: Patches of sagebrush shrub vegetation mainly in draws and swales on south-facing slopes, in a matrix of the bluebunch wheatgrass-Sandberg bluegrass association. These stands are intermediate with the mountain big sagebrush/Idaho fescue type.

Common species.

TREES:

SHRUBS: Wyoming big sagebrush

GRAMINOIDS: Bluebunch wheatgrass, cheatgrass, Idaho fescue, Sandberg and Cusick bluegrasses

FORBS: Hairy golden-aster,

6g. Aspect: Mainly east. Substrate: Granite
TNC type: Mountain big sagebrush/Idaho fescue shrubland
BLM type: Big sagebrush-mixed grass steppe
General description: Patches of sagebrush growing in east-facing draws and swales, in a matrix of bluebunch wheatgrass-Sandberg bluegrass vegetation. These stands are intermediate to the Wyoming big sagebrush/bluebunch wheatgrass patches in south-facing draws and swales.
Common species.
TREES:
SHRUBS: Mountain big sagebrush, Wyoming big sagebrush
GRAMINOIDS: Sandberg and Cusick bluegrasses, cheatgrass, Idaho fescue
FORBS: Hairy golden-aster

6h. Aspect: Northeast. Substrate: Limestone (Madison Formation)
TNC type: Limber pine/Idaho fescue woodland
BLM type: Limber pine-Utah juniper woodland
General description: Stands with open canopies of limber pine and open subcanopies of Rocky Mountain juniper above a sparse shrub layer of mountain big sagebrush and a moderately-dense herbaceous layer, growing on the limestone dip-slope of Green Peak and the ridge to the northwest.
Common species.
TREES: Limber pine, Rocky Mountain juniper
SHRUBS: Mountain big sagebrush
GRAMINOIDS: Idaho fescue, Sandberg bluegrass, bluebunch wheatgrass
FORBS: Rock parsely (*Cymopterus sp.*)
FERN ALLIES: Spike-moss (*Selaginella densa*)

Location 7. T40N, R90W, Sec 9, E1/2
Elevation: 6500 - 6900 feet. Substrate: Limestone (Madison Formation)

7a. Aspect: West.
TNC type: Black sagebrush/bluebunch wheatgrass sparse dwarf-shrubland.
BLM type: Black sagebrush steppe.
General description: Moderately dense grass vegetation with forbs and an open low shrub layer, on limestone dip-slope and sides of draws, in a mosaic with bluebunch wheatgrass grassland and mountain big sagebrush shrubland.
Common species:
TREES:
SHRUBS: Black sagebrush, some patches of Wyoming big sagebrush
GRAMINOIDS: Bluebunch wheatgrass, Cusick's bluegrass, prairie junegrass.
FORBS: Hood's phlox, hairy goldenaster, larch-leaved beardtongue

7b. Aspect: North.
TNC type: Basin big sagebrush/basin wildrye shrubland.
BLM type: Tall sagebrush steppe
General description: Ribbons of basin big sagebrush growing in valley bottom, through upland vegetation of black sagebrush dwarf-shrubland, bluebunch wheatgrass grassland, and mountain big sagebrush shrubland.

Common species.

TREES:

SHRUBS: Basin big sagebrush

GRAMINOIDS: Basin wildrye, Cusick bluegrass, spike fescue

7c. Aspect: East.

TNC type: Bluebunch wheatgrass-Sandberg bluegrass herbaceous vegetation

BLM type: Lowland short steppe

General description: Grass vegetation with forbs and scattered black sagebrush (canopy cover <10%), merging with stands of the black sagebrush/bluebunch wheatgrass association.

Common species.

TREES:

SHRUBS: Black sagebrush

GRAMINOIDS: Cusick bluegrass, Sandberg bluegrass, bluebunch wheatgrass

FORBS: Goldenweed, ballhead sandwort

7d. Aspect: North.

TNC type: Moss phlox-stalkless nailwort herbaceous vegetation (plot 96GJ04.01, 02, & 03)

BLM type: Lowland short steppe

General description: Vegetation of cushion plants and grasses, growing in patches (up to several hundred sq m) on very shallow soil along upper parts of ridges, in matrix of bluebunch wheatgrass-Sandberg bluegrass herbaceous vegetation and black sagebrush/bluebunch wheatgrass sparse dwarf-shrub vegetation. See photos 96GJ2.08 and 2.11.

Common species.

TREES:

SHRUBS: Black sagebrush (scattered)

GRAMINOIDS: Bluebunch wheatgrass, Sandberg bluegrass, prairie junegrass

FORBS: Moss phlox, stalkless nailwort, clusterheaded false-sagebrush, stemless goldenweed, stemless buckwheat, tufted cryptantha

7e. Aspect: Northeast to northwest

TNC type: Mountain big sagebrush/Idaho fescue shrubland

BLM type: Tall sagebrush steppe?

General description: Patches of dense shrubs, and areas of grass vegetation with shrubs, growing in swales and other areas where snow accumulates, in a matrix of bluebunch wheatgrass-Sandberg bluegrass herbaceous vegetation and black sagebrush/bluebunch wheatgrass vegetation, on north-facing limestone dip slope.

Common species.

TREES:

SHRUBS: Mountain big sagebrush

GRAMINOIDS: Idaho fescue, prairie junegrass, Cuskick bluegrass

FORBS: silvery lupine

Appendix B.

Conservation ranking system used by the network of state natural heritage programs.

Each plant association is assigned a two-part rank that reflects its conservation status both globally (the G portion of the rank) and within a state (the S portion). Ranks for species are determined primarily by the number of occurrences and the vulnerability to extinction; for plant associations, the ranks are determined primarily by the number of unaltered occurrences (i.e., the occurrences little affected by exotic plants or by changes in the ecological processes that form the vegetation) and the number of protected occurrences (i.e., the occurrences managed in a way that will assure their viability). The ranks are interpreted as follows:

- G1: Critically imperiled globally because of extreme rarity or because of some factors making it very vulnerable to extinction throughout its range; represented by very few unaltered occurrences.
- G2: Imperiled globally because of rarity or because of other factors making it very vulnerable to extinction throughout its range; represented by very few unaltered occurrences.
- G3: Either with a restricted geographic range, or rare and local throughout a broad geographic range, or subject to factors making it vulnerable to extinction throughout its range; represented by few unaltered occurrences.
- G4: Widespread, common, and apparently secure throughout its range, although it may be rare in parts of its range; represented by many essentially unaltered occurrences.
- G5: Widespread, abundant, and demonstrably secure globally; represented by very many essentially unaltered occurrences.

The state (S) portion of a rank is interpreted the same way for the species or association within a state. Thus a species or association with a rank of G4S2 in Wyoming is widespread, common, and apparently secure throughout its range, where it is represented by many essentially unaltered occurrences; but in Wyoming, it is rare or otherwise vulnerable to extinction, and is represented by very few unaltered occurrences.

Appendix C.

Element Occurrence Records
and Location Maps
for Plant Species of Special Concern
in the Copper Mountain Ecosystem

Appendix D.

Data from sample plots in the bluebunch wheatgrass-cushion plant association
and the moss phlox-stalkless nailwort association
in the Copper Mountain Ecosystem.

Table D1. Data from four sample plots in the bluebunch wheatgrass-cushion plant association in the Copper Mountain Ecosystem and summary data from the Pryor Mountains (DeVelice and Lesica 1993). Plots 04.04 and 04.14 are from the Fuller Peak-Greer Peak area; plots 03.05 and 03.06 are from the western part of the area.

Species	04.04	Copper 04.14	Plots 03.05	03.06	Pryor Cov.	Mts (1) Const.
TREES						
<i>Pinus flexilis</i>	1					
<i>Juniperus osteosperma</i>			1		1	12
DWARF SHRUBS						
<i>Artemisia nova</i>	3	3			1	12
<i>Artemisia tridentata</i> wyo.		3				
<i>Atriplex confertifolia</i>					3	6
<i>Chrysothamnus nauseosus</i>	1					
<i>Chrysothamnus viscidiflorus</i>		1				
<i>Gutierrezia sarothrae</i>		1			1	53
<i>Krascheninnikovia lanata</i>				1	2	82
GRAMINOIDS						
<i>Aristida purpurea</i>					3	6
<i>Bouteloua gracilis</i>		1				
<i>Bromus tectorum</i>		1				
<i>Carex eleocharis?</i>	1	1				
<i>Carex filifolia</i>	1			1	7	24
<i>Elymus spicatus</i>	10	10	10	30	13	100
<i>Koeleria macrantha</i>	1	3			12	12
<i>Oryzopsis hymenoides</i>				1		
<i>Poa secunda</i>	10	3		3	2	12
<i>Stipa comata</i>	1	1			2	18
FORBS						
<i>Arenaria hookeri</i>	1	3	1		4	94
<i>Artemisia frigida</i>	1	1			1	24
<i>Astragalus adsurgens</i>					1	6
<i>Astragalus chamaeleuce</i>					1	6
<i>Astragalus gilviflorus</i>			1			
<i>Astragalus gracilis</i>					1	6
<i>Astragalus hyalinus</i>					1	35
<i>Astragalus simplicifolius</i>	3	1				
<i>Astragalus spatulatus</i>					1	71
<i>Castilleja angustifolia</i>			1	1	1	6
<i>Chaenactis douglasii</i>					1	12
<i>Comandra umbellata</i>			1			

Table D1 (continued). Data from four sample plots in the bluebunch wheatgrass-cushion plant association in the Copper Mountain Ecosystem.

	04.04	Copper 04.14	Plots 03.05	03.06	Pryor Cov.	Mts (1) Const.
<i>Cryptantha celosioides</i>	1	1	1		1	12
<i>Cryptantha</i> , mat spp.(1)					5	35
<i>Cymopterus acaulis</i>					1	18
<i>Cymopterus terebinthinus</i>		1				
<i>Erigeron</i> spp. (2)		1	1	1	3	35
<i>Eriogonum brevicaule</i>					2	24
<i>Eriogonum flavum</i>			1		1	12
<i>Eriogonum mancum</i>					7	35
<i>Eriogonum ovalifolium</i>	1	1	1	1		
<i>Eriogonum pauciflorum</i>			1	3	2	12
<i>Erysimum asperum</i>			1			
<i>Gaura coccinea</i>					1	6
<i>Haplopappus acaulis</i>					1	6
<i>Haplopappus armerioides</i>	1	1	10	3	8	18
<i>Haplopappus nuttallii</i>	1		1	1	1	82
<i>Hedysarum boreale</i>					1	6
<i>Heterotheca villosa</i>		1				
<i>Hymenopappus</i> sp.					1	35
<i>Hymenoxys acaulis</i>	1	1	1	1	3	76
<i>Hymenoxys torreyana</i>					1	18
<i>Ipomopsis</i> sp.					1	6
<i>Leptodactylon pungens</i>	1					
<i>Lesquerella alpina</i>					1	41
<i>Linum lewisii</i>			1	1	1	6
<i>Lygodesmia juncea</i>				1		
<i>Mentzelia pumila</i>					1	6
<i>Mertensia oblongifolia</i>					1	6
<i>Musineon divaricatum</i>					1	35
<i>Opuntia polyacantha</i>	1	1			1	24
<i>Paronychia sessiliflora</i>	3	1				
<i>Penstemon laricifolius</i> lar.	1	1			1	18
<i>Penstemon</i> spp. (3)			1	1	2	24
<i>Phlox hoodii</i>			1	3	5	71
<i>Phlox muscoides</i>					8	59
<i>Potentilla ovina</i>		1	1			
<i>Sedum lanceolatum</i>				1	1	6
<i>Senecio canus</i>	1	1			1	12
<i>Sphaeralcea coccinea</i>					1	12

Table D1 (continued). Data from four sample plots in the bluebunch wheatgrass-cushion plant association in the Copper Mountain Ecosystem.

	04.04	Copper 04.14	Plots 03.05	03.06	Pryor Cov.	Mts (1) Const.
Sphaeromeria capitata			10	1	1	12
Stanleya pinnata					1	6
Stanleya tomentosa					1	18
Townsendia sp.	1		1		2	18
Wyethia scabra					1	6
Yucca glauca					3	6
FERN ALLIES						
Selaginella densa	40	40				
Total vegetation	15	25	50	60		
Bare soil	5	7	20	14		
Gravel	10	15	61	55		
Rock	7	28	15	25		
Bedrock	35	40				
Litter	1	3	2	1		
Elevation (ft.)	6840	7010	6150	6250		
Aspect (degrees)	120	65	340	340		
Slope (degrees)	6	6	20	20		
Substrate (4)	ss	ss	ls	ls		

(1) The Pryor Mountains data are average cover (Cov) and percent of stands occupied (constancy, Cons) from 17 stands.

(2) Cryptantha, mat spp includes *C. cana*, *C. cespitosa*, and *C. spiculifera*.

(3) Erigerion spp includes *E. allocotus*, *E. caespitosus*, *E. ochroleucus*, *E. pumilus*, & unknown sp.

(4) Penstemon spp. includes *P. nitidus*, *P. eriantherus*, & unknown spp.

(5) Substrate codes: ls=limestone, ss=sandstone

Table D2. Data from three sample plots in the moss phlox-stalkless nailwort plant association in the Copper Mountain Ecosystem and two plots from the Beaver Rim ACEC.

	Plot 964.1 Lysite	Number 964.3 Lysite	& 964.2 Lysite	Location (1) 891.3 893.2 BvRm BvRm	
TREES					
<i>Pinus flexilis</i>	1		1	1	1
DWARF SHRUBS					
<i>Artemisia nova</i>	3	1		1	
<i>Artemisia tridentata</i> wyo.		1			
<i>Chrysothamnus nauseosus</i>		1			
<i>Chrysothamnus viscidiflorus</i>				1	
<i>Gutierrezia sarothrae</i>	1				
<i>Ribes cereum</i>	1				
GRAMINOIDS					
<i>Carex filifolia</i>	1		1	1	1
<i>Carex rossii</i>					1
<i>Elymus spicatus</i>	3	10	3	1	1
<i>Koeleria macrantha</i>	10	3	1	1	
<i>Poa secunda</i>	10	3	3		
FORBS					
<i>Arenaria hookeri</i>	1	1	1	1	1
<i>Arenaria nuttallii</i>					1
<i>Artemisia frigida</i>	1	1			
<i>Astragalus sericoleucus</i>					3
<i>Astragalus simplicifolius</i>	3				
<i>Astragalus spatulatus</i>	1			1	
<i>Castilleja angustifolia</i>	1	1	1	1	1
<i>Cirsium</i> sp.				1	
<i>Comandra umbellata</i>	1		1		1
<i>Cryptantha celosioides</i>	1				
<i>Cryptantha</i> , mat spp.(2)	1	3	3	3	
<i>Draba oligosperma</i>	1	1	1	1	1
<i>Erigeron</i> spp. (3)	1	1	1		1
<i>Eriogonum acaule</i>	3	3	1		
<i>Eriogonum flavum</i>	1	1		3	1
<i>Eriogonum ovalifolium</i>				1	
<i>Eriogonum pauciflorum</i>	1				
<i>Gaura coccinea</i>				1	
<i>Haplopappus acaulis</i>			3		1
<i>Haplopappus armerioides</i>	10			1	1
<i>Haplopappus nuttallii</i>	3	1	1	1	1

Table D2 (continued). Data from sample plots in the moss phlox-stalkless nailwort plant association.

	Plot	Number	&	Location (1)	
	964.1 Lysite	964.3 Lysite	964.2 Lysite	891.3 BvRm	893.2 BvRm
Hymenopappus sp.		1	1	1	1
Hymenoxys acaulis	1	3			1
Leptodactylon pungens				1	
Lesquerella alpina	1		1		
Linum kingii				3	
Linum lewisii	1		1	1	
Oxytropis sericea				1	
Paronychia sessiliflora	10	3	10	3	1
Penstemon laricifolius lar.	1	1	1		1
Penstemon spp. (3)				1	
Petrophyton caespitosum	10	1	1		
Phlox hoodii	1	1			
Phlox muscoides	10	10	20	10	3
Phlox pungens				3	
Potentilla ovina	1				
Sedum lanceolatum	1				
Senecio canus	1		1	1	1
Sphaeromeria capitata	10	10	3		1
Townsendia sp.	1	1	1		
Zigadenus venenosus				1	
Total vegetation	50	45	32		
Bare soil	25	34	37	24	50
Gravel	8	40	37	40	49
Rock	15	20	5	30	1
Bedrock	25	3	10	5	
Litter	1	5	1	1	
Elevation (ft.)	6650	6920	6750	6970	7080
Aspect (degrees)	350	5	350	180	210
Slope (degrees)	10	5	3	23	1
Substrate	ls	ls	ls	ls	

Table D2 (continued). Data from sample plots in the moss phlox-stalkless nailwort plant association.

(1) Location abbreviations: Lysite= Lysite Mountain in the Copper Mountain study area; BvRm = Beaver Rim, central Wyoming.

(2) *Cryptantha*, mat spp includes *C. cana*, *C. cespitosa*, and *C. spiculifera*.

(3) *Erigerion* spp includes *E. allocotus*, *E. caespitosus*, *E. ochroleucus*, *E. pumilus*, and an unknown species

Appendix E.

Photographs of selected plant associations
in the Copper Mountain Ecosystem.

Photo 96GJ2.08

Location 7d, Lysite Mountain, looking from ridge north down draw. Foreground is moss phlox-stalkless nailwort association (plot 96GJ04.01) (lowland short steppe standard habitat site); gray shrub stands in east-facing swales to left of draw, and on left (east-facing) wall of draw, are mountain big sagebrush/Idaho fescue shrubland (big sagebrush-mixed grass steppe standard habitat site); light-colored vegetation on ridgeline to left of draw, and on right (west-facing) wall of draw, is mix of bluebunch wheatgrass-Sandberg bluegrass association (lowland short steppe standard habitat site) and black sagebrush/bluebunch wheatgrass association (black sagebrush standard habitat site); gray shrub stand in distant valley is Wyoming big sagebrush/bluebunch wheatgrass association (big sagebrush-mixed grass steppe standard habitat site). Photo taken 7/25/1996.

Photo 96GJ2.11

Moss phlox-stalkless nailwort association (plot 96GJ04.03) (lowland short steppe standard habitat site) at location 7d on Lysite Mountain. Photo taken 7/25/1996.

Photo 96GJ2.12

Clay badland (badland standard habitat site) at south foot of Lysite Mountain, looking south. Photo taken 7/25/1996.

Photo 96GJ2.16

Bluebunch wheatgrass-cushion plant association (plot 96GJ04.04) (lowland short steppe standard habitat site) at location 6d on Flathead sandstone near Fuller and Greer Peaks.

Photo 96GJ2.18

Bluebunch wheatgrass-cushion plant association (plot 96GJ04.14) (lowland short steppe standard habitat site) at location 6d on Flathead sandstone near Fuller and Greer Peaks.

Appendix F.

Slides of Plants of Special Concern
And Selected Plant Associations
from the Copper Mountain Ecosystem