

Plant Species of Special Concern
and Plant Associations
of the
Shirley Mountains Ecosystem
Carbon County, Wyoming

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Introduction

The Shirley Mountains are part of a complex, northwest-southeast trending uplift located between the northern Laramie Range and the southern Wind River Range in central Wyoming. Much of this uplift system consists of high desert shrublands and semi-barren outcrops of granite. The Shirley Mountains are unusual in that they support a rich diversity of coniferous forest, shrubland, and meadow vegetation types more typical of the higher mountain ranges of the state. Although relatively small in size, the Shirley Mountains have assumed great importance as an area of significant wildlife habitat, recreation opportunities, and natural resource development (USDI Bureau of Land Management 1987).

In 1995, the Bureau of Land Management (BLM) Wyoming State Office contracted on a cost-share basis with The Nature Conservancy's Wyoming Natural Diversity Database (WYNDD) to inventory plant species of special concern and plant associations in the Shirley Mountains 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 Shirley Mountains ecosystem;
- * integrate the existing vegetation classification systems used by the BLM and the Wyoming Game and Fish Department with the system of plant associations used by The Nature Conservancy and the network of state natural heritage programs and identify the plant associations in the Shirley Mountains;
- * identify any 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 Shirley Mountains ecosystem encompasses an area of approximately 102,000 acres in northern Carbon County, Wyoming. The ecosystem includes the summit, slopes and foothills of the Shirley Mountains, a Laramide-age anticline of Precambrian granite and Pennsylvanian limestone, and the foothills of the adjacent Shirley Basin. Most of the Shirley Mountain area is managed by the BLM Rawlins District, with scattered inholdings of private and state lands (Figure 1).

The Shirley Mountains are managed primarily for multiple use, including livestock grazing, logging, and recreation (USDI Bureau of Land Management 1987; Bottomley 1994). The mountains and surrounding basin are considered a high priority area by the Wyoming Game and Fish Department for summer and winter habitat for elk, mule deer, pronghorn, sage grouse, and raptors (Wyoming Game and Fish Department 1994). A developed camp ground is maintained at Pryor Flats and an additional camp ground has been proposed for the First Ranch Creek area (USDI Bureau of Land Management

1987). The BLM maintains the Shirley Mountain Loop Road (Rd 3115) to provide access across the top of the Shirley Mountains. Numerous side roads and four-wheel drive tracks provide additional access. An extensive cave system is managed within the Shirley Mountain Caves Special Recreation Management Area (USDI Bureau of Land Management 1988). No other special management areas have been established within the ecosystem's boundaries.

Methods

Vascular Plant Checklist

Fertig (unpublished records) has been conducting a general survey of the flora of the Shirley Mountains and adjacent basins since 1993. For this project, intensive field sampling was conducted in July 1995, June 1996, and August 1996. Species were identified in the field or collected for later determination and deposit at the Rocky Mountain Herbarium (RM).

Rare Plant Species

Surveys of plant species of special concern were conducted in the summers of 1993, 1995, and 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 forest vegetation of the Shirley Mountains has already been classified into general vegetation types and mapped at 1:100,000 scale by the BLM (USDI Bureau of Land Management 1993). The Wyoming Game and Fish Department (1994) has mapped general vegetation types (forest and non-forest) at 1:24,000 scale. Much of the work for the present project consisted of relating those general vegetation types to the plant associations in the classification scheme of The Nature Conservancy and the network of state natural heritage programs (Bourgeron and Engelking 1994), of which the WYNDD is a part. Each plant association in that classification has been assigned a rank that reflects its conservation status, as described in Appendix B. A small part of the study area covered by the present project is outside the area covered by the BLM and Wyoming Game and Fish Department maps.

Sampling locations were selected to include stands of the vegetation types mapped in the Shirley Mountains by the USDI Bureau of Land Management (1994) and the Wyoming Game and Fish Department (1994). A survey was made on foot at each sampling location, and the topographic position, substrate, structure, and composition

Figure 1. Shirley Mountains ecosystem.

of each vegetation type were described. This information was sufficient to allow the vegetation at each sampling point to be assigned to a plant association in the classification scheme used by The Nature Conservancy and the network of state natural heritage programs (Bourgeron and Engelking 1994).

The sampling locations were later superimposed over the existing vegetation maps of forest communities of the Shirley Mountains (USDI Bureau of Land Management, 1993; Wyoming Game and Fish Department, 1994). The identity of the plant associations at each sampling location could then be compared to the identities of the vegetation types assigned by the BLM and the Wyoming Game and Fish Department.

Results

Vascular Plant Checklist

A preliminary checklist of the vascular flora of the Shirley Mountains ecosystem is included in Table 1. This list has been annotated to include information on the occurrence of plant species by major vegetation types, as defined by the Wyoming Game and Fish Department (1994) and The Nature Conservancy. It is likely that additional species will be added to this list as more intensive field surveys are conducted.

Rare Plant Species

Surveys in 1995-96 targeted seven plant species considered to be of medium to high conservation concern by WYNDD (Fertig 1996). Five of these (*Arabis pendulina* var. *russeola*, *Eriogonum exilifolium*, *Haplopappus wardii*, *Polemonium brandegei*, and *Sphaeromeria simplex*) were previously known to occur in the study area and were relocated during this project. Two other rare species (*Parthenium alpinum* and *Physaria eburniflora*) were thought to potentially occur within the ecosystem, but were not located during surveys in 1995-96. Although both species are known from the vicinity of the Shirley Mountains, suitable habitat appears to be lacking within the ecosystem's boundaries.

Oryzopsis contracta (Contracted Indian ricegrass) has also been documented from the Shirley Basin within the study area (Fertig 1994). This species is a regional endemic of central Wyoming and adjacent Montana, Colorado, and Utah. It was formerly a G2 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). *Oryzopsis contracta* is no longer considered a high priority species by WYNDD and was not actively surveyed in the Shirley Mountains ecosystem in 1995-96.

Species Summaries

Information on the biology and conservation status of the five plant species of special concern known from the Shirley Mountains 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.

Table 1. Vascular Plants of the Shirley Mountains and Adjacent Shirley Basin.

The following list is based on field work conducted by the authors in the summers of 1993-96 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).

General vegetation types are included for each species, based on the classifications used by the Wyoming Game and Fish Department (1994) and The Nature Conservancy (Bourgeron and Engelking 1994). These types are explained in Tables 2 and 4. Coding is as follows: (1) mixed sagebrush/grassland; (2) mountain foothills/grassland; (3) bitterbrush/sagebrush/mixed shrub; (4) limber pine; (5) lodgepole pine; (6) aspen; (7) Engelmann spruce/subalpine fir; (8) birch/alder; (9) birdfoot sagebrush/Gardner saltbush; (10) black greasewood/western wheatgrass.

Scientific Name	Common Name	Family	Veg
<u>Trees</u>			
<i>Abies lasiocarpa</i>	Subalpine fir	PIN	5, 7
<i>Picea engelmannii</i>	Engelmann spruce	PIN	6, 7
<i>Pinus contorta</i> var. <i>latifolia</i>	Lodgepole pine	PIN	2, 5, 6, 7
<i>Pinus flexilis</i>	Limber pine	PIN	1, 2, 4, 5, 6
<i>Populus tremuloides</i>	Quaking aspen	SAL	2, 4, 5, 6
<u>Shrubs</u>			
<i>Acer glabrum</i>	Rocky Mountain maple	ACE	5, 6
<i>Alnus incana</i> var. <i>occidentalis</i>	Mountain alder	BET	6, 8
<i>Amelanchier alnifolia</i> var. <i>pumila</i>	Western serviceberry	ROS	1, 2, 4, 6
<i>Artemisia cana</i>	Silver sagebrush	AST	10
<i>Artemisia frigida</i>	Fringed sagebrush	AST	1, 2, 9
<i>Artemisia nova</i>	Black sagebrush	AST	1, 2
<i>Artemisia pedatifida</i>	Birdfoot sagebrush	AST	1, 9
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	Mountain big sagebrush	AST	1, 2, 4, 5
<i>Artemisia tridentata</i> var. <i>wyomingensis</i>	Wyoming big sagebrush	AST	1, 2, 3, 9, 10
<i>Artemisia tripartita</i> var. <i>rupicola</i>	Threetip sagebrush	AST	1, 2
<i>Atriplex confertifolia</i>	Shadscale saltbush	CHN	9
<i>Atriplex gardneri</i> var. <i>gardneri</i>	Gardner's saltbush	CHN	9
<i>Betula occidentalis</i>	Water birch	BET	8
<i>Ceanothus velutinus</i>	Deer brush	RHM	1, 4, 6
<i>Cercocarpus montanus</i>	Alder-leaf mountain mahogany	ROS	1, 2, 4
<i>Chimaphila umbellata</i> var. <i>occidentalis</i>	Common pipsissewa	ERI	6
<i>Chrysothamnus nauseosus</i>	Rubber rabbitbrush	AST	2, 9
<i>Chrysothamnus viscidiflorus</i>	Douglas rabbitbrush	AST	1, 2, 9
<i>Gutierrezia sarothrae</i>	Broom snakeweed	AST	9
<i>Holodiscus dumosus</i>	Mountain-spray	ROS	1
<i>Juniperus communis</i> var. <i>depressa</i>	Common juniper	CUP	1, 2, 4, 5, 6
<i>Juniperus scopulorum</i>	Rocky Mountain juniper	CUP	1, 5

<i>Krascheninnikovia lanata</i> [<i>Ceratoides lanata</i>]	Winterfat	CHN	9
<i>Leptodactylon pungens</i>	Sharp prickly-phlox	PLM	1, 2
<i>Mahonia repens</i>	Oregon grape	BER	4, 5, 6, 7
<i>Prunus virginiana</i> var. <i>melanocarpa</i>	Common chokecherry	ROS	1, 3
<i>Purshia tridentata</i>	Bitterbrush	ROS	1, 3
<i>Rhus trilobata</i>	Skunkbush sumac	ANA	2
<i>Ribes cereum</i> var. <i>pedicellare</i>	Wax currant	GRS	2, 4, 5, 6
<i>Ribes inerme</i>	Whitestem gooseberry	GRS	6
<i>Ribes lacustre</i>	Swamp black gooseberry	GRS	6, 8
<i>Ribes oxycanthoides</i>	Northern gooseberry	GRS	1
<i>Rosa sayi</i>	Prickly rose	ROS	6
<i>Rosa woodsii</i>	Woods' rose	ROS	6
<i>Rubus idaeus</i> var. <i>aculeatissimus</i>	Red raspberry	ROS	5, 6
<i>Salix drummondiana</i>	Drummond willow	SAL	1, 6
<i>Salix lutea</i> [<i>S. eriocephala</i> var. <i>watsonii</i>]	Yellow willow	SAL	8
<i>Salix scouleriana</i>	Scouler willow	SAL	6
<i>Sambucus racemosa</i>	Red elderberry	CPR	6
<i>Sarcobatus vermiculatus</i>	Greasewood	CHN	10
<i>Shepherdia canadensis</i>	Canada buffaloberry	ELE	5, 6
<i>Sorbus scopulina</i>	Mountain-ash	ROS	8
<i>Symphoricarpos oreophilus</i> var. <i>utahensis</i>	Mountain snowberry	CPR	1, 4, 5, 6, 7
<i>Tetradymia canescens</i>	Gray horsebrush	AST	1, 2, 3
<i>Vaccinium scoparium</i>	Grouse whortleberry	ERI	5, 7

Forbs

<i>Abronia fragrans</i>	Snowball sand verbena	NYC	9
<i>Achillea millefolium</i> var. <i>lanulosa</i>	Common yarrow	AST	1, 2, 9 10
<i>Actaea rubra</i>	Red baneberry	RAN	6, 7
<i>Agoseris glauca</i> var. <i>dasycephala</i>	Short-beaked agoseris	AST	1, 2
<i>Allium geayeri</i> var. <i>tenerum</i>	Geyer's onion	LIL	1, 2, 9
<i>Alyssum desertorum</i>	Desert alyssum	BRA	2
<i>Androsace septentrionalis</i>	Pygmyflower rock jasmine	PRM	4
<i>Antennaria anaphaloides</i>	Tall pussytoes	AST	1, 2, 6
<i>Antennaria dimorpha</i>	Low pussytoes	AST	1, 3
<i>Antennaria microphylla</i>	Small-leaved pussytoes	AST	1, 2, 5
<i>Antennaria rosea</i>	Rosy pussytoes	AST	1, 2
<i>Antennaria umbrinella</i>	Umber pussytoes	AST	1, 3, 4, 5
<i>Apocynum</i> sp.	Dogbane sp.	APO	6
<i>Arabis confinis</i> [<i>Arabis divaricarpa</i>]	Spreadingpod rockcress	BRA	2
<i>Arabis drummondii</i>	Drummond's rockcress	BRA	1
<i>Arabis glabra</i>	Towermustard	BRA	1
<i>Arabis holboellii</i> var. <i>secunda</i>	Holboell's rockcress	BRA	1, 3, 4
<i>Arabis nuttallii</i>	Nuttall's rockcress	BRA	5, 6
<i>Arabis pendulina</i> var. <i>russeola</i>	Daggett rockcress	BRA	1
<i>Arabis pendulocarpa</i> var. <i>pendulocarpa</i>	Pendulous rockcress	BRA	4
<i>Arceuthobium americanum</i>	American dwarf-mistletoe	VIS	5
<i>Arceuthobium cyanocarpum</i>	Limber pine dwarf-mistletoe	VIS	4

<i>Arenaria congesta</i>	Ballhead sandwort	CRY	1, 2, 4
<i>Arenaria hookeri</i>	Hooker's sandwort	CRY	1, 9
<i>Arenaria nuttallii</i> [<i>Minuartia nuttallii</i>]	Nuttall's sandwort	CRY	2
<i>Arnica cordifolia</i>	Heartleaf arnica	AST	5, 6, 7
<i>Arnica fulgens</i>	Orange arnica	AST	3
<i>Arnica mollis</i>	Hairy arnica	AST	1, 2
<i>Artemisia dracunculus</i>	Tarragon	AST	1
<i>Artemisia ludoviciana</i> var. <i>ludoviciana</i>	Louisiana sagewort	AST	2
<i>Aster ascendens</i>	Long-leaved aster	AST	1
<i>Astragalus adsurgens</i> var. <i>robustior</i>	Standing milkvetch	FAB	2, 5
<i>Astragalus agrestis</i>	Field milkvetch	FAB	1, 10
<i>Astragalus bisulcatus</i> var. <i>bisulcatus</i>	Two-grooved milkvetch	FAB	9
<i>Astragalus crassicaarpus</i> var. <i>paysonii</i>	Payson's ground-plum	FAB	1, 2
<i>Astragalus drummondii</i>	Drummond's milkvetch	FAB	1
<i>Astragalus miser</i> var. <i>decumbens</i>	Sagebrush weedy milkvetch	FAB	1, 2
<i>Astragalus miser</i> var. <i>oblongifolius</i>	Rydberg's weedy milkvetch	FAB	1, 5
<i>Astragalus missouriensis</i>	Missouri milkvetch	FAB	2
<i>Astragalus pectinatus</i> var. <i>pectinatus</i>	Narrowleaf milkvetch	FAB	9
<i>Astragalus purshii</i>	Woolly-pod milkvetch	FAB	2
<i>Astragalus spatulatus</i>	Spoon-leaved milkvetch	FAB	1, 9
<i>Atriplex argentea</i>	Silver orache	CHN	9
<i>Balsamorhiza sagittata</i>	Arrowleaf balsamroot	AST	1, 4
<i>Besseya wyomingensis</i>	Wyoming kittentails	SCR	1, 2, 4, 5
<i>Calochortus</i> sp.	Mariposa lily	LIL	2
<i>Calypso bulbosa</i>	Fairy-slipper	ORC	6
<i>Camissonia</i> sp	Camissonia	ONA	2
<i>Campanula rotundifolia</i>	Scotch bellflower	CAM	5
<i>Castilleja angustifolia</i> var. <i>dubia</i>	Desert paintbrush	SCR	1
<i>Castilleja linariifolia</i>	Wyoming paintbrush	SCR	1, 5
<i>Castilleja pallescens</i>	Pale paintbrush	SCR	1, 2
<i>Castilleja sulphurea</i>	Sulfur paintbrush	SCR	1, 6
<i>Cerastium arvense</i>	Field chickweed	CRY	1, 2, 4
<i>Cirsium pulcherrimum</i>	Pretty thistle	AST	1, 2, 9
<i>Cirsium scariosum</i>	Elk thistle	AST	1
<i>Claytonia lanceolata</i> var. <i>lanceolata</i>	Lanceleaf spring-beauty	POR	6, 7
<i>Collinsia parviflora</i>	Smallflowered blue-eyed Mary	SCR	1, 2, 4
<i>Collomia linearis</i>	Narrowleaf collomia	PLM	1, 6
<i>Comandra umbellata</i> var. <i>pallida</i>	Bastard toadflax	SAN	1, 2, 9
<i>Corallorrhiza maculata</i>	Spotted coralroot	ORC	5, 7
<i>Corydalis aurea</i>	Golden corydalis	FUM	1
<i>Coryphantha vivipara</i>	Ball cactus	CAC	1
<i>Crepis acuminata</i>	Mountain hawksbeard	AST	1, 4
<i>Crepis modocensis</i>	Modoc hawksbeard	AST	1, 2, 4
<i>Cryptantha ambigua</i>	Obscure cryptantha	BOR	1
<i>Cryptantha celosioides</i>	Cockscomb cryptantha	BOR	2, 9
<i>Cryptantha flavoculata</i>	Yellow-eye cryptantha	BOR	2, 9
<i>Cymopterus longilobus</i> [<i>Cymopterus hendersonii</i>]	Mountain rock-parsley	API	2
<i>Delphinium nuttallianum</i>	Nelson's larkspur	RAN	1
<i>Descurainia sophia</i>	Flixweed	BRA	3
<i>Disporum trachycarpum</i>	Roughfruit fairybells	LIL	6
<i>Dodecatheon conjugens</i>	Slimpod shooting-star	PRI	1, 4
<i>Draba albertina</i>	Alaska draba	BRA	1
<i>Draba nemorosa</i>	Woods draba	BRA	2

<i>Draba oligosperma</i>	Few-seeded draba	BRA	1
<i>Epilobium angustifolium</i>	Fireweed	ONA	6, 7
<i>Epilobium hornemannii</i>	Hornemann's willow-herb	ONA	1, 6
<i>Epilobium saximontanum</i>	Rocky Mountain willow-herb	ONA	1
<i>Erigeron caespitosus</i>	Tufted daisy	AST	2, 4, 5
<i>Erigeron compositus</i> var. <i>discoideus</i>	Cut-leaved daisy	AST	1, 4
<i>Erigeron eatonii</i>	Eaton's daisy	AST	1, 2
<i>Erigeron ochroleucus</i> var. <i>ochroleucus</i>	Buff fleabane	AST	2
<i>Erigeron ochroleucus</i> var. <i>scribneri</i>	Scribner's fleabane	AST	1
<i>Erigeron speciosus</i>	Aspen fleabane	AST	6, 7
<i>Eriogonum exilifolium</i>	Slender-leaved buckwheat	PLG	9
<i>Eriogonum flavum</i> var. <i>flavum</i>	Yellow buckwheat	PLG	1, 9
<i>Eriogonum gordonii</i>	Gordon's buckwheat	PLG	9
<i>Eriogonum ovalifolium</i>	Cushion buckwheat	PLG	1, 2, 9
<i>Eriogonum umbellatum</i> var. <i>majus</i>	Cream buckwheat	PLG	1, 2
<i>Eriogonum umbellatum</i> var. <i>umbellatum</i>	Sulfur buckwheat	PLG	1, 2, 4
<i>Erysimum asperum</i> var. <i>arkansanum</i>	Rough wallflower	BRA	1, 2
[<i>Erysimum capitatum</i>]			
<i>Erysimum inconspicuum</i>	Lesser wallflower	BRA	2
<i>Euclidium syriacum</i>	Syria-weed	BRA	9
<i>Fragaria virginiana</i>	Virginia strawberry	ROS	5, 6, 7
<i>Gaillardia aristata</i>	Blanket-flower	AST	1, 4
<i>Galium bifolium</i>	Twinleaf bedstraw	RUB	6
<i>Galium boreale</i>	Northern bedstraw	RUB	5, 6
<i>Galium triflorum</i>	Sweet-scented bedstraw	RUB	6, 7
<i>Gaura coccinea</i>	Scarlet gaura	ONA	2
<i>Gayophytum racemosum</i>	Racemed ground-smoke	ONA	1
<i>Geranium richardsonii</i>	White geranium	GER	1, 6, 8
<i>Geranium viscosissimum</i>	Sticky purple geranium	GER	1, 4, 6
<i>Geum macrophyllum</i> var. <i>perincisum</i>	Long-leaved avens	ROS	1
<i>Geum triflorum</i>	Prairie smoke	ROS	1
<i>Grindelia squarrosa</i>	Curlycup gumweed	AST	1, 2
<i>Gymnosteris parvula</i>	Gymnosteris	PLM	1
<i>Habenaria dilatata</i> var. <i>albiflora</i>	White bog-orchid	ORC	1, 6
[<i>Platanthera dilatata</i>]			
<i>Hackelia patens</i>	Pale stickseed	BOR	1
<i>Halimolobos virgata</i>	Twiggy halimolobos	BRA	1
<i>Halogeton glomeratus</i>	Halogeton	CHN	9, 10
<i>Haplopappus acaulis</i>	Stemless goldenweed	AST	1
<i>Haplopappus armerioides</i>	Thrifty goldenweed	AST	9
<i>Haplopappus nuttallii</i>	Nuttall goldenweed	AST	1, 9
[<i>Machaeranthera grindelioides</i>]			
<i>Haplopappus wardii</i>	Ward's goldenweed	AST	9
[<i>Oonopsis wardii</i>]			
<i>Heracleum sphondylium</i> var. <i>lanatum</i>	Cow parsnip	API	6
<i>Heterotheca</i> sp.	Golden-aster	AST	1, 4
<i>Heuchera parvifolia</i>	Littleleaf alumroot	SAX	1, 5, 6
<i>Hieracium albiflorum</i>	White hawkweed	AST	5, 7
<i>Hymenopappus filifolius</i> var. <i>luteus</i>	Fineleaf hymenopappus	AST	2, 9
<i>Hymenoxys acaulis</i>	Stemless hymenoxys	AST	1, 9
<i>Hymenoxys torreyana</i>	Torrey's hymenoxys	AST	1
<i>Ipomopsis aggregata</i>	Scarlet gilia	PLM	1, 4
[<i>Gilia aggregata</i>]			
<i>Ipomopsis spicata</i> var. <i>spicata</i>	Spike gilia	PLM	2, 3, 9
[<i>Gilia spicata</i> var. <i>spicata</i>]			
<i>Iris missouriensis</i>	Missouri iris	IRI	9, 10

<i>Iva axillaris</i>	Povertyweed	AST		9
<i>Ivesia gordonii</i>	Gordon's ivesia	ROS		4
<i>Lesquerella alpina</i> var. <i>alpina</i>	Alpine bladderpod	BRA		1
<i>Lesquerella arenosa</i> var. <i>arenosa</i>	Great Plains bladderpod	BRA	3, 9	
<i>Lewisia pygmaea</i>	Dwarf lewisia	POR		1, 5
<i>Lewisia rediviva</i>	Bitterroot	POR		1, 2
<i>Linanthus septentrionalis</i>	Northern linanthus	PLM		2
<i>Linum lewisii</i>	Blue flax	LIN		1, 2, 9
<i>Lithophragma glabrum</i> var. <i>ramulosum</i>	Bulbiferous fringecup	SAX		1
<i>Lithospermum incisum</i>	Yellow gromwell	BOR	2, 9	
<i>Lithospermum ruderales</i>	Western gromwell	BOR		1
<i>Lomatium dissectum</i> var. <i>multifidum</i>	Fern-leaved biscuitroot	API		2, 4, 6
<i>Lomatium foeniculaceum</i>	Fennel-leaved biscuitroot	API		9
<i>Lomatium orientale</i>	White biscuitroot	API		1, 2, 4
<i>Lupinus argenteus</i> var. <i>rubricaulis</i>	Subalpine lupine	FAB		1, 2, 5
<i>Lupinus sericeus</i>	Silky lupine	FAB		2
<i>Maianthemum racemosum</i>	Feathery false Solomon's seal	LIL		6
<i>Matricaria matricarioides</i>	Pineapple weed	AST		2
<i>Melilotus officinalis</i>	Yellow sweetclover	FAB		1
<i>Mertensia ciliata</i>	Mountain bluebells	BOR	6	
<i>Mertensia humilis</i>	Low bluebells	BOR		1, 2
<i>Microseris nutans</i>	Nodding microseris	AST		5
<i>Microsteris gracilis</i>	Slender microsteris	PLM		1
<i>Mitella pentandra</i>	Fivestar mitrewort	SAX		6
<i>Monolepis nuttalliana</i>	Nuttall's monolepis	CHN		1
<i>Musineon divaricatum</i>	Leafy musineon	API		9
<i>Musineon tenuifolium</i>	Narrow-leaved musineon	API		1, 4
<i>Myosurus</i> sp.	Mousetail	RAN		1
<i>Nemophila breviflora</i>	Basin nemophila	HYD		6
<i>Oenothera cespitosa</i> var. <i>cespitosa</i>	Tufted evening-primrose	ONA		9
<i>Opuntia polyacantha</i> var. <i>polyacantha</i>	Plains pricklypear	CAC		9
<i>Orobanche fasciculata</i>	Clustered broomrape	ORO		2
<i>Orthilia secunda</i>	Sidebells pyrola	ERI		5, 6, 7
<i>Osmorhiza chilensis</i>	Sweet-cicely	API		6
<i>Osmorhiza depauperata</i>	Blunt-fruit sweet-cicely	API		5, 6, 7
<i>Oxytropis lagopus</i> var. <i>atropurpurea</i>	Rabbitfoot crazyweed	FAB		1, 2
<i>Oxytropis multiceps</i>	Rocky Mountain crazyweed	FAB		2
<i>Oxytropis sericea</i> var. <i>sericea</i>	Silky crazyweed	FAB	1	
<i>Paronychia depressa</i>	Depressed nailwort	CRY		2
<i>Paronychia sessiliflora</i>	Stalkless nailwort	CRY		1, 2
<i>Pedicularis groenlandica</i>	Elephanthead	SCR		6, 8
<i>Penstemon eriantherus</i> var. <i>cleburnei</i>	Fuzzytongue beardtongue	SCR		1
<i>Penstemon laricifolius</i> var. <i>laricifolius</i>	Larch-leaved beardtongue	SCR		1
<i>Penstemon radicosus</i>	Matroot beardtongue	SCR		1
<i>Penstemon strictus</i>	Rocky Mountain beardtongue	SCR		4
<i>Perideridia montana</i>	Common yampah	API		7
<i>Phacelia sericea</i>	Silky phacelia	HYD		1, 4, 6
<i>Phlox hoodii</i>	Hood's phlox	PLM		1, 2, 9
<i>Phlox multiflora</i>	Mountain phlox	PLM		1, 4
<i>Phlox muscoides</i>	Moss phlox	PLM		2
<i>Physaria acutifolia</i>	Southern twinpod	BRA		1, 2, 9
<i>Plagiobothrys scouleri</i> var. <i>hispidulus</i>	Scouler's popcorn-flower	BOR		1
<i>Plantago major</i>	Common plantain	PTG		10
<i>Polemonium brandegei</i>	Brandegee's Jacob's-ladder	PLM		4, 5, 6
<i>Polygonum aviculare</i>	Prostrate knotweed	PLG		1, 2, 9
<i>Polygonum bistortoides</i>	American bistort	PLG		1, 5

<i>Polygonum douglasii</i>	Douglas' knotweed	PLG		1
<i>Potentilla concinna</i> var. <i>concinna</i>	Early cinquefoil	ROS		1, 2
<i>Potentilla diversifolia</i> var. <i>diversifolia</i>	Vari-leaf cinquefoil	ROS		1, 2
<i>Potentilla glandulosa</i>	Glandular cinquefoil	ROS		1, 4, 5, 6
<i>Var. pseudorupestris</i>				6
<i>Potentilla gracilis</i> var. <i>pulcherrima</i>	Beautiful cinquefoil	ROS		1, 4, 5
<i>Potentilla hippiana</i> var. <i>effusa</i>	Woolly cinquefoil	ROS		1, 4, 6
<i>Potentilla ovina</i> var. <i>ovina</i>	Sheep cinquefoil	ROS		1
<i>Potentilla plattensis</i>	Platte cinquefoil	ROS	10	
<i>Pterospora andromeda</i>	Woodland pinedrops	ERI		6
<i>Pyrola chlorantha</i>	Greenish wintergreen	ERI		7
<i>Ranunculus glaberrimus</i> var. <i>ellipticus</i>	Sagebrush buttercup	RAN		1, 4
<i>Ranunculus ranunculinus</i>	Tadpole buttercup	RAN		1, 5
<i>Ranunculus uncinatus</i> var. <i>uncinatus</i>	Little buttercup	RAN		1
<i>Rumex salicifolius</i> var. <i>triangulivalvis</i>	Narrowleaved dock	PLG		1
<i>Salsola australis</i>	Russian-thistle	CHN		9, 10
[<i>Salsola kali</i> , <i>S. pestifer</i>]				
<i>Saxifraga rhomboidea</i>	Diamondleaf saxifrage	SAX		1, 4
<i>Schoenocrambe linifolia</i>	Flaxleaf plainsmustard	BRA		9
<i>Sedum lanceolatum</i>	Lance-leaved stonecrop	CRS		1, 2, 4
<i>Senecio canus</i>	Woolly groundsel	AST		1, 2, 4, 9
<i>Senecio integerrimus</i> var. <i>exaltatus</i>	Western groundsel	AST		1, 2
<i>Senecio rapifolius</i>	Openwoods groundsel	AST		5
<i>Senecio triangularis</i>	Arrowleaf groundsel	AST		1, 6, 8
<i>Senecio werneriiifolius</i>	Rock butterweed	AST		1, 4, 6
<i>Var. werneriiifolius</i>				
<i>Silene drummondii</i>	Drummond's catchfly	CRY		1, 2
<i>Solidago missouriensis</i>	Missouri goldenrod	AST	1, 4	
<i>Spergularia rubra</i>	Red sandspurrey	CRY		5
<i>Sphaeralcea coccinea</i>	Scarlet globemallow	MLV		9
<i>Sphaeromeria simplex</i>	Laramie false sagebrush	AST		1
<i>Stanleya pinnata</i>	Prince's-plume	BRA		9
<i>Stellaria calycantha</i>	Northern starwort	CRY		6
<i>Stellaria umbellata</i>	Umbellate starwort	CRY		7
<i>Stephanomeria runcinata</i>	Desert wire-lettuce	AST		2
<i>Streptopus amplexifolius</i>	Clasping-leaved twisted-stalk	LIL		6, 8
<i>Suaeda calceoliformis</i>	Broom seepweed	CHN		9
<i>Swertia radiata</i>	Green gentian	GEN		1, 4
[<i>Frasera speciosa</i>]				
<i>Taraxacum laevigatum</i>	Red-seeded dandelion	AST		2, 10
<i>Taraxacum officinale</i>	Common dandelion	AST		2, 5
<i>Thalictrum fendleri</i>	Fendler's meadow-rue	RAN		5
<i>Thermopsis rhombifolia</i>	Prairie golden-pea	FAB		2
<i>Thlaspi arvense</i>	Field pennycress	BRA		1, 2
<i>Townsendia hookeri</i>	Hooker's Easter-daisy	AST		1, 2
<i>Tragopogon dubius</i>	Yellow salsify	AST		2
<i>Trifolium andinum</i>	Intermountain clover	FAB		1
<i>Trifolium gymnocarpon</i>	Hollyleaf clover	FAB		1, 2
<i>Trifolium repens</i>	White clover	FAB	1, 5	
<i>Trollius laxus</i>	American globeflower	RAN		1
<i>Urtica dioica</i>	Stinging-nettle	URT		6
<i>Valeriana occidentalis</i>	Western valerian	VAL		6
<i>Veronica biloba</i>	Bilobed speedwell	SCR		1, 2
<i>Veronica peregrina</i> var. <i>xalapensis</i>	Purslane speedwell	SCR		1
<i>Veronica serpyllifolia</i>	Thyme-leaved speedwell	SCR		1

<i>Vicia americana</i>	Plains vetch	FAB	2
<i>Viola adunca</i>	Hookedspur violet	VIO	6
<i>Viola canadensis</i>	Canada violet	VIO	7
<i>Viola nuttallii</i>	Nuttall's violet	VIO	2
<i>Viola palustris</i>	Marsh violet	VIO	6, 8
<i>Viola praemorsa</i> var. <i>altior</i>	Upland yellow violet	VIO	1
<i>Viola purpurea</i> var. <i>venosa</i>	Purplish violet	VIO	1, 6
<i>Xylorhiza glabriuscula</i>	Smooth woody-aster	AST	9, 10
<i>Zigadenus elegans</i>	Elegant death-camas	LIL	1
<i>Zigadenus venenosus</i> var. <i>gramineus</i>	Meadow death-camas	LIL	2, 9

Graminoids

<i>Agropyron cristatum</i>	Crested wheatgrass	POA	2
<i>Bromus carinatus</i>	California brome	POA	1, 5, 6
<i>Bromus ciliatus</i>	Fringed brome	POA	1
<i>Bromus inermis</i> var. <i>inermis</i>	Smooth brome	POA	1, 2
<i>Bromus tectorum</i>	Cheatgrass	POA	1, 2
<i>Carex aquatilis</i>	Water sedge	CYP	1, 8
<i>Carex canescens</i>	Grey sedge	CYP	6
<i>Carex disperma</i>	Soft-leaved sedge	CYP	6, 8
<i>Carex filifolia</i>	Threadleaf sedge	CYP	2
<i>Carex geyeri</i>	Elk sedge	CYP	5, 6, 7
<i>Cares hoodii</i>	Hood's sedge	CYP	1, 6
<i>Carex illota</i>	Sheep sedge	CYP	6, 8
<i>Carex microptera</i>	Smallwing sedge	CYP	1
<i>Carex raynoldsii</i>	Raynold's sedge	CYP	1, 4
<i>Carex rossii</i>	Ross' sedge	CYP	1, 2, 4, 5, 6, 7
<i>Carex rostrata</i>	Beaked sedge	CYP	6, 8
<i>Carex stenophylla</i>	Narrowleaf sedge	CYP	3
<i>Carex vallicola</i>	Valley sedge	CYP	1, 4, 5
<i>Danthonia intermedia</i>	Timber oatgrass	POA	2, 5
<i>Danthonia unispicata</i>	Oneside oatgrass	POA	1, 4
<i>Deschampsia cespitosa</i>	Tufted hairgrass	POA	1, 8
<i>Distichlis stricta</i>	Alkali saltgrass	POA	9
<i>Eleocharis</i> sp.	Spikerush	CYP	1, 8
<i>Elymus cinereus</i>	Great Basin wild rye	POA	1
<i>Elymus elymoides</i>	Squirreltail	POA	1, 2, 9
[<i>Sitanion hystrix</i>]			
<i>Elymus hispidus</i> var. <i>ruthenicus</i>	Intermediate wildrye	POA	1
<i>Elymus lanceolatus</i> var. <i>lanceolatus</i>	Thickspike wheatgrass	POA	9
<i>Elymus smithii</i>	Western wheatgrass	POA	1, 2, 4, 9
<i>Elymus spicatus</i>	Bluebunch wheatgrass	POA	1, 2, 3, 4
<i>Elymus trachycaulus</i> var. <i>trachycaulus</i>	Bearded wheatgrass	POA	4, 5, 6, 7
<i>Festuca idahoensis</i>	Idaho fescue	POA	1, 2, 3, 5
<i>Festuca saximontana</i>	Mountain sheep fescue	POA	1, 4
<i>Juncus balticus</i> var. <i>montanus</i>	Baltic rush	JUN	1
<i>Juncus mertensianus</i>	Merten's rush	JUN	1
<i>Juncus tracyi</i>	Tracy's rush	JUN	6, 8
<i>Koeleria macrantha</i>	Junegrass	POA	1, 2, 3, 9

<i>Leucopoa kingii</i>	Spike fescue	POA	1, 2, 3, 4, 5, 6
<i>Luzula parviflora</i>	Small-flowered woodrush	JUN	1
<i>Melica bulbosa</i>	Oniongrass	POA	1
<i>Oryzopsis contracta</i>	Contracted Indian ricegrass	POA	9
<i>Oryzopsis exigua</i>	Little ricegrass	POA	5
<i>Oryzopsis hymenoides</i>	Indian ricegrass	POA	6
<i>Phleum alpinum</i>	Alpine timothy	POA	1
<i>Phleum pratense</i>	Common timothy	POA	1, 2
<i>Poa cusickii</i> var. <i>cusickii</i>	Cusick's bluegrass	POA	1, 2, 3, 5
<i>Poa fendleriana</i>	Muttongrass	POA	1, 2, 3
<i>Poa interior</i>	Inland bluegrass	POA	4, 5, 6
<i>Poa juncifolia</i>	Alkali bluegrass	POA	1
<i>Poa nervosa</i> var. <i>wheeleri</i>	Wheeler's bluegrass	POA	5, 6, 7
<i>Poa palustris</i>	Fowl bluegrass	POA	1, 6
<i>Poa pratensis</i>	Kentucky bluegrass	POA	1, 2
<i>Poa secunda</i> var. <i>secunda</i>	Sandberg bluegrass	POA	1, 2, 3, 4, 9, 10
<i>Sporobolus airoides</i>	Alkali saccaton	POA	9
<i>Stipa comata</i>	Needle-and-thread	POA	1, 4
<i>Stipa nelsonii</i> var. <i>nelsonii</i>	Nelson's needlegrass	POA	1, 2, 5
<i>Stipa pinetorum</i>	Pinewoods needlegrass	POA	1, 2, 4
<i>Trisetum spicatum</i>	Spike trisetum	POA	5, 7

Ferns and Fern Allies

<i>Cheilanthes feei</i>	Fee's lipfern	ADI	5
<i>Cystopteris fragilis</i>	Brittle bladder fern	ASL	5, 6
<i>Equisetum arvense</i>	Common horsetail	EQU	6, 8
<i>Pellaea breweri</i>	Brewer's cliff-brake	ADI	1
<i>Selaginella densa</i>	Compact spike-moss	SEL	1, 2, 5
<i>Woodsia oregana</i>	Oregon woodsia	ASL	5

Arabis pendulina Greene var. *russeola* (Roll.) Roll.
Daggett rock cress
Brassicaceae or Cruciferae (Mustard Family)

Synonyms: *Arabis demissa* var. *russeola*.

Heritage Rank: G5T3/S3 (WYNDD Watch list)

Legal Status: None.

Description: Daggett rock cress is a perennial, tufted herb with 1-several erect stems from a caudex (Figure 2). Stems are 4-12 inches (10-30 cm) tall and hirsute at the base or completely glabrous. Basal leaves are linear to oblanceolate with simple (unbranched) hairs on the margins. Stem leaves are small, sparsely hirsute to glabrous, and lack auricles. Flowers have 4 white to pink petals 3/16-1/4 inches (4.5-6.5 mm) long. Fruits are borne on spreading to downward-arching stalks 3/16-5/16 inches (5-8 mm) long. Fruit pods (siliques) are 3/4-1 1/2 inches (2-4 cm) long, 1/8 inches (1.5-2 mm) wide, and straight to slightly curved with blunt tips. Seeds are arranged in a single row and wingless (Rollins 1941, 1982, 1993; Dorn 1992; Fertig 1992).

Similar Species: *Arabis demissa* var. *languida*, *A. fendleri* var. *spatifoia*, and *A. pusilla* have a mixture of forked and simple hairs on the leaf blades. Other *Arabis* species in Wyoming have either erect fruit or more densely appressed pubescence on the leaves and stems (Dorn 1992).

Geographic Distribution: Regional endemic of northern Utah, western Colorado, and southern and central Wyoming (Rollins 1982). In Wyoming, it is known from the foothills of the southern Wind River Range, southern Bighorn Range, northern Uinta Range, Shirley Mountains, and Laramie Range, as well as the Green River and North Platte River basins in Albany, Carbon, Fremont, Natrona, and Sweetwater counties (WYNDD records).

Occurrences Within the Study Area: There are at least five small populations of this species on limestone outcrops at the east and northwest ends of the Shirley Mountains. It appears to be absent from areas of exposed granite bedrock in the central and western portions of the mountains.

Habitat: Daggett rockcress is found primarily on dry hills and slopes in sagebrush grasslands or cushion plant communities associated with limestone outcrops. In the Shirley Mountains, this taxon is often found on limey sandstone ledges or plate-like outcrops of bedrock. Soils are typically thin, reddish-brown, and have well-developed cryptogam crusts. Common associated species include *Sedum lanceolatum*, *Delphinium nuttallianum*, *Erigeron ochroleucus* var. *scribneri*, *Mertensia humilis*, *Potentilla ovina*, *Heuchera parvifolia*, *Astragalus spatulatus*, *Hymenoxys acaulis*, and *Sphaeromeria simplex*.

Flowering/Fruiting Period: Flowering occurs from late May to July. Fruits are present from June to July.

Population Size and Condition: Individual populations of Daggett rockcress range in size from 7 to over 200 plants. All populations were observed to occupy small and restricted microsites within limestone outcrops. The total population in the ecosystem probably numbers in the low thousands.

Existing and Potential Threats: Populations in the Shirley Mountains could be threatened by quarrying for limestone or construction of roads. Disturbance by off-road vehicles or recreationists could also be a threat in some areas.

Notes: Prior to 1980, this taxon was known from only two locations in Wyoming, one of which was considered an historical record (Dorn 1979). Recent surveys in central and southwestern Wyoming have resulted in the discovery of over 25 new locations. As a consequence, Daggett rockcress was dropped as a high priority species by WYNDD in 1994, although it remains as a “watch list” species. *A. pendulina* var. *russeola* was formerly a candidate for listing under the Endangered Species Act, but was dropped from consideration in 1985.

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

Eriogonum exilifolium Reveal
Slender-leaved buckwheat
Polygonaceae (Buckwheat Family)

Heritage Rank: G3/S2.

Legal Status: None.

Description: Slender-leaved buckwheat is a taprooted perennial herb forming dense mats 4-8 inches (10-20 cm) across (Figure 3). Leaves are all basal with narrowly linear blades 1/16 inches (1-2.5 mm) wide and 1 1/4-2 3/8 inches (3-6 cm) long. Leaf blades are green and nearly glabrous above and densely white-woolly below with smooth, slightly inrolled margins. The inflorescence is a compact head of 3-7 involucre borne on sparsely woolly stems 1 1/4-4 inches (3-10 cm) long. Each involucre is 1/8 inches (2.5-3.5 mm) long and 5-lobed. Perianth segments are white to rose colored, glabrous, 1/8 inches (2-3.5 mm) long, and lack a stipe-like base. Fruits are 3-angled, brown achenes 1/8 inches (2-3.5 mm) long (Reveal 1967, 1969; Dorn 1992).

Similar Species: *Eriogonum pauciflorum* has wider leaves with grayish-white pubescence on the upper and lower surfaces and hairy perianth segments. *E. ovalifolium* has broadly oval, gray-woolly leaf blades and typically has longer flowering stems (Dorn 1992).

Geographic Distribution: Regional endemic of south-central Wyoming (Albany and Carbon counties) and adjacent north-central Colorado (Grant, Jackson, and Larimer counties) (Reveal 1967). In Wyoming, this species is restricted to the Laramie and Shirley basins and adjacent foothills of the Medicine Bow and Laramie ranges.

Occurrences Within the Study Area: One extensive occurrence is found along the Shirley Mountain Loop Road and County Road 102 in the Shirley Basin just northeast of the Shirley Mountains.

Habitat: Occurs on semi-bare, sandy-clay gumbo flats, white shaley-gypsum ridges, red clay hills, and limestone outcrops in cushion plant-bunchgrass communities with low total cover. In the Shirley Mountains, this species is found on seleniferous clay-gumbo soils in borrow pits and dirt roadsides with average vegetative cover of 10-25%. Common associated species include *Eriogonum gordonii*, *Cirsium pulcherrimum*, *Gutierrezia sarothrae*, *Chrysothamnus viscidiflorus*, *Haplopappus wardii*, and *Stanleya pinnata*.

Flowering/Fruiting Period: Mid-June to late August.

Population Size and Condition: The Shirley Mountains foothill population was estimated to contain 75-100 plants in a limited area along the loop road in August, 1996. The plants were observed to be "locally common" along the same road in a brief survey in July, 1993 (WYNDD records).

Existing and Potential Threats: Despite being located alongside the main access road to the Shirley Mountains, this population does not appear to be greatly threatened. Construction and periodic blading of this natural-surface road has probably created new habitat for this species where competition with surrounding vegetation is low. The plants appear to be resilient to low-levels of disturbance by vehicles and have not been observed to be grazed by livestock.

Notes: Slender-leaved buckwheat is currently known from seven locations in Wyoming, all of which have been discovered or relocated since 1979. The species may be locally abundant in areas of suitable habitat, but such areas are typically small and widely scattered.

Figure 3. Line drawing of *Eriogonum exilifolium* by W. Fertig.

Haplopappus wardii (Gray) Dorn
Ward's goldenweed
Asteraceae or Compositae (Sunflower Family)

Synonyms: *Oonopsis wardii*, *O. condensata*.

Heritage Rank: G2/S2.

Legal Status: None.

Description: Hall's goldenweed is a multi-branched, perennial herb with a woody caudex and leafy stems up to 16 inches (40 cm) tall (Figure 4). Leaves are alternate, lance-shaped to oblong, 7/8-4 inches (2-10 cm) long, 3/16-5/16 inches (4-7 mm) wide, glabrous, and smooth-margined. The flat-topped to slightly rounded inflorescence is composed of 3-12 rayless heads borne among the terminal leaves. The involucre of each head is 1/2-7/8 inches (12-20 mm) long and contains 15-25 yellow disk flowers. Fruits are glabrous achenes with capillary pappus bristles (Hall 1928; Clark and Dorn 1979; Dorn 1992).

Similar Species: *Haplopappus multicaulis* has yellow ray flowers, shorter stems, and leaves less than 5 mm wide. In vegetative condition, *Xylorhiza glabriuscula* can be distinguished by its narrower, gray-green leaves and ragged involucre margins. Species of *Chrysothamnus* differ in having numerous small heads, elongate involucres, and narrower leaves.

Geographic Distribution: Endemic to the Laramie and Shirley basins and the Casper Arch area in Albany, Carbon, and Natrona counties, Wyoming.

Occurrences Within the Study Area: One extensive occurrence consisting of seven subpopulations is found at the base of the Shirley Mountains along the Shirley Basin Road (County Road 102) and the Shirley Mountain Loop Road (BLM Road 3115).

Habitat: Ward's goldenweed is typically found on selenium-rich, clay-shale slopes, barren plains, and roadsides at elevations of 7100-8800 feet. In the Shirley Basin area, this species is mostly restricted to gravelly gumbo-clay roadside borrow pits and low areas dominated by *Atriplex gardneri*, *Elymus spicatus*, and *Oryzopsis contracta*. Scattered individuals may also be found in adjacent stands dominated by *Artemisia pedatifida* and *Atriplex gardneri*. Total vegetative cover in occupied habitats ranges from 20-25% in barrow pits to 50% in roadside shrub-grasslands. Common associated species include *Salsola australis*, *Suaeda calceoliformis*, *Distichlis stricta*, *Eriogonum exilifolium*, *E. gordonii*, *Stanleya pinnata*, *Cirsium pulcherrimum*, and *Cryptantha celosioides*.

Flowering/Fruiting Period: Late July-late September.

Population Size and Condition: The Shirley Mountain foothills population was surveyed in August 1996 and found to contain an estimated 20,000 individuals in 115 acres of habitat. This occurrence was found to consist of 7 subpopulations, each containing

2500-4500 individuals. Densities were observed to be as high as 8-12 plants per square foot.

Existing and Potential Threats: Although located mostly along roads, this species does not appear to be adversely impacted by vehicle disturbance in borrow pits and roadside areas. Periodic road blading may actually create suitable habitat where this species has an advantage over other species better adapted to competition. Herbicide spraying may be detrimental to this species.

Notes: Section *Oonopsis* of *Haplopappus* consists of six taxa that are all primary selenium indicators and all nearly endemic to the eastern plains of Wyoming and Colorado. Chloroplast DNA studies have shown little interspecific or interpopulational variation in these species, suggesting that the whole group is recently evolved. Based on chromosome studies, *H. wardii* is thought to be the basal species in the complex (Evans 1991).

Figure 4. Line drawing of *Haplopappus wardii* (Hall 1928).

Polemonium brandegei (Gray) Greene
Brandegee's Jacob's-ladder
Polemoniaceae (Phlox Family)

Synonyms: *Polemonium viscosum* var. *mellitum*.

Heritage Rank: G4/S2 (WYNDD Watch list).

Legal Status: None.

Description: Brandegee's Jacob's-ladder is a foul-smelling, perennial herb with erect, leafy, glandular-pubescent stems up to 16 inches (40 cm) tall (Figure 5). The leaves are 3-10 inches (7.5-25 cm) long and divided into 30-60 deeply 1-5 lobed oval leaflets (these leaflet segments often appear to be whorled, but may also be opposite). Flowers are arranged in a raceme or spike-like inflorescence. The yellowish-white corolla is shaped like a flared tube with 5 short lobes at the tip and is about 3 times longer than the calyx (Davidson 1950; Harrington 1954; Cronquist et al. 1984; Jensen 1987).

Similar Species: *Polemonium viscosum* typically has blue-purple, tubular flowers that are usually only 2 times longer than the calyx and leaflets that are more densely whorled. Occasional albino forms can be distinguished by their subalpine to alpine habitat (Dorn 1992).

Geographic Distribution: Occurs from northern Wyoming and South Dakota to central New Mexico and southern Utah (Davidson 1950). In Wyoming, this species is restricted to the Big Horn, Laramie, Medicine Bow, Shirley, Ferris, and Granite mountains (Albany, Big Horn, Carbon, Converse, Laramie, Natrona, and Washakie counties).

Occurrences Within the Study Area: At least 4 colonies are known from the summit and east slope of the Shirley Mountains. Many additional small colonies are likely to occur in the mountains based on the amount of potential granite and limestone cliff and boulder habitat present.

Habitat: Brandegee's Jacob's-ladder is found primarily in crevices in sandstone, limestone, or granite cliffs and rock outcrops in open or semi-shady forests of aspen, limber pine, lodgepole pine, or Douglas-fir at elevations below 9000 feet. Occasionally, it can also be found at the base of rock and boulder outcrops on well-shaded, needle-rich soil. In the Shirley Mountains, this species is commonly associated with *Potentilla glandulosa*, *Cystopteris fragilis*, *Heuchera parvifolia*, *Leucopoa kingii*, *Elymus trachycaulus*, *Holodiscus dumosus*, *Juniperus communis*, *Ribes cereum*, and *Acer glabrum*.

Flowering/Fruiting Period: Flowers from mid June-July. Fruits present from July - September.

Population Size and Condition: Individual colonies range in size from 50-500 individuals and may be restricted to single boulders or extensive cliff systems. The total population in the Shirley Mountains probably numbers in the low thousands.

Existing and Potential Threats: Threats to this species are fairly low due to its rugged habitat.

Notes: *P. brandegei* is currently known from about 20 occurrences in Wyoming, most of which have been discovered or relocated in the last 15 years. Recent surveys have found that this species is more abundant, more widespread, and less threatened than once thought. It was dropped as a high priority species by WYNDD in 1994, but is still maintained as a “watch list” species.

Figure 5. Line drawing of *Polemonium brandegei* (Davidson 1950).

Sphaeromeria simplex (A. Nels.) Heller
Laramie false sagebrush
Asteraceae (Sunflower Family)

Heritage Rank: G1/S1.

Legal Status: USDA Forest Service Region 2: Sensitive. USDI Fish and Wildlife Service: former C2 candidate.

Description: Laramie false sagebrush is a mat-forming, perennial herb less than 4 3/4 inches (12 cm) tall (Figure 6). The silvery-hairy leaves are crowded at the base of the stem and are entire or 2-3 toothed at the tip. Flowering stems have 2-3 small, linear leaves and a single, terminal flower head of numerous, yellow disk flowers (ray flowers are absent). The involucre is composed of 2 rows of green bracts with membranous margins. No pappus is present on the ribbed achenes (Coulter and Nelson 1909; Dorn 1980; Fertig 1993; Fertig et al. 1994).

Similar Species: *Sphaeromeria capitata* has a single, large, head-like inflorescence composed of 2 or more separate, sessile flower heads (recognized by the presence of more than one involucre). Herbaceous species of *Artemisia* have numerous flower heads arranged in spikes, racemes, or panicles (Fertig et al. 1994). Vegetative and rayless specimens of *Hymenoxys acaulis* differ in having tufts of white hairs at the base of the sessile, entire leaves (Fertig 1993).

Geographic Distribution: Endemic to south-central Wyoming, where it is known only from two sites in the foothills of the Laramie Range near Laramie and Little Medicine (Albany, Converse, and Natrona counties), and a third location on the summit of the Shirley Mountains (Carbon County) (Fertig 1993; Mountain West Environmental Services 1996).

Occurrences Within the Study Area: One population, composed of seven subpopulations, is known from a 1.7 square mile area on the northwest summit of the Shirley Mountains. This population was first discovered in 1984 and was initially suspected to represent a new and undescribed taxon due to its late flowering period and subtle morphological differences (R. Dorn, personal communication). For proprietary reasons, the location of this population was not initially reported (Mountain West Environmental Services 1996). Fertig (1993) independently discovered this population and reported initial census results to the BLM. Follow-up surveys were conducted by Fertig in 1995-96 and by R. Dorn in 1996 (Mountain West Environmental Services 1996).

Habitat: In the Shirley Mountains, this species is found primarily on gentle limestone slopes and ridgetops with pockets of reddish-brown, loose soil covered by small, gray limestone gravel at elevations of 8360-8760 feet. The vegetation consists of low cushion plants and scattered *Artemisia tripartita* var. *rupicola*, *A. tridentata* var. *vaseyana* and *Poa secunda*. Common associated species include *Lesquerella alpina*, *Arenaria hookeri*, *Draba oligosperma*, *Erigeron ochroleucus* var. *scribneri*, *Lomatium orientale*, *Haplopappus acaulis*, *Astragalus spatulatus*, and *Hymenoxys torreyana*.

Other populations in Wyoming differ in occurring on low limestone foothills ridges at elevations of 7200-7700 feet.

Flowering/Fruiting Period: In the Shirley Mountains, Laramie false sagebrush flowers from early June to mid July and can produce fruit into mid-August. Lower elevation populations in the state begin flowering in mid-May and complete fruiting by late June or early July.

Population Size and Condition: The Shirley Mountain population was originally estimated to contain several thousand individuals in 3 subpopulations by Fertig (1993). A more complete survey in 1995 and 1996 resulted in an estimate of 10,000-15,000 individuals in 5 subpopulations (Fertig, unpublished data). R. Dorn also surveyed this occurrence in 1996 and estimated the total population to be 18,100 individuals in 7 subpopulations (Mountain West Environmental Services 1996). Dorn found densities to range from 40 to 262 plants per acre.

Existing and Potential Threats: The construction of the microwave tower along BLM Road 3115 (sometime in the last 10 years) resulted in the loss of some habitat for this species (Mountain West Environmental Services 1996). Additional habitat has probably been lost due to construction of the Shirley Mountain Loop Road. Plants adjacent to this road may be threatened by vehicle disturbance or loss of habitat due to erosion. Construction of additional roads and the proliferation of unplanned two-track roads should be discouraged in this area.

Figure 6. Line drawing of *Sphaeromeria simplex* by Jane Dorn (Fertig et al. 1994).

Plant Associations

The Shirley Mountains apparently contain no rare plant associations (Table 2). Rather, the vegetation of the area consists of plant associations that are common in the low mountains of Wyoming. The limber pine forests mapped by the BLM (USDI Bureau of Land Management 1993) and the Wyoming Game and Fish Department (1994), which cover ca. 35% of all lands in the Mountains, comprise the limber pine/common juniper, limber pine/King spikefescue, and limber pine/bluebunch wheatgrass associations, with small inclusions of the quaking aspen/Fendler's meadow rue association (Tables 3 and 4). (The presence of seemingly disparate plant associations within a single vegetation type, such as the quaking aspen/Fendler's meadow rue association within the BLM limber pine vegetation type, is due partly to the plant associations being described at a larger scale. The descriptions of the BLM types [USDI Bureau of Land Management 1994] give more detail than does the BLM map [USDI Bureau of Land Management 1993]).

Lodgepole pine forests, which cover ca. 18% of all lands in the Shirley Mountains (USDI Bureau of Land Management 1994, Wyoming Game and Fish Department 1994), consist mainly of the lodgepole pine/grouse whortleberry association with some areas of the lodgepole pine/common juniper association (Tables 3 and 4). The aspen woodlands, a minor type, contain small patches of the quaking aspen/common juniper association and the quaking aspen/Utah snowberry association (Tables 3 and 4). Although the spruce-fir forests were not visited in this project, information about this type in the Shirley Mountains (USDI Bureau of Land Management 1994) and about spruce and fir forests in the Laramie and Medicine Bow Mountains and the Sierra Madre (Alexander et al. 1986) suggests that they include the subalpine fir/grouse whortleberry association on uplands and the Engelmann spruce/fragrant bedstraw association along streams (Tables 3 and 4).

The non-forest vegetation types of the Shirley Mountains (Wyoming Game and Fish Department 1994) contain a variety of shrubland and grassland plant associations (Table 4). Within the mixed sagebrush/grassland type, the most common association probably is the three-tip sagebrush/Idaho fescue association. The mixed sagebrush/grassland type also includes the Wyoming big sagebrush/bluebunch wheatgrass association, three associations with mountain big sagebrush as the dominant shrub (of which the most common is the mountain big sagebrush/Idaho fescue association), the Idaho fescue-bluebunch wheatgrass grassland association, and small areas of the water sedge association along stream channels.

The mountain foothills/grassland type contains an equally diverse collection of plant associations (Table 4). Among these, the mountain big sagebrush/Idaho fescue shrubland association is common in openings in the limber pine woodlands and lodgepole pine forests atop the Shirley Mountains, and the true mountain mahogany/bluebunch wheatgrass shrubland association is found on limestone outcrops around the fringes of the Mountains. Within the bitterbrush/sagebrush/mixed shrub type that occurs primarily along the eastern side of the Mountains (Wyoming Game and Fish Department 1994), the main plant association is the three-tip sagebrush/Idaho fescue association. The identity of the plant associations within the birch/alder vegetation type is less clear. Field work revealed one stand of the water birch shrubland plant association, and the thinleaf alder association, known from the Medicine Bow Mountains

and the Sierra Madre (Jones 1992), may also be present. Indeed the Wyoming Game and Fish Department's analysis of the Shirley Mountains (Wyoming Game and Fish Department 1994) mentions riparian vegetation along a number of creeks, but it does not describe the composition of the vegetation.

As is the case for many riparian plant associations, the water birch association has a relatively high conservation rank of G3 (Table 2). This rank suggests that the occurrences of the water birch association (and occurrences of other riparian associations) in the Shirley Mountains possess considerable conservation interest, as defined in this project. 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 occurrences have been substantially altered by livestock grazing, change in hydrologic regimes, removal of beavers, and introduction of exotic plants. According to the Wyoming Game and Fish Department habitat analysis (1994), much of the riparian vegetation in the Shirley Mountains is in rather poor condition, and the area may not contain any high-quality occurrences of the riparian shrub types.

The edges of this project's study area are outside the area covered by the BLM map of forest communities (USDI Bureau of Land Management 1993) and the Wyoming Game and Fish Department (1994) vegetation map. The vegetation within these edges was not sampled, but the northern and western edges are, geologically and topographically, extensions of the western Shirley Mountains, and observations from nearby roads suggest that the vegetation also is an extension of the mix of plant associations in the western part of the Shirley Mountains: a matrix of the three-tip sagebrush/Idaho fescue association and the Wyoming big sagebrush/ bluebunch wheatgrass association with inclusions of mountain big sagebrush shrub associations, the true mountain mahogany/ bluebunch wheatgrass association, and grassland associations. The southern and eastern edges of the study area contain shales and sandstones quite different from the geologic substrates of the Shirley Mountains and may best be considered parts of the adjoining basins. The vegetation there includes basin-type plant associations missing from the adjoining mountains: the Gardner saltbush/Indian ricegrass association and the birdfoot sagebrush-Gardner saltbush association on broad uplands, and the black greasewood/western wheatgrass association in draws.

Summary and Management Recommendations

Rare Plant Species

Of the five plant species of special concern known from the Shirley Mountains ecosystem, only *Sphaeromeria simplex* is in need of special management attention at the present time. The Shirley Mountains population is potentially threatened by surface-disturbing activities, including road construction and disturbance by off-road vehicles. The known habitat of this species should be withdrawn from mineral entry and additional road construction. In addition, an attempt should be made to prevent unplanned roads from being established in the area. A representative example of the cushion plant community inhabited by this species (preferably away from the Shirley Mountain Loop Road) should be designated as an Area of Critical Environmental Concern to ensure that the habitat receives the management attention it needs.

Plant Associations

The vegetation of the Shirley Mountains is valuable in providing a variety of resources (USDI Bureau of Land Management 1994, Wyoming Game and Fish Department 1994), and careful management that will maintain or improve the condition of the vegetation there is an important conservation goal. The Shirley Mountains apparently do not, though, contain occurrences of particular conservation interest as defined in this project: occurrences of rare plant associations, or occurrences that represent unusually high-quality examples of common plant communities, particularly those communities that are not represented in special management areas.

Table 2. TNC plant associations in the Shirley Mountains.

Common names are primarily from USDA Soil Conservation Service (1994) and scientific names are from Dorn (1992). "Ranks", assigned by the network of natural heritage programs, express the conservation status of a community and are explained in Appendix B. Locations of sample plots are described in Appendix A.

- Subalpine fir/Grouse whortleberry (*Abies lasiocarpa/Vaccinium scoparium*) forest. Rank: G5S5. Location: Not sampled; inferred from USDI Bureau of Land Management (1994).
- Engelmann spruce/Fragrant bedstraw (*Picea engelmannii/Galium triflorum*) forest. Rank: G4S4. Location: Not sampled; inferred from USDI Bureau of Land Management (1994).
- Lodgepole pine/Grouse whortleberry (*Pinus contorta/Vaccinium scoparium*) forest. Rank: G5S5. Locations: 19a, 19d, 20a.
- Lodgepole pine/Common juniper (*Pinus contorta/Juniperus communis*) woodland. Rank: G5S5. Locations: 12, 15a, 15d.
- Limber pine/Common juniper (*Pinus flexilis/Juniperus communis*) woodland. Rank: G5S4. Locations: 4b, 15c, 24c.
- Limber pine/Bluebunch wheatgrass (*Pinus flexilis/Elymus spicatus*) woodland? Rank: G4S?. Location: 20c?
- Limber pine/King spikefescue (*Pinus flexilis/Leucopoa kingii*) woodland. Rank: G4S4. Locations: 14, 24b.
- Quaking aspen/Fendler's meadowrue (*Populus tremuloides/Thalictrum fendleri*) forest. Rank: G5S?. Location: 15b.
- Quaking aspen/Utah snowberry (*Populus tremuloides/Symphoricarpos oreophilus*) forest. Rank: G5S4. Location: 26a.
- Quaking aspen/Common juniper (*Populus tremuloides/Juniperus communis*) forest. Rank: G4S3. Location: 17a.
- Water birch (*Betula occidentalis*) shrubland. Rank: G3S3. Location: 8a.
- Thinleaf alder (*Alnus incana*) shrubland? Rank: G3S3. No stands of this association were visited. Thinleaf alder shrub vegetation is present in riparian areas in central Wyoming at roughly the same elevations as the Shirley Mountains, and it may be present there.
- True mountain mahogany/Bluebunch wheatgrass (*Cercocarpus montanus/Elymus spicatus*) shrubland. Rank: G5S3. Locations: 10, 24a, 25b.
- Chokecherry (*Prunus virginiana*) shrubland. Rank: G4SP. Location: 17b.
- Wyoming big sagebrush/Bluebunch wheatgrass (*Artemisia tridentata ssp. wyomingensis/Elymus spicatus*) sparse shrubland. Rank: G5S5. Locations: 1, 6.
- Mountain big sagebrush/Idaho. fescue (*Artemisia tridentata ssp. vaseyana/Festuca idahoensis*) sparse shrubland. Rank G5S5. Locations: 1, 2, 19c, 22, 23.

Table 2 (continued). TNC plant associations in the Shirley Mountains.

- Mountain big sagebrush/Western wheatgrass (*Artemisia tridentata* ssp. *vaseyana*/*Elymus smithii*) shrubland. Rank: G3S3?. Locations: 9, 11b.
 - Mountain big sagebrush/Bluebunch wheatgrass (*Artemisia tridentata* ssp. *vaseyana*/*Elymus spicatus*) shrubland. Rank: G4S4. Locations: 20b, 25a.
 - Mountain big sagebrush/Basin wildrye (*Artemisia tridentata* ssp. *vaseyana*/*Elymus cinereus*) shrubland. Rank: G4S?. Location: 8b.
 - Three-tip sagebrush/Idaho fescue (*Artemisia tripartita* ssp. *rupicola*/*Festuca idahoensis*) sparse shrubland. Rank: G4S4. Locations: 2, 3, 17c?, 26b?
 - Black sagebrush/Bluebunch wheatgrass (*Artemisia nova*/*Elymus spicatus*) sparse dwarf shrubland. Rank: G5S4. Locations: 4a, 5, 7, 11a, 13, 17c.
 - Birdfoot sagebrush-Gardner saltbush (*Artemisia pedatifida*-*Atriplex gardneri*) sparse dwarf shrubland. Rank: G?S?. Location: Eastern edge of the study area, on the western fringe of the Shirley Basin.
 - Black greasewood/western wheatgrass (*Sarcobatus vermiculatus*/*Elymus smithii*) association. Rank: G4S4. Location: Eastern edge of the study area, on the western fringe of the Shirley Basin.
 - Idaho fescue-Bluebunch wheatgrass (*Festuca idahoensis*-*Elymus spicatus*) herbaceous vegetation. Rank G4S3S4. Locations: 1, 18, 21.
 - Idaho fescue-Timber oatgrass (*Festuca idahoensis*-*Danthonia intermedia*) herbaceous vegetation. Rank: G3?S3? Location: 19b.
 - Bluebunch wheatgrass (*Elymus spicatus*) - cushion plant herbaceous vegetation. Rank: G3S3. Location: 16.
 - Water sedge (*Carex aquatilis*) herbaceous vegetation. Rank: G5S4. Location: 2.
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Table 3. Comparison of BLM forest communities with TNC plant associations found at sampling locations in the Shirley Mountains.

The sampling locations are described in Appendix A. The BLM type at each location was identified from a 1:100,000-scale map of the Shirley Mountains (USDI Bureau of Land Management 1994). The TNC type at each location was identified during field work.

BLM Type: Woodland

TNC types:

- Limber pine/Common juniper (*Pinus flexilis/Juniperus communis*) woodland. Locations: 4b, 15c, 24c
- Limber pine/King spikefescue (*Pinus flexilis/Leucopoa kingii*) woodland. Location: 14
- Limber pine/Bluebunch wheatgrass (*Pinus flexilis/Elymus spicatus*) woodland? Location: 20c
- Quaking aspen/Fendler's meadow rue (*Populus tremuloides/Thalictrum fendleri*) forest. Location: 15b

BLM Type: Lodgepole pine

TNC types:

- Lodgepole pine/Common juniper (*Pinus contorta/Juniperus communis*) woodland. Locations: 12, 15a, 15d
- Lodgepole pine/Grouse whortleberry (*Pinus contorta/Vaccinium scoparium*) forest. Locations: 19a, 19d, 20a

BLM Type: Aspen

TNC types:

- Quaking aspen/Common juniper (*Populus tremuloides/Juniperus communis*) forest. Location: 17a
- Quaking aspen/Utah snowberry (*Populus tremuloides/Symphoricarpos oreophilus*) forest. Location: 26a

BLM Type: Spruce - Fir

TNC types:

No stands of forest or woodland dominated by Engelmann spruce or subalpine fir were visited during the 1996 field work. Based on the descriptions of the spruce-fir type in USDI Bureau of Land Management (1994) and the locations and composition of spruce and fir forests in nearby mountains, the Shirley Mountain spruce-fir type may include the following plant associations:

- Subalpine fir/Grouse whortleberry (*Abies lasiocarpa/Vaccinium scoparium*) forest. This type succeeds the lodgepole pine/grouse whortleberry association on relatively dry upland sites.
- Engelmann spruce/Fragrant bedstraw (*Picea engelmannii/Galium triflorum*) forest. This type grows in moist sites along stream channels.

Table 4. Comparison of Wyoming Game and Fish Department vegetation types with TNC plant associations at sampling locations in the Shirley Mountains.

The sampling locations are described in Appendix A. The Wyoming Game and Fish Department type at each location was identified from a 1:50,000-scale map of the Shirley Mountains (Wyoming Game and Fish Department 1994). The TNC type at each location was identified during field work.

WGFD Type: Mixed sagebrush/grassland

TNC types:

- Wyoming big sagebrush/Bluebunch wheatgrass (*Artemisia tridentata* ssp. *wyomingensis*/*Elymus spicatus*) sparse shrubland. Locations: 1, 6
- Mountain big sagebrush/Western wheatgrass (*Artemisia tridentata* ssp. *vaseyana*/*Elymus smithii*) shrubland. Locations: 9, 11b
- Mountain big sagebrush/Bluebunch wheatgrass (*Artemisia tridentata* ssp. *vaseyana*/*Elymus spicatus*) shrubland. Location: 20b
- Mountain big sagebrush/Idaho fescue (*Artemisia tridentata* ssp. *vaseyana*/*Festuca idahoensis*) sparse shrubland. Locations: 1, 2
- Mountain big sagebrush/Basin wildrye (*Artemisia tridentata* ssp. *vaseyana*/*Elymus cinereus*) shrubland. Location: 8b
- Three-tip sagebrush/Idaho fescue (*Artemisia tripartita* ssp. *rupicola*/*Festuca idahoensis*) dwarf shrubland. Locations: 2, 3:
- Idaho fescue-Bluebunch wheatgrass (*Festuca idahoensis*-*Elymus spicatus*) herbaceous vegetation. Location: 1
- Water sedge (*Carex aquatilis*) herbaceous vegetation. Location: 2

WGFD Type: Mountain foothills/grassland

TNC types:

- True mountain mahogany/Bluebunch wheatgrass (*Cercocarpus montanus*/*Elymus spicatus*) shrubland. Locations: 10, 24a
- Mountain big sagebrush/Idaho fescue (*Artemisia tridentata* ssp. *vaseyana*/*Festuca idahoensis*) sparse shrubland. Locations: 19c, 22, 23
- Mountain big sagebrush/Bluebunch wheatgrass (*Artemisia tridentata* ssp. *vaseyana*/*Elymus spicatus*) shrubland. Location: 25a
- Black sagebrush/Bluebunch wheatgrass (*Artemisia nova*/*Elymus spicatus*) sparse dwarf shrubland. Locations: 4a, 5, 7, 11a, 13
- Idaho fescue-Bluebunch wheatgrass (*Festuca idahoensis*-*Elymus spicatus*) herbaceous vegetation. Locations: 18, 21
- Idaho fescue-Timber oatgrass (*Festuca idahoensis*-*Danthonia intermedia*) herbaceous vegetation. Location: 19b

Table 4 (continued). Comparison of Wyoming Game and Fish Department vegetation types with TNC plant associations found at sampling locations in the Shirley Mountains.

WGFD Type: Mountain foothills/grassland (continued)

TNC types:

- Bluebunch wheatgrass (*Elymus spicatus*) - cushion plant herbaceous vegetation. Location: 16

WGFD Type: Bitterbrush/sagebrush/mixed shrub

TNC types:

- True mountain mahogany/Bluebunch wheatgrass (*Cercocarpus montanus/Elymus spicatus*) shrubland. Location: 25b
- Chokecherry (*Prunus virginiana*) shrubland. Location: 17b
- Three-tip sagebrush/Idaho fescue (*Artemisia tripartita ssp. rupicola/Festuca idahoensis*) dwarf shrubland. Locations: 17c, 26b

WGFD Type: Limber pine

TNC types:

- Limber pine/Bluebunch wheatgrass (*Pinus flexilis/Elymus spicatus*) woodland ? Locations: 20c, 24b

WGFD Type: Lodgepole pine

TNC types:

- Limber pine/Common juniper (*Pinus flexilis/Juniperus communis*) woodland. Locations: 4b, 15c, 24c
- Limber pine/King spikefescue (*Pinus flexilis/Leucopoa kingii*) woodland. Location: 14
- Lodgepole pine/Common juniper (*Pinus contorta/Juniperus communis*) woodland. Locations: 12, 15a, 15d
- Lodgepole pine/grouse whortleberry (*Pinus contorta/Vaccinium scoparium*) forest. Locations: 19a, 19d, 20a
- Quaking aspen/Fendler's meadow rue (*Populus tremuloides/Thalictrum fendleri*) forest. Location: 15b

WGFD Type: Aspen

TNC types:

- Quaking aspen/Common juniper (*Populus tremuloides/Juniperus communis*) forest. Location: 17a
- Quaking aspen/Utah serviceberry (*Populus tremuloides/Symphoricarpos oreophilus*) forest. Location: 26a

Table 4 (continued). Comparison of Wyoming Game and Fish Department vegetation types with TNC plant associations found at sampling locations in the Shirley Mountains.

WGFD Type: Engelmann spruce/Subalpine fir

TNC types:

No stands of forest or woodland dominated by Engelmann spruce or subalpine fir were visited during the 1996 field work. Based on the descriptions of the spruce-fir type in USDI Bureau of Land Management (1994) and the locations and composition of spruce and fir forests in nearby mountains, the Shirley Mountain spruce-fir type may include the following plant associations:

- Subalpine fir/Grouse whortleberry (*Abies lasiocarpa/Vaccinium scoparium*) forest. This type succeeds the lodgepole pine/grouse whortleberry association on relatively dry upland sites.
- Engelmann spruce/Fragrant bedstraw (*Picea engelmannii/Galium triflorum*) forest. This type grows in moist sites along stream channels.

WGFD Type: Birch/Alder

TNC types:

- Water birch (*Betula occidentalis*) shrubland. Location 8a. This is a common riparian shrub type in the region at elevations similar to the Shirley Mountains, and it may be present throughout the mountains as well as at location 8a on the northwestern side of the area.
 - Thinleaf alder (*Alnus incana*) shrubland? No stands of vegetation dominated by thinleaf alder (*Alnus sinuata*) were visited during the 1996 field work. Thinleaf alder shrub vegetation is present in riparian areas in central Wyoming at roughly the same elevations as the Shirley Mountains, and it may be present there.
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Appendix A. 1996 sampling locations in the Shirley Mountains. BLM types are taken from USDI Bureau of Land Management (1994) and WGFD types from Wyoming Game and Fish Department (1994).

Canopy cover is noted for the major species in each life form using the following cover classes and codes:

<u>Code</u>	<u>Range in Canopy Cover</u>
1	<1%
3	1% - 4.9%
10	5% - 14.9%
20	15% - 24.9%
30	25% - 34.9%
40	35% - 44.9%
50	45% - 54.9%
60	55% - 64.9%
70	65% - 74.9%
80	75% - 84.9%
90	85% - 94.9%
98	95% - 100%

Location 1. T26N, R83W, Sec 23, NW1/4

Elevation: 7250 feet Aspect: West

Substrate: Pre-Cambrian

TNC Type: Matrix of *Artemisia tridentata ssp. wyomingensis*/*Elymus spicatus* sparse shrubland, with inclusions of *Artemisia tridentata ssp. vaseyana*/*Festuca idahoensis* shrubland (in sagebrush islands and on edges of draws) and *Festuca idahoensis-Elymus spicatus* herbaceous vegetation on slopes.

BLM Type: Non-forest

WGFD Type: Mixed sagebrush/grassland

General description: Grassland vegetation with scattered shrubs, growing on rolling hills in the western part of the Shirley Mountains. Sagebrush cover is denser in island and in draws.

Vegetation:

TREES: None

SHRUBS: *Artemisia tridentata ssp. wyomingensis* 10, *Artemisia nova* 3, *Artemisia pedatifida* 3

GRAMINOIDS: *Elymus spicatus*, *Koeleria macrantha*, *Poa secunda*, *Poa cusickii*

FORBS: *Phlox hoodii*, *Sedum lanceolatum*

Location 2: T26N, R83W, Sec 24, SE1/4

Elevation: 7500 feet Aspect: North & northwest

Substrate: Pre-Cambrian

TNC Type: Matrix of *Artemisia tripartita ssp. rupicola*/*Festuca idahoensis* with inclusions of *Artemisia tridentata ssp. vaseyana*/*Festuca idahoensis* (in islands and draws) and *Carex aquatilis* herbaceous vegetation in draws.

BLM Type: Non-forest

WGFD Type: Mixed sagebrush/grassland

General description: Grassland with low shrubs growing on rolling hills on the northwestern side of the Shirley Mountains.

Vegetation:

TREES: None

SHRUBS: *Artemisia tripartita ssp. rupicola* 20, *Artemisia tridentata ssp. wyomingensis* 10

GRAMINOIDS: *Poa cusickii*, *Koeleria macrantha*, *Festuca idahoensis*

FORBS:

Location 3: T26N, R83W, Sec 24, SE1/4 & Sec 19, SW1/4
Elevation: 7500 feet Aspect: Northwest
Substrate: Pre-Cambrian
TNC Type: *Artemisia tripartita ssp. rupicola/Festuca idahoensis* sparse dwarf shrubland
BLM Type: Non-forest
WGFD Type: Mixed sagebrush/grassland
General description: Grassland with low shrubs growing on rolling hills on the northwestern side of the Shirley Mountains.
Vegetation:
TREES: None
SHRUBS: *Artemisia tripartita ssp. rupicola* 10, *Artemisia tridentata ssp. wyomingensis* 10
GRAMINOIDS: *Poa cusickii*, *Koeleria macrantha*, *Festuca idahoensis*, *Elymus spicatus*
FORBS:

Location 4a: T26N, R82W, Sec 18, SW1/4 and SE1/4
Elevation: 7250 feet Aspect: West
Substrate: Limestone
TNC Type: *Artemisia nova/Elymus spicatus* sparse dwarf shrubland
BLM Type: Non-forest
WGFD Type: Mountain foothills/grassland
General description: Grassland with sparse low shrubs, growing on limestone dipslope. Limber pine woodlands grow in nearby draws and on northerly slopes.
Vegetation:
TREES: None
SHRUBS: *Artemisia nova* 10, *Artemisia tridentata ssp. wyomingensis* 3
GRAMINOIDS: *Elymus spicatus*, *Poa secunda*
FORBS:

Location 4b: T26N, R82W, Sec 18, SW1/4 and SE1/4
Elevation: 7250 feet Aspect: Northeast
Substrate: Limestone
TNC Type: *Pinus flexilis/Juniperus communis* woodland
BLM Type: Woodland
WGFD Type: Lodgepole pine
General description: Conifer woodland, with small patches of aspen, on the edge of a valley.
Vegetation:
TREES: *Pinus flexilis* 40, *Juniperus scopulorum* 3, *Populus tremuloides* 3
SHRUBS: *Juniperus communis* 10, *Symphoricarpos oreophilus* 3, *Mahonia repens* 3
GRAMINOIDS:
FORBS:

Location 5: T26N, R82W, Sec 18, NE1/4
Elevation: 7300 feet Aspect: North
Substrate: Limestone
TNC Type: *Artemisia nova/Elymus spicatus* sparse dwarf shrubland
BLM Type: Non-forest
WGFD Type: Mountain foothills/grassland
General description: Grassland with shrub cover ca. 15% growing on a limestone dipslope; part of the same stand as location #7.
Vegetation:
TREES: None
SHRUBS: *Artemisia nova* 10
GRAMINOIDS: *Poa secunda*, *Elymus spicatus*
FORBS:

Location 6: T26N, R82W, Sec 17, W1/2

Elevation: 7400 feet Aspect: West
Substrate: Pre-Cambrian
TNC Type: *Artemisia tridentata ssp. wyomingensis*/*Elymus spicatus* sparse shrubland
BLM Type: Non-forest
WGFD Type: Mixed sagebrush/grassland
General description: Sparse grass vegetation with considerable cover of Wyoming big sagebrush and scattered common juniper and limber pine.
Vegetation:
TREES: *Pinus flexilis* 1
SHRUBS: *Artemisia tridentata ssp. wyomingensis* 10, *Juniperus communis* 3
GRAMINOIDS: *Elymus spicatus*?

Location 7: T26N, R82W, Sec 18, NE1/4
Elevation: 7220 feet Aspect: North
Substrate: Limestone
TNC Type: *Artemisia nova*/*Elymus spicatus* sparse dwarf shrubland
BLM Type: Non-forest
WGFD Type: Mixed sagebrush/grassland
General description: Grassland with shrub cover ca. 20% growing on a limestone dip slope; part of the same stand as location #5.
Vegetation:
TREES: None
SHRUBS: *Artemisia nova* 20, *Artemisia tridentata ssp. wyomingensis* 3
GRAMINOIDS: *Koeleria macrantha*, *Poa cusickii*, *Poa secunda*, *Elymus spicatus*
FORBS:

Location 8a: T26N, R82W, Sec 17, SW1/4 NW1/4
Elevation: 7150 feet Aspect: East
Substrate: Alluvium?
TNC Type: *Betula occidentalis* shrubland
BLM Type: Non-forest
WGFD Type: Mixed sagebrush/grassland
General description: Riparian shrub vegetation growing along the channel of Sage Creek at the crossing of road 3112. Water birch, alder, and willow form a taller shrub layer above a lower shrub layer of red-osier dogwood and gooseberry.
Vegetation:
TREES: None
SHRUBS: *Betula occidentalis*, *Alnus incana*, *Salix lutea*, *Cornus sericea*, *Ribes oxycanthoides*
GRAMINOIDS: *Agrostis stolonifera*, *Poa pratensis*, *Carex aquatilis*
FORBS: *Cirsium arvense*

Location 8b: T26N, R82W, Sec 17, SW1/4 NW1/4
Elevation: 7150 feet Aspect: East
Substrate: Alluvium?
TNC Type: *Artemisia tridentata ssp. vaseyana*/*Elymus cinereus* shrubland
BLM Type: Non-forest
WGFD Type: Mixed sagebrush/grassland
General description: Dense shrub and grass vegetation growing on the higher surfaces in the valley of Sage Creek. Mountain big sagebrush forms a taller shrub layer above the snowberry; basin wildrye patches are common above the lower herbaceous species.
Vegetation:
TREES: None
SHRUBS: *Artemisia tridentata ssp. vaseyana* 20, *Symphoricarpos oreophilus* 20
GRAMINOIDS: *Elymus cinereus* 20, *Poa pratensis*, *Elymus smithii*, *Bromus carinatus*, *Poa juncifolia*
FORBS:

Location 9: T26N, R82W, Sec 8, SW1/4 SW1/4

Elevation: 7200 feet Aspect: East

Substrate: Limestone

TNC Type: *Artemisia tridentata ssp. vaseyana*/*Elymus smithii* shrubland

BLM Type: Non-forest

WGFD Type: Mixed sagebrush/grassland

General description: Mountain big sagebrush forms a moderately dense shrub layer over a low herbaceous layer in a valley bottom between limestone hills. Bluegrasses dominate the understory; western wheatgrass is present beneath the sagebrush plants. This is part of the same stand as location #11b.

Vegetation:

TREES: None

SHRUBS: *Artemisia tridentata ssp. vaseyana* 30

GRAMINOIDS: *Poa secunda* 10, *Poa cusickii* 10, *Elymus smithii* 3

FORBS: *Antennaria microphylla* 3

Location 10: T26N, R82W, Sec 8, NW1/4 SE1/4

Elevation: 7250 feet Aspect: West

Substrate: Limestone

TNC Type: *Cercocarpus montanus*/*Elymus spicatus*

BLM Type: Non-forest

WGFD Type: Mountain foothills/grassland

General description: Mountain mahogany forms stands on limestone slopes, mixed with stands of (probably) mountain big sagebrush/bluebunch wheatgrass.

Vegetation:

TREES: None

SHRUBS: *Cercocarpus montanus* 20

GRAMINOIDS: *Elymus spicatus*

FORBS:

Location 11a: T26N, R82W, Sec 8, SW1/4 NW1/4

Elevation: 7150 feet Aspect: West

Substrate: Limestone

TNC Type: *Artemisia nova*/*Elymus spicatus*

BLM Type: Non-forest

WGFD Type: Mountain foothills/grassland

General description: Grassland with ca. 20% black sagebrush cover, and scattered limber pine, growing on limestone slopes.

Vegetation:

TREES: *Pinus flexilis* 3

SHRUBS: *Artemisia nova* 20

GRAMINOIDS: *Elymus spicatus*, *Carex filifolia*, *Poa secunda*, *Poa cusickii*

FORBS:

Location 11b: T26N, R82W, Sec 8, SW1/4 NW1/4

Elevation: 7100 feet Aspect: West

Substrate: Sandstone and limestone colluvium

TNC Type: *Artemisia tridentata ssp. vaseyana*/*Elymus smithii*

BLM Type: Non-forest

WGFD Type: Mixed sagebrush/grassland

General description: Mountain big sagebrush forms a dense shrub layer over a herbaceous layer, in a valley bottom between limestone hills. This is part of the same stand as location #9.

Vegetation:

TREES: None

SHRUBS: *Artemisia tridentata ssp. vaseyana*

GRAMINOIDS: *Poa secunda*, *Poa cusickii*, *Poa pratensis*, *Elymus smithii*
FORBS:

Location 12: T26N, R81W, Sec 20, NW1/4 SW1/4

Elevation: 8450 feet Aspect: Northeast

Substrate: Limestone

TNC Type: *Pinus contorta*/*Juniperus communis* woodland

BLM Type: Lodgepole pine

WGFD Type: Lodgepole pine

General description: Lodgepole pine trees to ca. 15 m tall dominate the tree overstory, which contains subalpine fir trees in the eastern part of the stand; subalpine fir saplings are present beneath; and the sparse understory contains patches of common juniper but few other species. Fallen trees are common, and some fallen trunks have charcoal.

Vegetation:

TREES: *Pinus contorta*

SHRUBS: *Juniperus communis* 3, *Shepherdia canadensis* 3, *Mahonia repens* 3

GRAMINOIDS: *Carex rossii* 1

FORBS: *Hieracium albiflorum* 1

Location 13: T26N, R81W, Sec 20, NW1/4 SW1/4

Elevation: 8500 feet Aspect: South

Substrate: Limestone

TNC Type: *Artemisia nova*/*Elymus spicatus* sparse dwarf shrubland

BLM Type: Non-forest

WGFD Type: Mountain foothills/grassland

General description: Grass vegetation with a sparse shrub layer and scattered limber pines

Vegetation:

TREES: *Pinus flexilis* 10

SHRUBS: *Artemisia nova* 10, *Artemisia tripartita* ssp. *rupicola* 3, *Leptodactylon pungens* 3

GRAMINOIDS: *Poa cusickii* 20, *Poa secunda* 20, *Leucopoa kingii* 10, *Elymus spicatus* 10, *Carex rossii* 10, *Koeleria macrantha* 10, *Carex fillifolia* 3

FORBS:

Location 14: T26N, R81W, Sec 19, SE1/4 SE1/4

Elevation: 8550 feet Aspect: South

Substrate: Sandstone

TNC Type: *Pinus flexilis*/*Leucopoa kingii* woodland

BLM Type: Woodland

WGFD Type: Lodgepole pine

General description: Limber pine to ca. 7 m tall form patches of woodland; lodgepole pine and subalpine fir are present in the overstory. The shrub layer is patchy, and most of the understory is dominated by herbaceous species. Openings in the woodland are Idaho fescue and King spike-fescue grassland with some shrubs.

Vegetation:

TREES: *Pinus flexilis* 60, *Pinus contorta* 3, *Abies lasiocarpa* 3

SHRUBS: *Juniperus communis* 3, *Artemisia tridentata* ssp. *vaseyana* 3

GRAMINOIDS: *Leucopoa kingii* 10, *Carex rossii* 10, *Poa cusickii* 3, *Festuca idahoensis* 3, *Bromus carinatus*

FORBS:

Location 15a: T26N, R81W, Sec 20, SW1/4 SE1/4

Elevation: 8340 feet Aspect: North

Substrate: Limestone

TNC Type: *Pinus contorta*/*Juniperus communis* woodland

BLM Type: Lodgepole pine

WGFD Type: Lodgepole pine

General description: Lodgepole pine to ca. 20 m tall forms an overstory above a very sparse understory. The trees have been thinned. This is part of the same stand as location 15d (from which it is separated by an opening of three-tip sagebrush and King spikefescue vegetation), and the trees here were thinned more recently than were the trees at location 15d.

Vegetation:

TREES: *Pinus contorta* 60

SHRUBS: *Juniperus communis* 1

GRAMINOIDS: *Poa interior* 3, *Leucopoa kingii* 1

FORBS:

Location 15b: T26N, R81W, Sec 29, NW1/4 NE1/4

Elevation: 8360 feet Aspect: East

Substrate: Sandstone

TNC Type: *Populus tremuloides*/*Thalictrum fendleri* forest?

BLM Type: Woodland

WGFD Type: Lodgepole pine

General description: Aspen trees to ca. 18 m tall form a grove covering ca. 2000 square meters on the eastern side of a knob within a forest of lodgepole pine and limber pine. Limber pine trees are present in the overstory, and subalpine fir trees form a sparse sub-canopy. Limber pine and subalpine fir saplings and seedlings are present in the understory. The herbaceous understory is rich in graminoids and forbs.

Vegetation:

TREES: *Populus tremuloides* 50, *Pinus flexilis* 20, *Abies lasiocarpa* 30

SHRUBS: *Mahonia repens* 30

GRAMINOIDS: *Elymus trachycaulus* ssp. *trachycaulus* 10, *Leucopoa kingii* 3

FORBS: *Osmorhiza* sp. 20, *Galium boreale* 10

Location 15c: T26N, R81W, Sec 29, NW1/4 NE1/4

Elevation: 8360 feet Aspect: West

Substrate: Sandstone

TNC Type: *Pinus flexilis*/*Juniperus communis*

BLM Type: Woodland

WGFD Type: Lodgepole pine

General description: Limber pine to ca. 10 m tall form a stand on a knob above a lodgepole pine forest. The understory consists of common juniper patches and sparse graminoids.

Vegetation:

TREES: *Pinus flexilis* 10

SHRUBS: *Juniperus communis* 10

GRAMINOIDS: *Carex rossii* 3, *Poa interior* 1

FORBS:

Location 15d: T26N, R81W, Sec 20, SW1/4 SE1/4

Elevation: 8320 feet Aspect: North

Substrate: Sandstone

TNC Type: *Pinus contorta*/*Juniperus communis* woodland

BLM Type: Lodgepole pine

WGFD Type: Lodgepole pine

General description: Lodgepole pine to ca. 20 m tall form an overstory above a very sparse understory. This is part of the same stand as location 15a (from which it is separated by an opening of three-tip sagebrush and King spikefescue vegetation), and the trees here were thinned longer ago than were the trees at location 15a.

Vegetation:

TREES: *Pinus contorta* 50

SHRUBS: *Mahonia repens* 3, *Juniperus communis* 1

GRAMINOIDS: *Poa interior* 3, *Leucopoa kingii* 1

FORBS: *Orthilia secunda* 1

Location 16: T26N, R81W, Sec 20, SW1/4 SE1/4

Elevation: 8350 feet Aspect: South

Substrate: Limestone

TNC Type: *Elymus spicatus*-Cushion plant herbaceous vegetation

BLM Type: Non-forest

WGFD Type: Mountain foothills/grassland

General description: Low vegetation, rich in forbs, growing on a limestone dip slope with 15% - 20% bedrock. Scattered limber pines are present.

Vegetation:

TREES: *Pinus flexilis* 3

SHRUBS: *Artemisia tripartita* ssp. *rupicola* 3, *Artemisia tridentata* ssp. *vaseyana* 1, *Ribes cereum* 1

GRAMINOIDS: *Elymus spicatus* 10, *Poa secunda* 10, *Koeleria macrantha* 10, *Poa cusickii* 3

FORBS: *Arenaria hookeri* 10, *Cymopterus longilobus*(?) 10, *Selaginella densa* 10, *Cerastium arvense* 3, *Eriogonum* spp. 1, *Paronychia* sp. 1

Location 17a: T26N, R81W, Sec 20, SE1/4 SE1/4

Elevation: 8100 feet Aspect: East

Substrate: Limestone

TNC Type: *Populus tremuloides*/*Juniperus communis* forest

BLM Type: Aspen

WGFD Type: Aspen

General description: Aspen trees to ca. 12 m tall dominate an overstory that includes some limber pine and, on northerly exposures, subalpine fir. Common juniper dominates rich shrub layer, and the herbaceous layer is rich in forbs. The aspen stands are generally small (< 1000 sq m) and are mixed with shrub stands.

Vegetation:

TREES: *Populus tremuloides* 60

SHRUBS: *Acer glabrum* 1, *Juniperus communis* 10, *Symphoricarpos oreophilus* 20, *Rosa woodsii* 10, *Mahonia repens* 30

GRAMINOIDS: *Elymus trachycaulus* ssp. *trachycaulus* 10, *Poa interior* 3, *Bromus carinatus* 3, *Carex rossii* 3

FORBS: *Osmorhiza chilensis* 10, *Galium boreale* 10

Location 17b: T26N, R81W, Sec 20, SE1/4 SE1/4

Elevation: 8100 feet Aspect: East

Substrate: Limestone

TNC Type: *Prunus virginiana* shrubland

BLM Type: Non-forest

WGFD Type: Bitterbrush/sagebrush/mixed shrub

General description: Chokecherry forms shrub patches on limestone talus among aspen stands and sagebrush vegetation.

Vegetation:

TREES: None

SHRUBS: *Prunus virginiana* 60

GRAMINOIDS: None

FORBS: None

Location 17c: T26N, R81W, Sec 20, SW1/4 SE1/4

Elevation: 8250 feet Aspect: East

Substrate: Limestone

TNC Type: *Artemisia tripartita* ssp. *rupicola*/*Elymus spicatus* dwarf shrub

BLM Type: Non-forest

WGFD Type: Bitterbrush/sagebrush/mixed shrub

General description: Low grass vegetation with scattered three-tip sagebrush.

Vegetation:

TREES: None

SHRUBS: *Artemisia tripartita* ssp. *rupicola* 10

GRAMINOIDS: *Elymus spicatus* 10, *Leucopoa kingii* 10

FORBS:

Location 18: T26N, R81W, Sec 31, NE1/4 SW1/4

Elevation: 8780 feet Aspect: Southwest

Substrate: Pre-Cambrian

TNC Type: *Festuca idahoensis*-*Elymus spicatus* herbaceous vegetation

BLM Type: Non-forest

WGFD Type: Mountain foothills/grassland

General description: Scattered limber pine and scattered mountain big sagebrush grow above an open herbaceous layer on knob within lodgepole pine forest.

Vegetation:

TREES: *Pinus flexilis* 10, *Pinus contorta* 1

SHRUBS: *Artemisia tridentata* ssp. *vaseyana* 10, *Juniperus communis* 1

GRAMINOIDS: *Festuca idahoensis* 3, *Leucopoa kingii* 3, *Poa secunda* 3, *Carex rossii* 3, *Stipa* sp. 1, *Elymus elymoides* 1

FORBS: *Arenaria congesta* 20, *Antennaria microphylla* 3, *Eriogonum* sp. 1, *Sedum lanceolatum* 1, *Senecio canus* 1, *Cerastium arvense* 1, *Lupinus* 1

Location 19a: T26N, R81W, Sec 31, SW1/4 SW1/4

Elevation: 8800 feet Aspect: North

Substrate: Pre-Cambrian

TNC Type: *Pinus contorta*/*Vaccinium scoparium* forest

BLM Type: Lodgepole pine

WGFD Type: Lodgepole pine

General description: Lodgepole pine trees to ca. 30 m tall form an overstory above an understory dominated by patches of grouse whortleberry, with few other plants. This is part of the same stand as location 19d.

Vegetation:

TREES: *Pinus contorta* 40

SHRUBS: *Vaccinium scoparium* 60, *Juniperus communis* 1, *Abies lasiocarpa* seedlings 1

GRAMINOIDS: *Trisetum spicatum* 3, *Poa interior* 1, *Stipa nelsonii* ssp. *nelsonii* 1

FORBS: *Fragaria virginiana* 1, *Antennaria microphylla* 1

Location 19b: T26N, R81W, Sec 31, SW1/4 SW1/4

Elevation: 8800 feet Aspect: North

Substrate: Pre-Cambrian

TNC Type: *Festuca idahoensis*-*Danthonia intermedia* herbaceous vegetation?

BLM Type: Non-forest

WGFD Type: Mountain foothills/grassland

General description: Meadow of several hundred square meters in a broad draw next to a lodgepole pine forest. To the north is a slope with mountain big sagebrush vegetation (location 19c).

Vegetation:

TREES: *Pinus contorta* seedlings 1

SHRUBS: None

GRAMINOIDS: *Danthonia intermedia* 20, *Festuca idahoensis* 3

FORBS: *Arenaria congesta* 10, *Antennaria microphylla* 10

Location 19c: T26N, R81W, Sec 31, SW1/4 SW1/4

Elevation: 8800 feet Aspect: South

Substrate: Pre-Cambrian

TNC Type: *Artemisia tridentata ssp. vaseyana/Festuca idahoensis*
BLM Type: Non-forest
WGFD Type: Mountain foothills/grassland
General description: Sparse sagebrush/grass stand on a south facing slope within the lodgepole pine forest.
Vegetation:
TREES: None
SHRUBS: *Artemisia tridentata ssp. vaseyana* 20
GRAMINOIDS: *Festuca idahoensis* 20, *Poa secunda* 10, *Carex* sp. 3, *Elymus elymoides* 1, *Stipa nelsonii ssp. nelsonii* 1
FORBS: *Arenaria congesta* 20, *Antennaria microphylla* 3, *Cerastium arvense* 3, *Sedum lanceolatum* 1

Location 19d: T26N, R81W, Sec 31, SW1/4 SW1/4
Elevation: 8800 feet Aspect: South
Substrate: Pre-Cambrian
TNC Type: *Pinus contorta/Vaccinium scoparium*
BLM Type: Lodgepole pine
WGFD Type: Lodgepole pine
General description: This is part of the same stand as location 19a. Lodgepole pine trees to ca. 30 m tall form an overstory. The understory throughout the stand is dominated by patches of grouse whortleberry, but there is little whortleberry at this spot.
Vegetation:
TREES: *Pinus contorta* 40
SHRUBS: *Vaccinium scoparium* 1, *Juniperus communis* 1
GRAMINOIDS: *Poa interior* 3, *Carex rossii* 3, *Danthonia intermedia* 1
FORBS: *Antennaria microphylla* 1, *Hieracium albiflorum* 1

Location 20a: T25N, R81W, Sec 7, NE1/4 SW1/4
Elevation: 8560 feet Aspect: North
Substrate: Pre-Cambrian
TNC Type: *Pinus contorta/Vaccinium scoparium*
BLM Type: Lodgepole pine
WGFD Type: Lodgepole pine
General description: Lodgepole pine trees form an overstory above a depauperate understory dominated by patches of grouse whortleberry. Stands of this forest have been clearcut and thinned in the vicinity.
Vegetation:
TREES: *Pinus contorta* 50?
SHRUBS: *Vaccinium scoparium* 20?
GRAMINOIDS: *Poa interior*, *Elymus trachycaulus ssp. trachycaulus*
FORBS: *Antennaria microphylla*, *Hieracium albiflorum*

Location 20b: T25N, R81W, Sec 7, NE1/4 SW1/4
Elevation: 8600 feet Aspect: Southeast
Substrate: Limestone
TNC Type: *Artemisia tridentata ssp. vaseyana/Elymus spicatus*
BLM Type: Non-forest
WGFD Type: Mixed sagebrush/grassland
General description: Mountain big sagebrush forms an open shrub layer above a sparse herbaceous understory. Scattered limber pines usually are present, and in places they provide enough cover to form a limber pine/bluebunch wheatgrass woodland. This vegetation occupies openings, mainly on southerly slopes, among stands of limber pine and lodgepole pine.
Vegetation:
TREES: *Pinus flexilis* 10

SHRUBS: *Artemisia tridentata ssp. vaseyana* 20, *Juniperus communis* 1
GRAMINOIDS: *Elymus spicatus* 10, *Poa secunda*, *Leucopoa kingii* 10, *Carex rossii* 3, *Elymus smithii* 3, *Koeleria macrantha* 3, *Festuca idahoensis* 1, *Elymus elymoides* 1
FORBS: *Arenaria congesta* 10, *Balsamorhiza sagittata* 3, *Cerastium arvense* 3

Location 20c: T25N, R81W, Sec 7, NE1/4 SW1/4

Elevation: 8600 feet Aspect: South

Substrate: Limestone

TNC Type: *Pinus flexilis*/*Elymus spicatus* woodland?

BLM Type: Woodland

WGFD Type: Limber pine

General description: Scattered limber pine trees form an open, patchy overstory above an open shrub layer of mountain big sagebrush and a sparse herbaceous layer. This vegetation occupies ridge tops and southerly slopes among stands of lodgepole pine forest, and is mixed with mountain big sagebrush/bluebunch wheatgrass vegetation.

Vegetation:

TREES: *Pinus flexilis*

SHRUBS: *Artemisia tridentata ssp. vaseyana*

GRAMINOIDS: *Elymus spicatus*, *Poa secunda*, *Leucopoa kingii*, *Carex rossii*, *Elymus smithii*

FORBS: *Arenaria congesta*, *Balsamorhiza sagittata*, *Cerastium arvense*

Location 21: T25N, R81W, Sec 3, SW1/4 SW1/4

Elevation: 8740 feet Aspect: East

Substrate: Pre-Cambrian

TNC Type: *Festuca idahoensis*-*Elymus spicatus* herbaceous vegetation

BLM Type: Non-forest

WGFD Type: Mountain foothills/grassland

General description: Sparse herbaceous vegetation with scattered mountain big sagebrush in an opening in the lodgepole pine forest.

Vegetation:

TREES: None

SHRUBS: *Artemisia tridentata ssp. vaseyana* 3

GRAMINOIDS: *Festuca idahoensis* 10, *Stipa nelsonii var. nelsonii* 10

FORBS:

Location 22: T25N, R81W, Sec 10, SW1/4 SW1/4

Elevation: 8860 feet Aspect: West

Substrate: Pre-Cambrian

TNC Type: *Artemisia tridentata ssp. vaseyana*/*Festuca idahoensis*

BLM Type: Non-forest

WGFD Type: Mountain foothills/grassland

General description: Mountain big sagebrush forms an open shrub layer above a moderately dense herbaceous layer on the west side of a ridge. Surrounding vegetation is lodgepole pine forest and limber pine woodland. Little clubmoss covers much of the ground surface.

Vegetation:

TREES: None

SHRUBS: *Artemisia tridentata ssp. vaseyana* 20

GRAMINOIDS: *Poa secunda* 20, *Festuca idahoensis* 10, *Elymus spicatus* 10, *Leucopoa kingii* 10

FORBS: *Selaginella densa* 30, *Antennaria microphylla* 10

Location 23: T25N, R81W, Sec 14, SW1/4 NW1/4

Elevation: 8850 feet Aspect: East

Substrate: Limestone

TNC Type: *Artemisia tridentata ssp. vaseyana*/*Festuca idahoensis*

BLM Type: Non-forest

WGFD Type: Mountain foothills/grassland

General description: Mountain big sagebrush forms a dense shrub layer above a dense herbaceous layer in an opening of several acres. Scattered limber pines are present. Surrounding vegetation is limber pine woodland.

Vegetation:

TREES: *Pinus flexilis* 10

SHRUBS: *Artemisia tridentata* ssp. *vaseyana* 50

GRAMINOIDS: *Elymus spicatus* 30, *Festuca idahoensis* 20, *Poa secunda* 20, *Koeleria macrantha* 10, *Leucopoa kingii* 10, *Carex rossii* 3

FORBS: *Cerastium arvense* 10

Location 24a: T25N, R81W, Sec 12, SW1/4 SE1/4

Elevation: 8100 feet Aspect: North

Substrate: Limestone

TNC Type: *Cercocarpus montanus*/*Elymus spicatus*

BLM Type: Non-forest

WGFD Type: Bitterbrush/sagebrush/mixed shrub

General description: Mountain mahogany forms a moderately dense shrub layer above a species-rich herbaceous layer. This vegetation occupies the middle of the slope, between stands of limber pine woodland.

Vegetation:

TREES: *Pinus flexilis* 1

SHRUBS: *Cercocarpus montanus* 30, *Tetradymia canescens* 1, *Juniperus communis* 1, *Chrysothamnus viscidiflorus* ssp. *lanceolatus* 1, *Amelanchier alnifolia* 1

GRAMINOIDS: *Elymus spicatus* 20, *Poa secunda* 10, *Koeleria macrantha* 10, *Carex rossii* 3

FORBS: *Antennaria* sp. 3, numerous others present

Ground cover: Cobbles, rock, and gravel common.

Location 24b: T25N, R81W, Sec 12, SW1/4 SE1/4

Elevation: 8250 feet Aspect: North

Substrate: Limestone

TNC Type: *Pinus flexilis*/*Leucopoa kingii*

BLM Type: Non-forest

WGFD Type: Limber pine

General description: Limber pine trees to ca. 10 m tall form an open overstory above a sparse shrub layer and a moderately dense herbaceous layer. This vegetation grows on the upper part of the slope, above a mountain mahogany shrub stand (location 24a).

Vegetation:

TREES: *Pinus flexilis* 30

SHRUBS: *Symphoricarpos oreophilus* 3, *Cercocarpus montanus* 3, *Juniperus communis* 1

GRAMINOIDS: *Leucopoa kingii* 20, *Carex rossii* 10, *Elymus spicatus* 1

FORBS:

Ground cover: Limestone gravel covers most of the ground

Location 24c: T25N, R81W, Sec 12, SW1/4 SE1/4

Elevation: 8000 feet Aspect: North

Substrate: Limestone

TNC Type: *Pinus flexilis*/*Juniperus communis* woodland

BLM Type: Lodgepole pine

WGFD Type: Lodgepole pine

General description: Limber pine, lodgepole pine, and aspen form a tree overstory above a sparse shrub layer and a depauperate herbaceous layer. This woodland grows in a draw low on the slope, below a mountain mahogany shrub stand (location 24a).

Vegetation:

TREES: *Pinus flexilis* 20, *Pinus contorta* 10, *Populus tremuloides* 10

SHRUBS: *Juniperus communis* 10, *Symphoricarpos oreophilus* 1, *Mahonia repens* 10

GRAMINOIDS: *Poa interior*, *Carex rossii*, *Stipa lettermanii*? 1
FORBS:

Location 25a: T25N, R81W, Sec 12, SW 1/4
Elevation: 8300 feet Aspect: South
Substrate: Pre-Cambrian
TNC Type: *Artemisia tridentata ssp. vaseyana*/*Elymus spicatus*?
BLM Type: Non-forest
WGFD Type: Mountain foothills/grassland
General description: Scattered mountain big sagebrush grow in a grass-dominated vegetation on southerly slopes. Scattered limber pine may be present. (This location was viewed from a distance, through binoculars.)
Vegetation:
TREES: *Pinus flexilis* 1
SHRUBS: *Artemisia tridentata ssp. vaseyana* 20
GRAMINOIDS: *Elymus spicatus*, *Poa secunda*
FORBS:

Location 25b: T25N, R81W, Sec 12, SW 1/4
Elevation: 8300 feet Aspect: South
Substrate: Limestone
TNC Type: *Cercocarpus montanus*/*Elymus spicatus*?
BLM Type: Non-forest
WGFD Type: Bitterbrush/sagebrush/mixed shrub
General description: Mountain mahogany shrubs ca. 1 m tall form a shrub layer above a sparse herbaceous layer. (This location was viewed from a distance, through binoculars.)
Vegetation:
TREES: None
SHRUBS: *Cercocarpus montanus* 20
GRAMINOIDS: *Elymus spicatus*?
FORBS:

Location 26a: T25N, R81W, Sec 12, SW1/4 NE1/4
Elevation: 7850 feet Aspect: East
Substrate: Limestone
TNC Type: *Populus tremuloides*/*Symphoricarpos oreophilus* forest
BLM Type: Aspen
WGFD Type: Aspen
General description: Aspen trees to ca. 6 m tall form a canopy in an aspen woodland of ca. 1 acre at the foot of the steep eastern side of the Shirley Mountains. Taller aspen (to ca. 18 m tall) grow above the canopy, and shorter limber pine (to ca. 4 m tall) grow beneath the aspen canopy. The dense shrub layer is dominated by snowberry and a dense herbaceous layer is dominated by elk sedge. Fallen aspen trunks are common. The herbaceous vegetation had been grazed.
Vegetation:
TREES: *Populus tremuloides* 50, *Pinus flexilis* 10
SHRUBS: *Acer glabrum* 1, *Symphoricarpos oreophilus* 40, *Juniperus communis* 1
GRAMINOIDS: *Carex geyeri* 60, *Elymus trachycaulus ssp. trachycaulus* 10
FORBS:

Location 26b: T25N, R81W, Sec 12, SW1/4 NE1/4
Elevation: 7800 feet Aspect: Northeast
Substrate: Limestone colluvium?
TNC Type: *Artemisia tripartita ssp. rupicola*/*Festuca idahoensis*
BLM Type: Non-forest
WGFD Type: Bitterbrush/sagebrush/mixed shrub

General description: Moderately dense grass vegetation with scattered shrubs, growing on gentle slopes at the eastern foot of the Shirley Mountains.

Vegetation:

TREES: None

SHRUBS: *Artemisia tripartita ssp. rupicola* 20, *Chrysothamnus nauseosus* 1

GRAMINOIDS: *Elymus spicatus* 10, *Poa secunda* 10, *Koeleria macrantha* 10, *Poa cusickii* 3

FORBS: *Phlox hoodii* 3, *Lupinus* 1, *Antennaria microphylla* 1

Ground cover: Limestone cobbles and gravel cover most of the ground. Pocket-gopher diggings are common.

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 are determined primarily by the number of occurrences of a plant association and the total area covered by the association, but the rank also reflects the historic trend in distribution, the degree to which the occurrences of the association have been altered 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 factor 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; or 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, or represented by few unaltered occurrences.
- G4: Widespread, abundant, 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 association within a state. Thus an association with a rank of G4S2 in Wyoming is widespread, abundant, and apparently secure throughout its range, where it is represented by many 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 Population maps for plant species of special concern in the Shirley Mountain ecosystem.