

ECOLOGICAL EVALUATION OF
THE MANN CREEK POTENTIAL RESEARCH NATURAL AREA
WITHIN THE BIGHORN NATIONAL FOREST,
SHERIDAN COUNTY, WYOMING

Prepared for the
Bighorn National Forest
USDA Forest Service

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INTRODUCTION

The Mann Creek potential Research Natural Area (RNA) is located within the drainage basin of the Little Bighorn River, in the Bighorn Mountain Range of north-central Wyoming. The area includes deep canyons cut into carbonate rocks. One of the canyons contains a perennial stream that supports a population of Yellowstone cutthroat trout of 95% genetic purity, and the other canyon contains an intermittent stream. Vegetation is mainly Douglas-fir forests and grasslands of Idaho fescue and associated species. The potential RNA is in the Tongue Ranger District and is currently used primarily for recreation.

In 1996, The Nature Conservancy entered an agreement with USDA Forest Service (Bighorn National Forest) and Trout Unlimited (Little Bighorn Chapter) to prepare an ecological evaluation of the valleys of Mann Creek and Pumpkin Creek in the West Fork Little Bighorn River drainage for use by the Forest Service in examining the suitability of the area as a research natural area. The evaluation was done by the Wyoming Natural Diversity Database. This report presents the results of that evaluation.

LAND MANAGEMENT PLANNING

In 1996, the Mann Creek - Pumpkin Creek area was selected by USDA Forest Service staff as a potential RNA for possible analysis during revision of the Land and Resource Management Plan. This ecological evaluation is intended to aid the Forest Service staff in that analysis.

OBJECTIVES

One of the primary objectives of research natural areas is to "...preserve a wide spectrum of pristine representative areas that typify important forest, shrubland, grassland, alpine, aquatic, geologic and similar natural situations..." (Forest Service Manual 4063.02).

The objectives of a Mann Creek RNA would be to 1) maintain a reference area for (a) monitoring effects of resource management techniques and practices applied to similar ecosystems, (b) comparing results from manipulative research, and (c) determining the range of natural variability; 2) protect elements of biological diversity (especially the Yellowstone cutthroat trout); 3) provide a site for non-manipulative scientific

research; and 4) provide on-site and extension educational opportunities.

PRINCIPAL DISTINGUISHING FEATURES

The principal distinguishing features of the Mann Creek potential RNA are deep canyons cut into the limestone and dolomite rocks of the eastern side of the Bighorn Mountains. The vegetation on the canyon walls is primarily Douglas-fir woodlands on east- and west-facing slopes, with smaller areas of subalpine fir forest on steep, north-facing slopes, mountain big sagebrush shrubland and grassland on south-facing slopes, and Engelmann spruce woodlands in the canyon bottoms.

LOCATION

The Mann Creek potential RNA is located within the Bighorn National Forest in north-central Wyoming. The approximate center of the potential RNA is at latitude 44°57'33"N and longitude 107°43'30"W.

The potential RNA includes all or parts of the following sections:

- T57N, R90W, 6th p.m.; Sections 3, 4, 5, 6, 7, 8, 9, 10.
- T57N, R91W, 6th p.m.; Sections 1, 2, 12.
- T58N, R89W, 6th p.m.; Sections 18, 19.
- T58N, R90W, 6th p.m.; Sections 13, 14, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36.
- T58N, R91W, 6th p.m.; Sections 25, 36.

BOUNDARY

The area to be evaluated in this project was only generally described in the authorizing documents. In the Memorandum of Understanding (section I, Purpose), the Wyoming Natural Diversity Database was directed to collect information that would allow the Forest Service to determine whether the drainage of the West Fork of the Little Bighorn River (including Pumpkin Creek and Mann Creek) meets the criteria for designation as a research natural area or special interest area. The statement of work accompanying that memorandum was more specific in directing that the evaluation be done "...of a potential Research Natural Area in the Mann Creek/Dark Canyon area..." (section I, Ecological evaluations). However, the statement of work did not describe a boundary of the area to be evaluated, but recognized that several sets of boundaries were possible (section I.3.).

Perusal of aerial photographs of the West Fork of the Little Bighorn, and initial field work, revealed features that were

judged to clearly disqualify parts of the West Fork drainage from consideration as a potential RNA. These features are clearcuts in the upper reaches of the drainage basin, including the valleys of Mann Creek and Pumpkin Creek; a burned area in the middle section of Dark Canyon of at least 80 acres (32 ha) that had been seeded and is strongly dominated by exotic plants; two-track roads on Boyd Ridge and Crater Ridge; and a cow camp of several buildings on Boyd Ridge. The boundary of the area to be evaluated for possible RNA designation, as described here, was drawn to exclude these features, and to include the deeper canyons of Pumpkin Creek and Mann Creek, and of the West Fork of the Little Bighorn River below their confluence (Figure 1).

The boundary of the area evaluated as a potential RNA follows topographic features and the National Forest boundary. Starting at the northeastern corner of the potential RNA, at a point on the eastern section line of Section 18, T58N, R89W, and on the National Forest boundary, ca. 0.4 mile (0.6 km) north of the southeastern corner of Section 18, the boundary extends south ca. 0.74 mile (1.2 km) along the National Forest boundary to a point on the divide between the watersheds of the West Fork of the Little Bighorn River and the Little Bighorn River; thence generally southwest ca. 2.5 miles (4 km) along that divide to the summit of Fisher Peak; thence generally south ca. 0.66 mile (1.1 km) along the ridge of Fisher Peak; thence generally west ca. 1 mile (1.6 km) along the southeastern rim of the canyon of the West Fork of the Little Bighorn River to a point on the rim east of the confluence of Mann Creek and Pumpkin Creek; thence generally south ca. 2 miles (3.2 km) along the eastern rim of Dark Canyon to a point on the Boyd Ridge pack trail; thence generally southwest ca. 1.5 miles (2.4 km) along the eastern rim of Dark Canyon to a point on the rim east of the mouth of Crater Creek; thence generally west ca. 0.5 mile (0.8 km) down the eastern wall of Dark Canyon to the mouth of Crater Creek; thence southwest 0.66 mile (1.1 km) up the ridge forming the southern divide of the drainage of Crater Creek to a point on the southern rim of the canyon of Crater Creek; thence southwest, west, and northeast ca. 3.25 miles (5.2 km) around the head of the canyon of Crater Creek, following the canyon rim, to the point where the rim intersects the divide between the drainages of Crater Creek and Cub Creek; thence generally northwest ca. 0.4 mile (0.5 km) and southwest ca. 3 miles (4.8 km) along the southern rim of the canyon of Cub Creek to the valley of a stream flowing northeast into Cub Creek; thence northeast ca. 0.6 mile (1 km) across the canyon of Cub Creek to the north rim of the canyon; thence northeast ca. 2 miles (3.2 km) along the northwestern rim of the canyon of Cub Creek to a point where the rim intersects the divide between the drainage of Cub Creek and the drainage of a stream tributary to Pumpkin Creek; thence generally west and

north ca. 3 miles along the rim of the valleys of two streams flowing into Pumpkin Creek from the south, to a point on the southern rim of the canyon of Pumpkin Creek; thence generally southwest ca. 1.75 miles (2.8 km) along the southern rim of the canyon of Pumpkin Creek to a point on the rim ca. 0.2 mile (0.3 km) southwest of the broad ridge with an elevation of 8828 feet (2691 m); thence west and northwest ca. 0.75 mile (1.2 km) across the canyon of Pumpkin Creek to a point on the northwestern side of the canyon ca. 0.1 mile (0.16 km) southeast of the broad peak with an elevation of 8838 feet (2694 m); thence generally north and east along the northern rim of the canyon of Pumpkin Creek ca. 7 miles (11 km) to a point on the rim north of the mouth of Cub Creek; thence generally northeast ca. 5 miles (8 km) along the northern rim of the canyon of Pumpkin Creek and along the northwestern rim of the canyon of the West Fork of the Little Bighorn River to the point where the rim intersects the northern boundary of the National Forest; thence east ca. 1.7 mile (2.7 km) to the starting point.

AREA

The total area enclosed by the proposed boundary of the Mann Creek potential RNA is ca. 9,069 acres (3,668 ha).

ELEVATION

The elevation of the Mann Creek potential RNA ranges from ca. 4480 feet (1366 m) on the West Fork of the Little Bighorn River in the northeastern corner of the area, to 8800 feet (2684 m) on the ridge between Cub Creek and Pumpkin Creek at the western end of the area.

ACCESS

The Mann Creek potential RNA may be reached on public roads. From U.S. Highway Alternate 14 ca. 20 miles (32 km) west of Burgess Junction, travel north ca. 7.5 miles (12 km) on Primary Forest Route 11 to the intersection with Secondary Forest Route 110. To reach the east-central part of the potential RNA, travel east from that point ca. 10 miles (16 km) on Secondary Forest Route 110 to Boyd Ridge above Dark Canyon, thence on foot into the Canyon. To reach the northeastern part of the area, travel an additional 2.5 miles (4 km) to the end of Secondary Forest Route 110, thence an additional 2 miles (3.2 km) on the pack trail, and north into the potential RNA.

To reach the west-central part of the area, from the intersection of Primary Forest Route 11 and Secondary Forest Route 110, travel north on Primary Forest Route 11 ca. 1.25 miles (2 km) to the intersection with Secondary Forest Route 111, thence north on Secondary Forest Route 111 ca. 1.5 miles (2.4 km) to the intersection with Low Standard Forest Road 108, thence

east ca. 6 miles (9.6 km) on Low Standard Forest Road 108 to the end of that road on Crater Ridge. The potential RNA may be entered on foot to the north, east, or south of that point.

To reach the northern part of the area, from the intersection of Secondary Forest Route 111 and Low Standard Forest Road 108 travel north on Secondary Forest Route 111 ca. 3.5 miles (5.6 km). From this point for an additional 4.5 miles (7.2 km), Route 111 runs within several hundred yards of the northern boundary of the potential RNA.

ECOREGION

The Mann Creek potential RNA lies within the Southern Rocky Mountain Steppe - Open Woodland - Coniferous Forest - Alpine Meadow Province, Bighorn Mountain Section, Bighorn Mountain Sedimentary Subsection (M331Ba) of the ecoregion classification of Bailey et al. (1994) (Freeouf 1996).

MAPS

USDA Forest Service 1/2 inch = 1 mile scale map of the Bighorn National Forest
USDI Geological Survey 7.5 minute topographic Quadrangle
Maps: Boyd Ridge, Wyoming and Bull Elk Park, Wyoming.

AREA BY COVER TYPES

Areas of the SAF cover types (Table 1) were estimated by using a dot grid on the map of those types (Figure 1). The areas of the Kuchler types (Table 2) were calculated indirectly, by estimating areas of complexes of plant associations (with use of a dot grid on Figure 2), then summing the estimates for the complexes belonging to the same Kuchler type. Areas of the individual plant associations were not estimated, but Table 3 shows the major and minor associations in the potential RNA.

Table 1. Areas of Society of American Foresters types (Eyre 1980) in the Mann Creek potential RNA.

<u>Cover Type</u>	<u>Acres</u>	<u>Hectares</u>
Engelmann Spruce-Subalpine Fir (206)	774	313
Interior Douglas-fir (210)	4751	1924
Limber pine (219)	394	160
Interior Ponderosa Pine (237)	444	180
Non-forest types	2706	1096

Table 2. Areas of Kuchler types (Kuchler 1966) in the Mann Creek potential RNA.

<u>Cover Type</u>	<u>Acres</u>	<u>Hectares</u>
Douglas-fir forest (11) (<i>Pseudotsuga</i>)	5602	2269
Western spruce-fir forest (14) (<i>Picea-Abies</i>)	761	308
Fescue-wheatgrass (43) (<i>Festuca-Agrophyron</i>)	1353	548
Sagebrush steppe (49) (<i>Artemisia</i>)	1353	548

Table 3. Plant associations in the Mann Creek potential RNA.

See synonyms in Appendix 7. Major types are denoted by "**(M)**" after the name, and minor types by "(m)".

CONIFEROUS FORESTS AND WOODLANDS

Subalpine fir/heartleaf arnica (m)
Engelmann spruce/field horsetail (m)
Engelmann spruce/red-osier dogwood (m)
Engelmann spruce/mountain ninebark (m)
Douglas-fir/common juniper **(M)**
Douglas-fir/mountain ninebark **(M)**
Douglas-fir/shinyleaf spiraea (m)
Ponderosa pine/shinyleaf spiraea (m)
Ponderosa pine/bluebunch wheatgrass (m)
Limber pine/common juniper (m)

DECIDUOUS WOODLAND

Quaking aspen woodland (m)

DECIDUOUS SHRUB

Water birch/red-osier dogwood (m)
Prickly currant shrubland (m)
Mountain ninebark shrubland (m)

EVERGREEN SHRUB

Mountain big sagebrush/Idaho fescue (m)

HERBACEOUS

Idaho fescue-northern singlespike sedge (m)
Idaho fescue-slender wheatgrass (m)
Idaho fescue-bluebunch wheatgrass (m)
Mountain bluebells (m)

PHYSICAL AND CLIMATIC CONDITIONS

PHYSICAL SETTING

The Mann Creek potential RNA is located in the drainage of the West Fork of the Little Bighorn River. The streams in this drainage flow primarily northeast, through canyons up to 2,000 feet (610 m) deep. Slopes are steep and face mainly northwest or southeast.

DESCRIPTION OF VALUES

VEGETATION TYPES

Upland vegetation

See Appendix 7 for synonyms to the plant association names used in this report.

The major upland vegetation type in the Mann Creek potential RNA is forest belonging to the Interior Douglas-fir cover type of the Society of American Foresters (Eyre 1980) (Figure 1) and the Douglas-fir forest type of Kuchler (1966). On slopes with northerly aspects, this woodland consists primarily of the Douglas-fir/mountain ninebark association, with smaller areas of Douglas-fir/shinyleaf spiraea association and Douglas-fir/common juniper association. This woodland generally consists of poles or small trees with sparse understories. It also includes small quaking aspen groves, patches of mountain ninebark shrubland on rocky slopes, grass- and forb-rich meadows, and ribbons of water birch/red-osier dogwood shrubland along small streams. (On the low-elevation, north-facing slopes in the northeastern corner of the area, on the south wall of the canyon of the West Fork, the Douglas-fir woodlands may give way to the ponderosa pine/mountain ninebark association, but no information was collected from those slopes during the 1996 survey.) On southerly and westerly slopes, the woodlands are primarily the Douglas-fir/common juniper association with smaller amounts of the Douglas-fir/mountain ninebark and Douglas-fir/shinyleaf spiraea associations. On upper slopes, particularly those facing south and west, the woodland contains a substantial amount of the limber pine/common juniper association. The woodland on lower portions of slopes contains areas of the Engelmann spruce/mountain ninebark and Engelmann spruce/shinyleaf spiraea associations.

Steep, north-facing slopes at the higher elevations contain woodlands of the Western spruce-fir forest type of Kuchler (1966) and the Engelmann Spruce-Subalpine Fir SAF cover type (Eyre 1980). The major plant association is the subalpine fir/heartleaf arnica association, and smaller amounts of Engelmann spruce/shinyleaf spiraea may be present. The lodgepole pine/grouse whortleberry association grows on the uplands west of the potential RNA, and small areas of this type may also occur in the subalpine fir woodlands on the north-facing slopes of the potential RNA.

The north side of the canyon of Pumpkin Creek contains a substantial area of grassland and shrubland with scattered trees, belonging to the sagebrush steppe type and fescue-wheatgrass type of Kuchler (1966). The main plant association in this vegetation is the mountain big sagebrush/Idaho fescue association. Smaller amounts of Idaho fescue grassland without sagebrush, and the Douglas-fir/common juniper association, also occur in this type. The north side of the canyon of the West Fork, and the west side of Dark Canyon, support a mosaic of the ponderosa pine/bluebunch wheatgrass association and the Idaho fescue/bluebunch wheatgrass association that have been classified into the Douglas fir forest and the fescue-wheatgrass types, respectively, of Kuchler (1966) and the Inland Ponderosa Pine SAF cover type (Eyre 1980). The north-facing slopes in the northeastern corner of the potential RNA, on the south wall of the West Fork canyon, may support forests of the ponderosa pine/mountain ninebark association, but no information was collected from those slopes during field survey.

Riparian vegetation

The Mann Creek potential RNA contains only a small amount of riparian vegetation growing along the narrow streams in the bottoms of the canyons and in small draws on the canyon walls. This vegetation belongs to the Engelmann Spruce-Subalpine Fir SAF cover type (Eyre 1980) and the Western spruce-fir forest type of Kuchler (1966). The plant associations are the Engelmann spruce/field horsetail association along streams at the higher elevations, and the Engelmann spruce/red-osier dogwood association along the channel of the West Fork of the Little Bighorn. The Engelmann spruce/mountain ninebark association borders these riparian types on the lower slopes of the canyons. Small areas of non-forest riparian vegetation, belonging to the prickly currant association and the mountain bluebells association, grow in the upper reaches of the canyons.

FLORA

Threatened, Endangered, and Sensitive Plant Species

No federally listed Threatened or Endangered plant species are found in the Mann Creek potential RNA. Three species listed as Sensitive in USDA Forest Service Region 2 (Bighorn National Forest 1992; Estill 1993), *Arnica lonchophylla*, *Aster mollis*, and *Sullivantia hapemanii* are known to occur within the Mann Creek area (Fertig et al. 1994). Four other plants listed as "species of special concern" by WYNDD were discovered in the potential RNA during surveys in 1996 (Fertig 1997). The status of each of these species is briefly summarized below. Complete Element

Occurrence Records for each population are included in Appendix 2.

Arnica lonchophylla (Northern arnica)

Heritage Rank: G4/S1

Federal Status: USDA Forest Service Region 2: Sensitive.

Geographic Range: Newfoundland to British Columbia, south to northern Minnesota. Disjunct in the South Dakota Black Hills and the Bighorn Mountains of Wyoming (Big Horn, Johnson, and Sheridan counties).

Habitat: Open slopes of sandstone or limestone talus; shady, moss-covered calcareous rock slopes in forests of Douglas-fir and Engelmann spruce, and mossy boulders and wet cliffs along shady creek banks and seep springs.

Comments: Northern arnica is known from 5 extant populations in Wyoming, including one extensive occurrence discovered in the Mann Creek potential RNA in 1996. This occurrence consists of 7 small sub-populations on steep, calcareous, open or forested, north-facing slopes along Cub, Mann, and Pumpkin Creeks and the northwestern slope of Fisher Mountain. The total population is estimated to contain 1430-2350 plants, although much additional potential habitat remains to be surveyed. Many flowering and fruiting plants were observed to have their heads removed by grazers (deer, elk, pikas, rodents, or snails), which could result in a serious decline in the reproductive fitness of the population. Impacts from livestock grazing appear to be low due to the inaccessibility of most colonies. Recent surveys in the Black Hills of South Dakota have resulted in the discovery of over 30 new populations, resulting in a proposal to drop this species as Sensitive in USDA Forest Service Region 2 (D. Ode, South Dakota Natural Heritage Program, personal communication).

Aster mollis (Soft aster)

Heritage Rank: G3/S3.

Federal Status: USDA Forest Service Region 2: Sensitive; USDA Forest Service Region 4: Sensitive; USFWS: former C2.

Geographic Range: Endemic to the Hoback Canyon area and Bighorn Mountains of Wyoming in Big Horn, Johnson, Natrona, Sheridan, Sublette, and Washakie counties.

Habitat: Sagebrush grasslands and mountain meadows on deep, calcareous soils at the edge of aspen or pine woodlands (Fertig et al. 1994).

Comments: Soft aster is known from 29 extant and 2 historical occurrences in Wyoming. The species was first documented in the Mann Creek area during preliminary surveys of the area by Bighorn National Forest personnel in 1995. Surveys in 1996 resulted in the discovery of 3 main occurrences (consisting of 12 large sub-populations) in the potential RNA. The total population of these colonies is conservatively estimated at 6700-9700 plants in

approximately 800 acres of suitable habitat. Most colonies occur on semi-disturbed soils impacted by burrowing rodents, livestock grazing, and off-road vehicles. This species appears to be adapted to such disturbances (at least in moderation) and populations in the potential RNA appear to be stable.

Botrychium minganense (Mingan Island moonwort)

Synonym: *Botrychium lunaria* var. *onondagense*.

Heritage Rank: G4/S1.

Federal Status: None.

Geographic Range: Alaska to Newfoundland south to New York, Minnesota, and northern Arizona. In Wyoming, it is known from the Bighorn and Absaroka Ranges in Fremont, Johnson, Park, and Sheridan counties.

Habitat: Moist meadows and woods at low to mid-elevations (Fertig 1995).

Comments: A small population containing 2-10 plants was discovered along the wet, mossy banks of a waterfall on the north side of Crater Ridge above the Cub Creek valley in the potential RNA in 1996. Three other populations of this species are known in the state, only one of which is protected within a designated special management area on the Shoshone National Forest. The Mann Creek potential RNA population is vulnerable to habitat loss, although it appears to be unthreatened under current management.

Botrychium virginianum (Rattlesnake fern)

Heritage Rank: G5/S1.

Federal Status: None.

Geographic Range: Circumboreal; in North America found from British Columbia to Newfoundland and south to Oregon, northwestern Wyoming, and Florida. In Wyoming, it is known from the Black Hills, Clark's Fork of the Yellowstone River, the Yellowstone Plateau, and the Teton and Bighorn Mountain Ranges. It occurs in Crook, Park, Sheridan, and Teton Counties.

Habitat: Moist woods and thickets in mountain valleys.

Comments: Rattlesnake fern is currently known from 7 occurrences in Wyoming. A new population was discovered on damp, moss-covered limestone cliffs near the lower end of Cub Creek in the potential RNA in 1996. Only one vegetative plant was observed, although additional potential habitat in the vicinity was not surveyed. This population may be secure at the present time due to its inaccessibility. Other colonies in the state are threatened by logging, road-building, and recreational activities.

Cryptogramma stelleri (Fragile rock-brake)

Heritage Rank: G5/S1.

Federal Status: None.

Geographic Range: Circumboreal, in North America occurs from Alaska to Newfoundland south to northern Washington, northeast Nevada, Colorado, Iowa, and New Jersey. In Wyoming, it is known from the Wind River, Teton, Wyoming, and Bighorn Ranges in Fremont, Sheridan, and Teton Counties.

Habitat: Ledges and cracks in limestone boulders and cliffs in moist, shady canyons and streambanks.

Comments: The first population of fragile rock-brake in the Bighorn Range was discovered along Pumpkin Creek in the potential RNA in 1996. A small colony consisting of 3 clusters of fronds was found in a shady, calcareous alcove with populations of *Arnica lonchophylla* and *Sullivantia hapemanii*. This species is known from 4 other locations in Wyoming, none of which are currently protected in designated special management areas. The Pumpkin Creek population appears to be secure due to the inaccessibility of its habitat, although logging or high recreational activity could be threats in the future.

Eritrichium howardii (Howard forget-me-not)

Heritage Rank: G4/S1.

Federal Status: None.

Geographic Range: Regional endemic of northern Wyoming and adjacent Idaho and Montana. In Wyoming, it is known from the eastern Absaroka and Bighorn Mountain Ranges in Johnson, Park, and Sheridan Counties.

Habitat: Foothill and montane cushion plant communities on ridges and slopes of calcareous gravel and talus.

Comments: Howard forget-me-not is currently known from 6 extant populations in Wyoming, including a new occurrence discovered in the Mann Creek potential RNA along the rim of Boyd Ridge in 1996. This population was observed to be locally common, but restricted to a limited area of red-bed clays above dolomite cliffs. Although not threatened by grazing or logging activity, the Mann Creek colony is vulnerable due to its small size and specialized habitat. No occurrences in Wyoming are currently found within designated special management areas, although 2 populations are found in potential research natural areas on the Bighorn and Shoshone National Forests.

Sullivantia hapemanii* var. *hapemanii (Hapeman's sullivantia)

Heritage Rank: G3T3/S3.

Federal Status: USDA Forest Service Region 2: Sensitive; USFWS: former C2.

Geographic Range: South-central Montana, north-central Wyoming, and central Idaho. In Wyoming, it is known from the Bighorn Range, northern Laramie Range, and Wind River Canyon in Big Horn, Hot Springs, Johnson, Natrona, Sheridan, and Washakie Counties.

Habitat: Moist calcareous cliffs and boulders in shady stream canyons in Douglas-fir and Engelmann spruce forests (Fertig et al. 1994).

Comments: Hapeman's sullivantia is known from 23 extant occurrences in Wyoming. A large population was discovered near Deer Park at the confluence of Pumpkin and Mann creeks within the potential RNA by Bighorn National Forest staff in 1995. A more thorough survey in 1996 resulted in the discovery of 7 additional colonies in the Mann Creek drainage (including Mann, Cub, and Pumpkin creeks and the main stem of the West Fork of the Little Bighorn River). The total population of these colonies was estimated at 60,000-80,000 plants, making the Mann Creek site one of the largest known occurrences of this species. Populations in the Mann Creek drainage appear to be secure under present management, but could be threatened by water development projects in the future. At least 10 populations of this species are currently protected in conservation easements held by The Nature Conservancy and existing BLM areas of critical environmental concern in the Bighorn Range. Recent surveys have found sullivantia to be more widespread and numerous than once known and the plant's continued status as regionally sensitive may need to be reassessed in the near future.

The following rare or USDA Forest Service Sensitive plant species could occur within the Mann Creek potential RNA, but were not observed during 1996 surveys:

Agoseris lackschewitzii (Pink agoseris) G3Q/S2S3; USDA Forest Service Region 2 Sensitive: potential wet meadow habitat was surveyed in the bottom of Mann Creek Canyon, but only *A. aurantiaca* or *A. glauca* were found.

Asplenium trichomanes-ramosum [*A. viride*] (Green spleenwort) G4/S2: known from one record near the head of Wagon Box Creek just west of the boundaries of the potential RNA, but not relocated in 1996.

Cypripedium calceolus var. *pubescens* (Large yellow lady's slipper) G5/S1S2: known from the canyon of the Little Bighorn River between Kettle Gulch and Fisher Mountain, east of the potential RNA, but not relocated in 1996. Suitable habitat may

exist along the West Fork of the Little Bighorn River near the eastern boundary of the potential RNA.

Erigeron allocotus (Branched fleabane) G3/S3: reported from the canyon of the Little Bighorn River, east of the potential RNA, but not relocated in 1996. Suitable habitat may occur along the dolomite cliffs of Boyd Ridge.

Penstemon caryi (Cary beardtongue) G3/S2; USDA Forest Service Region 2 Sensitive: known from the summit and upper slopes of Fisher Mountain (just outside the potential RNA), but not relocated during 1996 surveys.

Table 4. Vascular Plants of the Mann Creek potential RNA.

The following species checklist is based on field surveys conducted by the authors in early August 1996 (unpublished records). For more information on the vascular flora of the Bighorn Range, consult Nelson and Hartman (1984) and Jensen (1987). 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).

<u>Scientific Name</u>	<u>Common Name</u>	<u>Family</u>
TREES		
<i>Abies lasiocarpa</i>	Subalpine fir	PIN
<i>Picea engelmannii</i>	Engelmann spruce	PIN
<i>Pinus contorta</i> var. <i>latifolia</i>	Lodgepole pine	PIN
<i>Pinus flexilis</i>	Limber pine	PIN
<i>Pinus ponderosa</i>	Ponderosa pine	PIN
<i>Populus angustifolia</i>	Narrow-leaved cottonwood	SAL
<i>Populus balsamifera</i>	Balsam cottonwood	SAL
<i>Populus tremuloides</i>	Quaking aspen	SAL
<i>Pseudotsuga menziesii</i> var. <i>glauca</i>	Douglas-fir	PIN
SHRUBS		
<i>Acer glabrum</i>	Rocky Mountain maple	ACE
<i>Amelanchier alnifolia</i> var. <i>alnifolia</i>	Saskatoon serviceberry	ROS
<i>Arctostaphylos uva-ursi</i>	Bearberry	ERI
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	Mountain big sagebrush	AST
<i>Betula occidentalis</i>	Water birch	BET
<i>Ceanothus velutinus</i>	Deer-brush	RHM

<i>Cercocarpus ledifolius</i> var. <i>ledifolius</i>	Curl-leaf mountain mahogany	ROS
<i>Cornus sericea</i> [<i>Cornus stolonifera</i>]	Red-osier dogwood	COR
<i>Juniperus communis</i> var. <i>depressa</i>	Common juniper	CUP
<i>Juniperus horizontalis</i>	Creeping juniper	CUP
<i>Juniperus scopulorum</i>	Rocky Mountain juniper	CUP
<i>Mahonia repens</i>	Oregon-grape	BER
<i>Pentaphylloides floribunda</i> [<i>Potentilla fruticosa</i>]	Shrubby cinquefoil	ROS
<i>Physocarpus monogynus</i>	Mountain ninebark	ROS
<i>Prunus virginiana</i> var. <i>melanocarpa</i>	Common chokecherry	ROS
<i>Rhus trilobata</i>	Skunkbush	ANA
<i>Ribes cereum</i> var. <i>pedicellare</i>	Wax currant	GRS
<i>Ribes lacustre</i>	Swamp black gooseberry	GRS
<i>Ribes montigenum</i>	Mountain gooseberry	GRS
<i>Ribes oxyacanthoides</i>	Northern gooseberry	GRS
<i>Ribes viscosissimum</i>	Sticky currant	GRS
<i>Rosa sayi</i>	Prickly rose	ROS
<i>Rosa woodsii</i>	Woods' rose	ROS
<i>Rubus idaeus</i> var. <i>aculeatissimus</i>	Raspberry	ROS
<i>Rubus parviflorus</i>	Thimbleberry	ROS
<i>Salix bebbiana</i>	Bebb willow	SAL
<i>Salix boothii</i>	Booth willow	SAL
<i>Salix drummondiana</i>	Drummond willow	SAL
<i>Salix lutea</i> [<i>Salix eriocephala</i> var. <i>watsonii</i>]	Yellow willow	SAL
<i>Salix planifolia</i> var. <i>planifolia</i>	Plane-leaf willow	SAL
<i>Salix scouleriana</i>	Scouler willow	SAL
<i>Sambucus racemosa</i>	Black elderberry	CPR
<i>Shepherdia canadensis</i>	Canada buffaloberry	ELE
<i>Sorbus scopulina</i>	Rock mountain-ash	ROS
<i>Spiraea betulifolia</i> var. <i>lucida</i>	Shiny-leaf spirea	ROS
<i>Symphoricarpos albus</i> var. <i>laevigatus</i>	Common snowberry	CPR
<i>Symphoricarpos oreophilus</i> var. <i>utahensis</i>	Mountain snowberry	CPR
<i>Vaccinium scoparium</i>	Grouse whortleberry	ERI

FORBS

<i>Achillea millefolium</i>	Common yarrow	AST
<i>Actaea rubra</i>	Baneberry	RAN
<i>Agoseris aurantiaca</i>	Orange agoseris	AST
<i>Agoseris glauca</i> var. <i>dasycephala</i>	Short-beaked agoseris	AST
<i>Allium brevistylum</i>	Short-style onion	LIL
<i>Allium cernuum</i>	Nodding onion	LIL

<i>!Alyssum alyssoides</i>	Pale alyssum	BRA
<i>Anaphalis margaritacea</i>	Common pearly-everlasting	AST
<i>Androsace septentrionalis</i> var. <i>subulifera</i>	Northern rockjasmine	PRM
<i>Anemone multifida</i>	Cutleaf anemone	RAN
<i>Anemone patens</i> var. <i>multifida</i>	Pasqueflower	RAN
<i>Angelica roseana</i>	Rock angelica	API
<i>Antennaria anaphaloides</i>	Tall pussytoes	AST
<i>Antennaria microphylla</i>	Small-leaved pussytoes	AST
<i>Antennaria racemosa</i>	Raceme pussytoes	AST
<i>Antennaria rosea</i>	Rosy pussytoes	AST
<i>Antennaria umbrinella</i>	Umber pussytoes	AST
<i>Apocynum androsaemifolium</i>	Spreading dogbane	APO
<i>Arabis drummondii</i>	Drummond's rockcress	BRA
<i>Arabis holboellii</i>	Pendulous rockcress	BRA
<i>Arabis nuttallii</i>	Nuttall's rockcress	BRA
<i>!Arctium minus</i>	Common burdock	AST
<i>Arenaria congesta</i> var. <i>congesta</i>	Ballhead sandwort	CRY
<i>Arenaria nuttallii</i> [<i>Minuartia nuttallii</i>]	Nuttall's sandwort	CRY
<i>Arenaria obtusiloba</i> [<i>Minuartia obtusiloba</i>]	Arctic sandwort	CRY
<i>Arenaria rubella</i> [<i>Minuartia rubella</i>]	Reddish sandwort	CRY
<i>Arnica cordifolia</i>	Heartleaf arnica	AST
<i>Arnica latifolia</i> var. <i>latifolia</i>	Mountain arnica	AST
<i>Arnica lonchophylla</i>	Northern arnica	AST
<i>Arnica longifolia</i>	Seep-spring arnica	AST
<i>Artemisia biennis</i> var. <i>biennis</i>	Mystery wormwood	AST
<i>Artemisia dracuncululus</i>	Tarragon	AST
<i>Artemisia frigida</i>	Fringed sagewort	AST
<i>Artemisia ludoviciana</i> var. <i>ludoviciana</i>	Louisiana sagewort	AST
<i>Artemisia michauxiana</i>	Michaux sagewort	AST
<i>Asclepias speciosa</i>	Showy milkweed	ASC
<i>Aster alpigenus</i> var. <i>haydenii</i>	Alpine aster	AST
<i>Aster ascendens</i>	Long-leaved aster	AST
<i>Aster bracteolatus</i>	Eaton's aster	AST
<i>Aster ciliolatus</i>	Lindley aster	AST
<i>Aster conspicuus</i>	Showy aster	AST
<i>Aster falcatus</i> var. <i>falcatus</i>	Creeping white aster	AST
<i>Aster foliaceus</i> var. <i>apricus</i>	Leafybract aster	AST
<i>Aster foliaceus</i> var. <i>parryi</i>	Parry's leafybract aster	AST
<i>Aster glaucodes</i>	Blueleaf aster	AST
<i>Aster meritus</i>	Arctic aster	AST
<i>Aster mollis</i>	Soft aster	AST
<i>Astragalus adsurgens</i> var. <i>robustior</i>	Standing milkvetch	FAB

<i>Astragalus alpinus</i>	Alpine milkvetch	FAB
<i>Astragalus gilviflorus</i> var. <i>gilviflorus</i>	Plains milkvetch	FAB
<i>Astragalus miser</i> var. <i>decumbens</i> FAB	Sagebrush weedy milkvetch	
<i>Balsamorhiza incana</i>	Hoary balsamroot	AST
<i>Balsamorhiza sagittata</i>	Arrowleaf balsamroot	AST
<i>Balsamorhiza x tomentosa</i> [hybrid between <i>B. incana</i> & <i>B. sagittata</i>]	Tomentose balsamroot	AST
<i>Besseya wyomingensis</i>	Wyoming kittentails	SCR
<i>Bupleurum americanum</i>	American thoroughwax	API
<i>Calochortus gunnisonii</i>	Gunnison's mariposa-lily	LIL
<i>Campanula rotundifolia</i>	Scotch bellflower	CAM
! <i>Capsella bursa-pastoris</i>	Shepherd's purse	BRA
<i>Castilleja cusickii</i>	Cusick's paintbrush	SCR
<i>Castilleja linariifolia</i>	Wyoming paintbrush	SCR
<i>Castilleja miniata</i>	Scarlet paintbrush	SCR
<i>Castilleja rhexifolia</i>	Rhexia-leaved paintbrush	SCR
<i>Castilleja sulphurea</i>	Sulphur paintbrush	SCR
<i>Cerastium arvense</i>	Field chickweed	CRY
<i>Chenopodium atrovirens</i>	Mountain goosefoot	CHN
<i>Chenopodium fremontii</i>	Fremont's goosefoot	CHN
<i>Chimaphila umbellata</i>	Common pipsissewa	ERI
! <i>Cirsium arvense</i>	Canada thistle	AST
<i>Cirsium hookerianum</i>	Hooker's thistle	AST
<i>Cirsium pulcherrimum</i>	Pretty thistle	AST
<i>Cirsium undulatum</i>	Wavy-leaved thistle	AST
! <i>Cirsium vulgare</i>	Bull thistle	AST
<i>Clematis columbiana</i> var. <i>tenuiloba</i>	Matted purple virgin's bower	RAN
<i>Clematis hirsutissima</i>	Sugar bowls	RAN
<i>Clematis occidentalis</i> var. <i>grosseserrata</i>	Purple virgin's bower	RAN
<i>Collinsia parviflora</i>	Small-flowered blue- eyed Mary	SCR
<i>Collomia linearis</i>	Narrowleaf collomia	PLM
<i>Comandra umbellata</i> var. <i>pallida</i>	Pale bastard toadflax	SAN
<i>Corallorrhiza maculata</i>	Spotted coral-root	ORC
<i>Corydalis aurea</i>	Golden smoke	FUM
<i>Crepis acuminata</i>	Mountain hawksbeard	AST
<i>Cymopterus terebinthinus</i> var. <i>albiflorus</i>	Turpentine rock parsley	API
<i>Cynoglossum officinale</i>	Common hound's tongue	BOR
<i>Delphinium bicolor</i>	Little larkspur	RAN
<i>Delphinium geyeri</i>	Geyer's larkspur	RAN
<i>Descurainia</i> sp.	Tansymustard	BRA
<i>Disporum trachycarpum</i>	Wartberry fairybell	LIL
<i>Dodecatheon pulchellum</i>	Pretty shooting-star	PRM

<i>Draba albertina</i>	Alaska draba	BRA
<i>Draba crassifolia</i>	Hairy draba	BRA
<i>Draba oligosperma</i>	Few-seeded draba	BRA
<i>Draba reptans</i>	Dwarf draba	BRA
<i>Epilobium angustifolium</i>	Fireweed	ONA
<i>Epilobium brachycarpum</i>	Autumn willowherb	ONA
<i>Epilobium ciliatum</i> var. <i>ciliatum</i>	Northern willowherb	ONA
<i>Epilobium hornemannii</i>	Hornemann's willowherb	ONA
<i>Epilobium lactiflorum</i>	Milky willowherb	ONA
<i>Erigeron acris</i> var. <i>asteroides</i>	Bitter fleabane	AST
<i>Erigeron caespitosus</i>	Tufted daisy	AST
<i>Erigeron compositus</i> var. <i>discoideus</i>	Cut-leaved daisy	AST
<i>Erigeron eatonii</i>	Eaton's daisy	AST
<i>Erigeron ochroleucus</i> var. <i>scribneri</i>	Scribner's fleabane	AST
<i>Erigeron peregrinus</i>	Wandering fleabane	AST
<i>Erigeron speciosus</i>	Showy fleabane	AST
<i>Erigeron subtrinervis</i> var. <i>conspicuus</i>	Three-veined fleabane	AST
<i>Erigeron subtrinervis</i> var. <i>subtrinervis</i>	Three-veined fleabane	AST
<i>Erigeron ursinus</i>	Bear River fleabane	AST
<i>Eriogonum umbellatum</i> var. <i>majus</i>	Cream buckwheat	PLG
<i>Eritrichium howardii</i>	Howard forget-me-not	BOR
<i>Erysimum asperum</i> var. <i>arkansanum</i> [<i>Erysimum capitatum</i>]	Pretty wallflower	BRA
<i>Euphorbia brachycera</i> var. <i>robusta</i>	Rocky Mountain spurge	EUP
<i>Fragaria vesca</i>	Woods strawberry	ROS
<i>Fragaria virginiana</i>	Virginia strawberry	ROS
<i>Gaillardia aristata</i>	Blanket-flower	AST
<i>Galium aparine</i>	Cleavers	RUB
<i>Galium bifolium</i>	Twinleaf bedstraw	RUB
<i>Galium boreale</i>	Northern bedstraw	RUB
<i>Galium triflorum</i>	Sweet-scented bedstraw	RUB
<i>Gayophytum diffusum</i> var. <i>strictipes</i>	Spreading groundsmoke	ONA
<i>Gentiana affinis</i> var. <i>affinis</i>	Prairie gentian	GEN
<i>Gentianella amarella</i> var. <i>amarella</i>	Northern gentian	GEN
<i>Geranium richardsonii</i>	White geranium	GER
<i>Geranium viscosissimum</i>	Sticky purple geranium	GER
<i>Geum aleppicum</i>	Yellow avens	ROS
<i>Geum macrophyllum</i> var. <i>perincisum</i>	Large-leaved avens	ROS
<i>Geum triflorum</i>	Prairie smoke	ROS
<i>Goodyera oblongifolia</i>	Western rattlesnake plantain	ORC
<i>Grindelia squarrosa</i>	Curlycup gumweed	AST

<i>Habenaria dilatata</i>	White bog orchid	ORC
[<i>Platanthera dilatata</i>]		
<i>Habenaria unalascensis</i>	Alaska rein-orchid	ORC
[<i>Piperia unalascensis</i>]		
<i>Habenaria viridis</i> var. <i>bracteosa</i>	Frog orchid	ORC
[<i>Coeloglossum viride</i>]		
<i>Halimolobos virgata</i>	Twiggy halimolobos	BRA
<i>Hedysarum sulphurescens</i>	Yellow sweet-vetch	FAB
<i>Helianthella quinquenervis</i>	Five-nerve sunflower	AST
<i>Heracleum sphondylium</i> var. <i>lanatum</i>	Cow-parsnip	API
<i>Heterotheca fulcrata</i>	Golden-aster	AST
<i>Heterotheca villosa</i>	Hairy golden-aster	AST
<i>Heuchera parvifolia</i>	Littleleaf alumroot	SAX
<i>Hieracium albiflorum</i>	White hawkweed	AST
<i>Hieracium gracile</i>	Slender hawkweed	AST
<i>Hieracium umbellatum</i> var. <i>scabriusculum</i>	Canada hawkweed	AST
<i>Hieracium umbellatum</i> var. <i>umbellatum</i>	Narrow-leaved hawkweed	AST
<i>Hymenoxys acaulis</i>	Stemless hymenoxys	AST
<i>Hymenoxys grandiflora</i>	Old man of the mountain	AST
<i>Ipomopsis congesta</i> var. <i>congesta</i>	Ballhead gilia	PLM
<i>Ipomopsis spicata</i> var. <i>spicata</i>	Spike gilia	PLM
! <i>Lactuca serriola</i>	Prickly lettuce	AST
<i>Lesquerella alpina</i>	Alpine bladderpod	BRA
<i>Liatris punctata</i>	Blazing-star	AST
<i>Linnaea borealis</i>	Twinflower	CPR
<i>Linum lewisii</i>	Blue flax	LIN
<i>Lithophragma tenellum</i>	Slender fringe-cup	SAX
<i>Lithospermum ruderale</i>	Western gromwell	BOR
<i>Lomatium cous</i>	Cous biscuitroot	API
! <i>Lotus corniculatus</i>	Birdsfoot trefoil	FAB
<i>Lupinus argenteus</i> var. <i>argenteus</i>	Silvery lupine	FAB
<i>Maianthemum racemosum</i>	Western false Solomon's-seal	LIL
<i>Maianthemum stellatum</i>	Starry false Solomon's-seal	LIL
<i>Matricaria matricarioides</i>	Pineapple weed	AST
! <i>Medicago lupulina</i>	Black medic	FAB
<i>Mentha arvensis</i> var. <i>canadensis</i>	Field mint	LAM
<i>Mertensia ciliata</i>	Mountain bluebells	BOR
<i>Microseris nutans</i>	Nodding microseris	AST
<i>Mimulus guttatus</i>	Yellow monkeyflower	SCR
<i>Mitella pentandra</i>	Fivestar mitrewort	SAX
<i>Monarda fistulosa</i> var. <i>menthifolia</i>	Wild bergamot	LAM
<i>Moneses uniflora</i>	Wood-nymph	ERI
<i>Musineon vaginatum</i>	Sheathed musineon	API
<i>Myosotis alpestris</i>	Wood forget-me-not	BOR

<i>Orobanche ludoviciana</i> var. <i>ludoviciana</i>	Louisiana broom-rape	ORO
<i>Orthilia secunda</i>	Sidebells pyrola	ERI
<i>Orthocarpus luteus</i>	Yellow owl-clover	SCR
<i>Osmorhiza chilensis</i>	Mountain sweet-cicely	API
<i>Osmorhiza depauperata</i>	Blunt-fruit sweet-cicely	API
<i>Oxytropis campestris</i> var. <i>cusickii</i>	Yellow locoweed	FAB
<i>Oxytropis lagopus</i>	Rabbitfoot crazyweed	FAB
<i>Oxytropis sericea</i>	Silky crazyweed	FAB
<i>Parnassia fimbriata</i>	Fringed grass-of-Parnassus	SAX
<i>Pedicularis bracteosa</i> var. <i>paysoniana</i>	Bracted lousewort	SCR
<i>Pedicularis groenlandica</i>	Elephant-head	SCR
<i>Pedicularis parryi</i> var. <i>parryi</i>	Parry's lousewort	SCR
<i>Pedicularis racemosa</i> var. <i>alba</i>	White sickletop lousewort	SCR
<i>Penstemon aridus</i>	Stiff-leaf beardtongue	SCR
<i>Penstemon glaber</i> var. <i>glaber</i>	Showy beardtongue	SCR
<i>Penstemon montanus</i>	Mountain beardtongue	SCR
<i>Penstemon nitidus</i>	Shining beardtongue	SCR
<i>Penstemon procerus</i>	Smallflower beardtongue	SCR
<i>Perideridia montana</i> [<i>Perideridia gairdneri</i>]	Common yampah	API
<i>Petrophyton caespitosum</i>	Rocky Mountain rockmat	ROS
<i>Phlox hoodii</i>	Hood's phlox	PLM
<i>Phlox multiflora</i>	Mountain phlox	PLM
<i>Polemonium viscosum</i>	Sky pilot	PLM
<i>Polygonum achoreum</i>	Knotweed	PLG
<i>Polygonum aviculare</i>	Prostrate knotweed	PLG
<i>Polygonum bistortoides</i>	American bistort	PLG
<i>Polygonum douglasii</i> var. <i>douglasii</i>	Douglas knotweed	PLG
<i>Potentilla arguta</i>	Tall cinquefoil	ROS
<i>Potentilla diversifolia</i> var. <i>diversifolia</i>	Vari-leaf cinquefoil	ROS
<i>Potentilla diversifolia</i> var. <i>perdissecta</i>	Vari-leaf cinquefoil	ROS
<i>Potentilla gracilis</i> var. <i>pulcherrima</i>	Beautiful cinquefoil	ROS
<i>Potentilla hippiana</i> var. <i>effusa</i>	Woolly cinquefoil	ROS
<i>Potentilla hippiana</i> var. <i>hippiana</i>	Woolly cinquefoil	ROS
<i>Potentilla ovina</i> var. <i>ovina</i>	Sheep cinquefoil	ROS
<i>Potentilla pensylvanica</i>	Prairie cinquefoil	ROS
<i>Pyrola asarifolia</i>	Pink wintergreen	ERI
<i>Pyrola chlorantha</i>	Green wintergreen	ERI
<i>Ranunculus inamoenus</i>	Unlovely buttercup	RAN
! <i>Ranunculus repens</i> var. <i>repens</i>	Creeping buttercup	RAN
<i>Ranunculus uncinatus</i> var. <i>uncinatus</i>	Little buttercup	RAN
<i>Ratibida columnifera</i>	Prairie coneflower	AST

<i>Rorippa</i> sp.	Yellowcress	BRA
<i>Rudbeckia laciniata</i> var. <i>ampla</i>	Tall coneflower	AST
<i>Rumex paucifolius</i>	Mountain sorrel	PLG
<i>Sanicula marilandica</i>	Black snakeroot	API
<i>Saxifraga occidentalis</i>	Western saxifrage	SAX
<i>Saxifraga odontoloma</i>	Brook saxifrage	SAX
<i>Saxifraga rhomboidea</i>	Diamondleaf saxifrage	SAX
<i>Sedum lanceolatum</i>	Lance-leaved stonecrop	CRS
<i>Senecio canus</i>	Woolly groundsel	AST
<i>Senecio integerrimus</i>	Western groundsel	AST
<i>Senecio pauperculus</i>	Balsam groundsel	AST
<i>Senecio streptanthifolius</i>	Cleft-leaved groundsel	AST
<i>Senecio triangularis</i>	Arrowleaf groundsel	AST
<i>Sibbaldia procumbens</i>	Sibbaldia	ROS
<i>Silene menziesii</i>	Menzies' campion	CRY
<i>Solidago canadensis</i>	Canada goldenrod	AST
<i>Solidago multiradiata</i> var. <i>scopulorum</i>	Northern goldenrod	AST
<i>Solidago nemoralis</i> var. <i>longipetiolata</i>	Gray goldenrod	AST
<i>Solidago simplex</i> var. <i>nana</i>	Mt. Albert goldenrod	AST
<i>Solidago simplex</i> var. <i>simplex</i>	Mt. Albert goldenrod	AST
<i>Sullivantia hapemanii</i> var. <i>hapemanii</i>	Hapeman's sullivantia	SAX
<i>Swertia radiata</i>	Green gentian	GEN
[<i>Frasera speciosa</i>]		
! <i>Taraxacum laevigatum</i>	Red-seeded dandelion	AST
! <i>Taraxacum officinale</i>	Common dandelion	AST
<i>Telesonix heucheriformis</i>	James' saxifrage	SAX
<i>Thalictrum fendleri</i>	Fendler's meadow-rue	RAN
<i>Thalictrum occidentale</i>	Western meadow-rue	RAN
<i>Townsendia parryi</i>	Parry's Easter-daisy	AST
<i>Toxicodendron rydbergii</i>	Poison ivy	ANA
[<i>Rhus radicans</i>]		
! <i>Tragopogon dubius</i>	Yellow salsify	AST
! <i>Tragopogon pratensis</i>	Meadow salsify	AST
! <i>Trifolium hybridum</i>	Alsike clover	FAB
! <i>Trifolium repens</i>	White clover	FAB
<i>Trollius laxus</i> var. <i>albiflorus</i>	American globeflower	RAN
<i>Urtica dioica</i> var. <i>procera</i>	Stinging nettle	URT
<i>Valeriana dioica</i>	Northern valerian	VAL
<i>Valeriana edulis</i>	Tobacco-root	VAL
<i>Veronica americana</i>	American brooklime	SCR
! <i>Veronica biloba</i>	Bilobed speedwell	SCR
<i>Veronica wormskjoldii</i>	Alpine speedwell	SCR
<i>Viola</i> sp.	Violet sp.	VIO
<i>Viola canadensis</i>	Canada violet	VIO
<i>Zigadenus elegans</i>	Elegant death camas	LIL

GRAMINOIDS

<i>Agrostis exarata</i>	Spike bentgrass	POA
<i>Bromus carinatus</i>	California brome	POA
<i>Bromus ciliatus</i>	Fringed brome	POA
! <i>Bromus inermis</i> var. <i>inermis</i>	Smooth brome	POA
! <i>Bromus japonicus</i>	Japanese brome	POA
! <i>Bromus tectorum</i>	Cheatgrass	POA
<i>Calamagrostis canadensis</i>	Bluejoint wheatgrass	POA
<i>Carex atrata</i> var. <i>erecta</i>	Blackened sedge	CYP
<i>Carex capillaris</i>	Hair sedge	CYP
<i>Carex elynoides</i>	Kobresia segde	CYP
<i>Carex geeyeri</i>	Elk sedge	CYP
<i>Carex haydeniana</i>	Hayden's sedge	CYP
<i>Carex hoodii</i>	Hood's sedge	CYP
<i>Carex lanuginosa</i>	Woolly sedge	CYP
<i>Carex microptera</i> var. <i>microptera</i>	Smallwing sedge	CYP
<i>Carex petasata</i>	Liddon's sedge	CYP
<i>Carex phaeocephala</i>	Dunhead sedge	CYP
<i>Carex raynoldsii</i>	Raynold's sedge	CYP
<i>Carex rossii</i>	Ross' sedge	CYP
<i>Carex rostrata</i>	Beaked sedge	CYP
[<i>Carex utriculata</i>]		
<i>Carex rupestris</i>	Curly sedge	CYP
<i>Carex scirpoidea</i> var. <i>scirpoidea</i>	Spikerush sedge	CYP
<i>Carex sprengeii</i>	Sprengel's sedge	CYP
! <i>Dactylis glomerata</i>	Orchard grass	POA
<i>Danthonia intermedia</i>	Timber oatgrass	POA
<i>Deschampsia cespitosa</i>	Tufted hairgrass	POA
<i>Elymus albicans</i> var. <i>albicans</i>	Thickspike wheatgrass	POA
<i>Elymus glaucus</i>	Blue wildrye	POA
<i>Elymus lanceolatus</i>	Thickspike wildrye	POA
[<i>Agropyron dasystachyum</i>]		
<i>Elymus x saxicolus</i>	Hybrid wildrye	POA
<i>Elymus spicatus</i>	Bluebunch wheatgrass	POA
<i>Elymus trachycaulus</i>	Bearded wheatgrass	POA
<i>Festuca idahoensis</i>	Idaho fescue	POA
! <i>Festuca rubra</i> var. <i>rubra</i>	Red fescue	POA
<i>Glyceria striata</i>	Fowl mannagrass	POA
<i>Hierochloe odorata</i>	Sweetgrass	POA
<i>Juncus ensifolius</i>	Swordleaf rush	JUN
<i>Juncus tracyi</i>	Tracy's rush	JUN
<i>Koeleria macrantha</i>	Junegrass	POA
<i>Leucopoa kingii</i>	Spike-fescue	POA
<i>Luzula spicata</i>	Spike woodrush	JUN
<i>Melica spectabilis</i>	Showy oniongrass	POA
<i>Melica subulata</i>	Alaska oniongrass	POA

<i>Muhlenbergia andina</i>	Alkali muhly	POA
<i>Muhlenbergia cuspidata</i>	Plains muhly	POA
<i>Phleum alpinum</i>	Alpine timothy	POA
! <i>Phleum pratense</i>	Common timothy	POA
<i>Poa alpina</i>	Alpine bluegrass	POA
! <i>Poa bulbosa</i>	Bulbous bluegrass	POA
<i>Poa cusickii</i> var. <i>cusickii</i>	Cusick's bluegrass	POA
<i>Poa cusickii</i> var. <i>epilis</i>	Skyline bluegrass	POA
<i>Poa interior</i>	Inland bluegrass	POA
<i>Poa juncifolia</i> var. <i>ampla</i>	Alkali bluegrass	POA
<i>Poa palustris</i>	Fowl bluegrass	POA
<i>Poa pratensis</i>	Kentucky bluegrass	POA
<i>Poa reflexa</i>	Nodding bluegrass	POA
<i>Poa secunda</i> var. <i>elongata</i>	Canby bluegrass	POA
<i>Poa secunda</i> var. <i>incurva</i>	Curly bluegrass	POA
<i>Stipa nelsonii</i> var. <i>nelsonii</i>	Nelson's needlegrass	POA
<i>Trisetum spicatum</i>	Spike trisetum	POA

FERNS AND FERN ALLIES

<i>Botrychium minganense</i>	Mingan Island moonwort	OPH
<i>Botrychium virginianum</i>	Rattlesnake fern	OPH
<i>Cheilanthes feei</i>	Fee's lipfern	ADI
<i>Cryptogramma stelleri</i>	Fragile rock-brake	ADI
<i>Cystopteris fragilis</i>	Brittle bladder-fern	ASL
<i>Equisetum arvense</i>	Common horsetail	EQU
<i>Equisetum hyemale</i> var. <i>affine</i>	Common scouring-rush	EQU
<i>Equisetum laevigatum</i>	Smooth scouring-rush	EQU
<i>Pellaea occidentalis</i>	Western cliff-brake	ADI
<i>Selaginella densa</i>	Compact spike-moss	SEL

FAUNA

Threatened, Endangered, and Sensitive Vertebrates

No federally listed Threatened or Endangered vertebrate species are currently known to breed or regularly occur within the Mann Creek potential RNA (WYNDD records), although potential habitat exists for the peregrine falcon in the area. One USDA Forest Service Region 2 Sensitive species (the Yellowstone cutthroat trout) has been documented to occur in the potential RNA, and potential habitat exists for 9 other forest Sensitive animal species (Bighorn National Forest 1996) or other vertebrates of special concern tracked by WYNDD (Fertig 1997). The status of each of these species is briefly summarized below. Additional information on the Yellowstone cutthroat trout record in the potential RNA is included in Appendix 2.

Fringed myotis (*Myotis thysanodes*)

Heritage Rank: G5/S2.

Federal Status: USDA Forest Service Region 2: Sensitive; USFWS: former C2.

Geographic Range: Southern British Columbia to western South Dakota and south to Mexico. In Wyoming, it is known from the Black Hills, and the foothills of the Bighorn, Owl Creek, Absaroka, Wind River, and Laramie Mountain Ranges (Priday and Luce 1996).

Habitat: Dry coniferous forests, juniper and desert scrublands, and mid-elevation grasslands (Bighorn National Forest 1996).

Roosts in caves and abandoned mines (Priday and Luce 1996).

Comments: One 3-5 day/night roosting site is known from the west side of the Bighorn Range, west of the Mann Creek area (Priday and Luce 1996). No roosting sites are known in the potential RNA, although cave habitats may occur in the dolomite outcrops along the canyon walls of Mann and Pumpkin Creeks. Feeding habitat may also occur in the potential RNA.

Townsend's big-eared bat (*Corynorhinus townsendii*)

Synonym: *Plecotus townsendii*.

Heritage Rank: G4/S3.

Federal Status: USDA Forest Service Region 2: Sensitive; USDA Forest Service Region 4: Sensitive; USFWS: former C2.

Geographic Range: Southern British Columbia to South Dakota, south to northern Mexico, western Texas, and Virginia. In Wyoming, it is known from the Black Hills, southeastern plains, and the foothills of the Absaroka, Wind River, Owl Creek, Laramie, and Bighorn Mountain Ranges (Priday and Luce 1996).

Habitat: Desert and foothills shrublands, juniper woodlands, and dry coniferous forests. Roosts in caves and abandoned mine shafts (Merrill et al. 1996).

Comments: Several day/night roosts have been investigated on the western and eastern slopes of the Bighorn Range in the vicinity of the potential RNA (Priday and Luce 1996). Potential roosting cave habitat may exist in the cliffs of the Mann Creek drainage, but no roosts were observed in 1996 surveys. Foraging habitat may exist in open riparian habitats along upper Cub and Pumpkin Creeks.

American marten (*Martes americana*)

Heritage Rank: G4G5/S3.

Federal Status: USDA Forest Service Region 2: Sensitive.

Geographic Range: Alaska to Newfoundland south to central California, northern New Mexico, Michigan, and northern New England. In Wyoming, it is known from the Bighorn, Medicine Bow, Absaroka, Teton, Wind River, and Salt River Mountain Ranges, the Sierra Madre, and the Yellowstone Plateau.

Habitat: Late-successional stands of mesic coniferous forests, especially with fallen logs and stumps on the ground (Bighorn National Forest 1996).

Comments: Potential habitat exists in the Engelmann spruce and subalpine fir forests on the north slopes of Boyd and Crater Ridges in the Mann Creek potential RNA. Other areas of the drainage that have been logged or burned may no longer provide habitat for this species. No martens were observed during 1996 surveys.

Northern goshawk (*Accipiter gentilis*)

Heritage Rank: G4/S3B, SZN.

Federal Status: USDA Forest Service Region 2: Sensitive; USFWS: former C2.

Geographic Range: Alaska to Newfoundland south to central California, New Mexico, northern Minnesota, and Pennsylvania. In Wyoming it is known from all of the major mountain ranges of the state (Merrill et al. 1996).

Habitat: Prefers old growth forests with sparse understories near running water interspersed with fields or wetlands (Bighorn National Forest 1996).

Comments: Potential nesting and foraging habitat exists throughout the Mann Creek potential RNA.

Merlin (*Falco columbarius*)

Heritage Rank: G5/S2B, SZN.

Federal Status: USDA Forest Service Region 2: Sensitive.

Geographic Range: Breeds from northwestern Alaska to Newfoundland, south to British Columbia, northern Wyoming, Minnesota, and southern Quebec and winters in the southern third of the United States and Mexico. In Wyoming, it is known to breed in mountain foothills in the western half of the state, with scattered reports from the Bighorns and Black Hills (Dorn and Dorn 1990; Downing 1990; Merrill et al. 1996).

Habitat: Breeds in open woodlands of ponderosa pine, limber pine, Douglas-fir, or aspen in valley bottoms with abandoned magpie, crow, or raptor nests available for use (Merrill et al. 1996; Oakleaf et al. 1996). Foraging habitat includes grasslands, shrublands, and agricultural lands (Dorn and Dorn 1990).

Comments: Potential foraging habitat may exist in the Mann Creek area. Downing (1990) reports merlin observations from the Sheep Mountain Road, just west of the potential RNA. Most nesting records in the Bighorn Range, however, come from riparian areas at lower elevations.

Peregrine falcon (*Falco peregrinus anatum*)

Heritage Rank: G4T4/S1B, S1N.

Federal Status: USFWS: Endangered.

Geographic Range: Occurs sporadically from Alaska to Greenland and south in the Rocky Mountains to northern Mexico. Reintroduced over much of its former range in the eastern United States (Bighorn National Forest 1996). In Wyoming, it is found primarily in the western mountains of the state and the Black Hills (Dorn and Dorn 1990).

Habitat: Nests primarily on tall cliffs, typically in wooded habitats (Merrill et al. 1996). Non-breeding individuals occupy mountainous areas near large lakes and rivers (Dorn and Dorn 1990).

Comments: This species has been reintroduced in the Shell Canyon area of the Bighorn National Forest, south of the potential RNA. Potential nesting and foraging habitat exists in the Mann Creek drainage. The potential RNA may also offer potential habitat for migrant falcons.

Three-toed woodpecker (*Picoides tridactylus*)

Heritage Rank: G5/S3.

Federal Status: USDA Forest Service Region 2: Sensitive; USDA Forest Service Region 4: Sensitive.

Geographic Range: Circumboreal; in North America occurs from northwestern Alaska to Newfoundland and south locally to southeastern Oregon, New Mexico, and northern New England (Bighorn National Forest 1996). In Wyoming it is known sporadically from the major mountain ranges of the state.

Habitat: Old-growth spruce-fir forest, especially those that have recently burned (Oakleaf et al. 1992).

Comments: This species is thought to occur throughout the Bighorn National Forest in low numbers (Bighorn National Forest 1996). Potential habitat exists in the recently burned conifer stands at the head of Mann and Pumpkin Creeks and in unburned forests along the West Fork of the Little Bighorn River.

Olive-sided flycatcher (*Contopus borealis*)

Heritage Rank: G4/S4B, SZN (not tracked by WYNDD).

Federal Status: USDA Forest Service Region 2: Sensitive.

Geographic Range: Breeds from Alaska to southern Labrador, south to California, western Texas, and northern Ohio and winters in South America. In Wyoming, it is uncommon over most of the western 2/3 of the state (Dorn and Dorn 1990).

Habitat: Edges of coniferous montane forests, burned areas, and boggy meadows (Merrill et al. 1996).

Comments: Reported as uncommon but well-distributed across the Bighorn Range (Downing 1990; Bighorn National Forest 1996). Potential habitat may occur throughout the Mann Creek potential RNA.

Golden-crowned kinglet (*Regulus satrapa*)

Heritage Rank: G5/S3.

Federal Status: USDA Forest Service Region 2: Sensitive.

Geographic Range: Breeds from southern Alaska to northern Alberta and Newfoundland, south to southern California, New Mexico, Michigan, and North Carolina. Winters south to Baja California, Central America, and Florida (Bighorn National Forest 1996). In Wyoming, it is found sporadically in the mountains of the western part of the state.

Habitat: Breeds primarily in dense spruce-fir forest. Winters in conifer forests near streams at lower elevations and cities (Dorn and Dorn 1990).

Comments: Potential habitat is found in the dense spruce-fir forests on the north side of the canyons of Mann, Pumpkin, and Cub Creeks and along the West Fork of the Little Bighorn River. This species is highly susceptible to disturbance of its forest habitat during the nesting season (Bighorn National Forest 1996).

Northern leopard frog (*Rana pipiens*)

Heritage Rank: G5/S3S4.

Federal Status: USDA Forest Service Region 2: Sensitive.

Geographic Range: Northern Alberta to Labrador, south to southeastern California, Mexico, and Florida. Widespread in Wyoming except for Yellowstone and Grand Teton National Parks (Baxter and Stone 1985).

Habitat: Found in cattail marshes, beaver ponds, wetland meadows, and riparian forest habitats from the plains to the mountains (Merrill et al. 1996).

Comments: Although not documented in the Mann Creek area, some habitat may occur in riparian areas of the potential RNA. This species was formerly abundant throughout the West, but is thought to be undergoing a rapid decline in recent years.

Yellowstone cutthroat trout (*Oncorhynchus clarki bouvieri*)

Heritage Rank: G4T2/S2.

Federal Status: USDA Forest Service Region 2: Sensitive.

Geographic Range: Historically restricted to the Yellowstone and Snake River Drainages in southern Montana, northwestern Wyoming, southeastern Idaho, northeastern Nevada, and northwestern Utah (May 1996). In Wyoming, native populations are known from streams and rivers in the northern Bighorn, Absaroka, Teton, and Gros Ventre Mountain Ranges and the Yellowstone Plateau.

Habitat: Cold-water lakes, large rivers, and small tributaries, especially in deep pools and undercut banks with overhanging vegetation. Spawns in riffles with pea to egg-sized gravel (Baxter and Stone 1995; Bighorn National Forest 1996).

Comments: A population of this species has been known for many years from the West Fork of the Little Bighorn River and the Mann

Creek drainage (Michael Allison, personal communication). Recent electrophoretic analysis of trout collected from Mann Creek indicates that the population is made up of hybrids of Yellowstone cutthroat trout and rainbow trout (*Oncorhynchus mykiss*), with an average frequency of Yellowstone cutthroat alleles at diagnostic loci of 94.7% and an average frequency of rainbow trout alleles at the diagnostic loci of only 5.3% (Leary 1994). Analysis of morphological and anatomical characteristics of trout from Pumpkin Creek and the West Fork suggests that this population was derived from an endemic cutthroat trout population, not from cutthroat trout introduced from elsewhere (Behnke 1994).

Animal Species List

Vertebrate species have not been systematically inventoried in the Mann Creek potential RNA. The following tentative species list is derived from literature sources and includes only those species for which potential habitat is present within the Mann Creek area (Baxter and Stone 1985, 1995; Clark and Stromberg 1987; Dorn and Dorn 1990; Merrill et al. 1996; Oakleaf et al. 1992). Species indicated by "*" are known to occur within the potential RNA based on observations by the authors in 1996.

Table 5. Vertebrates that may occur in the Mann Creek potential RNA.

<u>Common Name</u>	<u>Scientific Name</u>
MAMMALS	
Masked shrew	<i>Sorex cinereus</i>
Vagrant shrew	<i>Sorex vagrans</i>
Dusky shrew	<i>Sorex monticolus</i>
Water shrew	<i>Sorex palustris</i>
Fringed myotis	<i>Myotis thysanodes</i>
Little brown myotis	<i>Myotis lucifugus</i>
Long-legged myotis	<i>Myotis volans</i>
Silver-haired bat	<i>Lasionycteris noctivagans</i>
Townsend's big-eared bat	<i>Corynorhinus townsendii</i> [<i>Plecotus townsendii</i>]
* American pika	<i>Ochotona princeps</i>
* Snowshoe hare	<i>Lepus americanus</i>
* Least chipmunk	<i>Tamias minimus</i>
Yellow-bellied marmot	<i>Marmota flaviventris</i>
* Red Squirrel	<i>Tamiasciurus hudsonicus</i>
* Northern pocket gopher	<i>Thomomys talpoides</i>
American beaver	<i>Castor canadensis</i>

Deer mouse
Bushy-tailed woodrat
Southern red-backed vole
Meadow vole
Montane vole
Long-tailed vole
Muskrat
Western jumping mouse
Common porcupine
Coyote
Mountain lion
Bobcat
* Black bear
American marten
Long-tailed weasel
Mink
American badger
* Elk
Mule deer
White-tailed deer
Moose

Peromyscus maniculatus
Neotoma cinerea
Clethrionomys gapperi
Microtus pennsylvanicus
Microtus montanus
Microtus longicaudus
Ondatra zibethicus
Zapus princeps
Erethizon dorsatum
Canis latrans
Felis concolor
Lynx rufus
Ursus americanus
Martes americana
Mustela frenata
Mustela vison
Taxidea taxus
Cervus elaphus
Odocoileus hemionus
Odocoileus virginianus
Alces alces

BIRDS

Turkey vulture
Sharp-shinned hawk
Cooper's hawk
Northern goshawk
Red-tailed hawk
Rough-legged hawk
Golden eagle
American kestrel
Merlin
Peregrine falcon
Prairie falcon
* Blue grouse
Ruffed grouse
* Sage grouse
Killdeer
Common snipe
Great-horned owl
Northern saw-whet owl
Common nighthawk
White-throated swift
Broad-tailed hummingbird
Belted kingfisher
* Hairy woodpecker
Three-toed woodpecker

Cathartes aura
Accipiter striatus
Accipiter cooperi
Accipiter gentilis
Buteo jamaicensis
Buteo lagopus
Aquila chrysaetos
Falco sparverius
Falco colmbarius
Falco peregrinus
Falco mexicanus
Dendragapus obscurus
Bonasa umbellus
Centrocercus urophasianus
Charadrius vociferus
Gallinago gallinago
Bubo virginianus
Aegolius acadicus
Chordeiles minor
Aeronautes saxatalis
Selasphorus platycercus
Ceryle alcyon
Picoides villosus
Picoides tridactylus

* Northern flicker
 Olive-sided flycatcher
 Western wood pewee
 Cordilleran flycatcher
 Horned lark
 Violet-green swallow
 Cliff swallow
 * Gray jay
 * Clark's nutcracker
 Common raven
 Mountain chickadee
 * Red-breasted nuthatch
 Brown creeper
 American dipper
 Golden-crowned kinglet
 * Ruby-crowned kinglet
 * Mountain bluebird
 Townsend's solitaire
 Swainson's thrush
 Hermit thrush
 * American robin
 Yellow warbler
 Yellow-rumped warbler
 Macgillivray's warbler
 Wilson's warbler
 Western tanager
 Chipping sparrow
 Vesper sparrow
 Lincoln's sparrow
 White-crowned sparrow
 Dark-eyed junco
 Brewer's blackbird
 Cassin's finch
 Red crossbill
 Pine siskin

Colaptes auratus
Contopus borealis
Contopus sordidulus
Empidonax occidentalis
Eremophila alpestris
Tachycineta thalassina
Hirundo pyrrhonota
Perisoreus canadensis
Nucifraga columbiana
Corvus corax
Parus gambeli
Sitta canadensis
Certhia americana
Cinclus mexicanus
Regulus satrapa
Regulus calendula
Sialia currucoides
Myadestes townsendi
Catharus ustulatus
Catharus guttatus
Turdus migratorius
Dendroica petechia
Dendroica coronata
Oporornis tolmiei
Wilsonia pusilla
Piranga ludoviciana
Spizella passerina
Pooectes gramineus
Melospiza lincolni
Zonotrichia leucophrys
Junco hyemalis
Euphagus cyanocephalus
Carpodacus cassinii
Loxia curvirostra
Carduelis pinus

REPTILES AND AMPHIBIANS

Northern leopard frog
 * Wandering garter snake
 * Prairie rattlesnake

Rana pipiens
Thamnophis elegans
vagrans
Crotalus viridis

FISH

Brook trout
 Rainbow trout
 * Yellowstone cutthroat trout

Salvelinus fontinalis
Oncorhynchus mykiss
Oncorhynchus clarki
bouvieri

GEOLOGY

Bedrock in the Mann Creek potential RNA is mainly limestone and dolomite of the Madison Formation (Mississippian), Bighorn Formation (Ordovician), and Gallatin Formation (Cambrian), with thinner beds of shale of the Gros Ventre Formation (Cambrian) and sandstone of the Flathead Formation (Cambrian) (Love and Christiansen 1985). The bedrock dips primarily to the northeast off of the flank of the Bighorn Mountains.

LANDS

The Mann Creek potential RNA is National Forest System land and is bordered on all but the northeastern corner by National Forest System land. A short stretch of the northern boundary in Township 58 North, Ranges 89 West and 90 West adjoins the Crow Indian Reservation in Montana, and a short stretch of the eastern boundary in T58N, R89W adjoins private land and BLM-managed public land.

SUITABILITY FOR RESEARCH NATURAL AREA SELECTION

An area is suitable for designation as a research natural area according to how well it meets four criteria: quality, condition, viability, and defensibility (Andrews 1993). Each criterion is briefly defined below, and the information collected during field work that is pertinent to each criterion is described.

QUALITY

Definition: The degree to which the potential RNA represents the range in variability within the ecosystem types that it contains.

The Douglas-fir woodlands in the Mann Creek potential RNA grow on a variety of slopes over a range in elevation, and exhibit a broad range of variation in the composition and structure of the understory. The overstory also varies throughout the area, although most of Douglas-fir woodland is composed of small trees.

The Engelmann spruce forests cover a much smaller area, but grow in a variety of mesic environments and show a range of variation in tree density and in composition of the understory. Hence the potential RNA apparently contains good representatives of the low-elevation Engelmann spruce forests. Ponderosa pine forests also cover a limited area, and grow primarily on relatively dry sites--a situation that illustrates the status of this tree species in the Bighorn Mountains (Despain 1973, Driese

et al. 1994). The most mesic of the ponderosa pine forest types, the ponderosa pine/mountain ninebark type (Hoffman and Alexander (1976) may be absent. Nevertheless, these forests in the potential RNA apparently represent much of the variation described by Despain (1973) in the ponderosa pine forests of the Bighorn Mountains.

Limber pine woodlands are also of limited extent in the Bighorn Mountains (Driese et al. 1994), and have been considered minor components of Douglas-fir woodlands (Despain 1973, Hoffman and Alexander 1976). Hence the limber pine/common juniper woodlands of the potential RNA may be good representatives of these woodlands in the Bighorns.

Despain (1973) notes that the grasslands of the Bighorn Mountains are dominated by Idaho fescue at intermediate and higher elevations, and by bluebunch wheatgrass at lower elevations. With the mix of these two species in the grass vegetation, the potential RNA apparently represents a transition between these two major grassland types. The Idaho fescue-upland sedge (*Carex obtusata*) vegetation that apparently constitutes the major grassland type of the Bighorns (Beetle 1956) is absent from the potential RNA.

Considering the variation in composition and structure of the forest overstories and understories, and the variation in composition in the grasslands, the potential RNA represents well the landscapes on carbonate rocks at middle and low elevations on the eastern side of the Bighorn National Forest.

CONDITION

Definition: the degree to which the potential RNA has been altered from pre-settlement conditions.

The potential RNA has been altered from its pre-settlement condition by the introduction of exotic species, the presence of a few structures, and changes in the ecological processes that shaped the area's ecosystems. These causes of change are interrelated and a complete discussion is impossible here; this discussion is largely restricted to observations made during field survey.

Exotic species

Exotic plant species (primarily grasses) appear to be most common in the riparian zones and the mesic sagebrush shrublands of the potential RNA. The Douglas-fir forests that cover most of the area appear to contain few exotic plants. The following observations were made of exotic plants.

Smooth brome (*Bromus inermis*) and orchardgrass (*Dactylis glomerata*) were seeded into the burn in Dark Canyon within 0.25 mile (0.4 km) of the southern boundary of the potential RNA, and have invaded the drier (higher) part of the riparian zone of Mann Creek downstream from the burn inside the potential RNA, where they are common and co-dominate patches. The amounts of these species appear to decrease downstream with distance from the burn. Scattered plants of orchardgrass also are present in the riparian zone of the West Fork of the Little Bighorn ca. 1.1 miles (1.7 km) downstream from confluence of Mann Creek and Pumpkin Creek.

Meadow timothy (*Phleum pratense*) was observed in a meadow west of Fisher Mountain, in a valley on the south side of the canyon of the West Fork, where it is common and scattered throughout the dense herbaceous vegetation. Scattered plants of this species also are present in the riparian zone of the West Fork ca. 1.1 miles (1.7 km) downstream from the confluence of Mann Creek and Pumpkin Creek. Meadow timothy co-dominates the vegetation in Deer Park at the confluence of Mann Creek and Pumpkin Creek. In the mountain big sagebrush shrubland on the northern side of Pumpkin Creek Canyon, the species is common and scattered throughout the herbaceous layer in relatively mesic sites.

Kentucky bluegrass (*Poa pratensis*) co-dominates the vegetation in Deer Park at the confluence of Mann Creek and Pumpkin Creek. In the mountain big sagebrush shrub stands on the north side of Pumpkin Creek Canyon, the species co-dominates or dominates the herbaceous layer in mesic microsites, in areas >100 sq m. It is present in small amounts in the Idaho fescue grassland vegetation.

Cheatgrass (*Bromus tectorum*) is present in the ponderosa pine woodland in the canyon of the West Fork, where it grows as scattered plants that contribute little canopy cover to the herbaceous layer. It probably also is present in the Idaho fescue-bluebunch wheatgrass grass vegetation on south-facing slopes in the lower reaches of the West Fork canyon.

Bulbous bluegrass (*Poa bulbosa*) was observed in the Idaho fescue grassland on the dip slope within 0.5 mile (0.8 km) of the western boundary of the potential RNA, and may be present in the grasslands and the ponderosa pine woodland in the lower parts of West Fork Canyon, within the potential RNA.

The only exotic forb noted in any amount was Canada thistle (*Cirsium arvense*). The species is present in small amounts

(scattered stems) in the riparian zone of Mann Creek in Dark Canyon, and scattered plants are present in the riparian zone of the West Fork ca. 1.1 miles (1.7 km) downstream from confluence of Mann Creek and Pumpkin Creek. Outside the potential RNA, Canada thistle was observed in the riparian zone of Mann Creek upstream from Dark Canyon, growing in scattered patches of <100 stems and covering ca. 100 square yards each. It was also observed in the dry meadow on Crater Ridge between Crater Creek and Cub Creek, in small patches (<100 sq m) on pocket gopher diggings, especially in swales.

Pale alyssum (*Alyssum alyssoides*) was observed in the Idaho fescue grassland on the north side of Pumpkin Creek Canyon, where it grows in small amounts scattered throughout the vegetation.

These observations suggest that exotic plants are present throughout the potential RNA, but they have had substantial impacts in altering the composition of the vegetation only in a few of the mesic grasslands.

Structures

Few human structures were observed in the potential RNA. A feature was sighted from the north side of the canyon of Pumpkin Creek, across the canyon on the south wall, that may be a road descending into Cub Creek from Crater Ridge (Figure 1). The feature appeared through binoculars as a thin line originating near the top of the talus field and descending westward into the valley.

A small building stands at the foot of the south wall of the Pumpkin Creek valley, at the mouth of a small tributary valley running into the main valley from the south (Figure 1). This building was observed through binoculars from a point on the north side of the Pumpkin Creek valley ca. 0.5 mile (0.8 km) to the northeast, and the condition, size, and purpose of this building are unknown.

These two small structures appear to have little effect on the ecological processes of the potential RNA.

Ecological processes

-- Grazing and browsing: Dorn's (1986) review of the writings of early travellers in the Bighorn Mountains indicates that grazing and browsing animals--bison, elk, and mule deer--were present, but their numbers (of bison at least) were quite variable. Given the small amount of forage in the forests of the potential RNA, those ungulates probably spent little time in most

of the area. They may have had a substantial effect on the grassland and shrubland in Pumpkin Creek Canyon, but it is doubtful that enough information on this topic is available to indicate whether the role of grazers and browsers has changed significantly since settlement by Europeans. No obvious impacts from grazing or browsing were noted during field work in the potential RNA.

-- Fire: Despain (1973) reviews accounts showing that fire was a major ecological process in the Bighorn Mountains before European settlement, and the common occurrence of burned stumps, snags, and logs in the forests of the potential RNA (Appendix 5) indicates that fire has shaped the landscape there. In the past several decades, fire has burned ca. 1,068 acres (432 ha) in the western end of the potential RNA and at least several hundred acres in Dark Canyon immediately south of the recommended boundary of the area. A judgement of how much the current fire regime differs from the pre-settlement fire regime must await research on the fire history of the potential RNA.

VIABILITY

Definition: the prospect for long-term maintenance of the ecosystem types in the area and the survival of their constituent species.

No immediate threats to the maintenance of the ecosystems or the survival of the constituent species in the potential RNA were noted during field work. If the exotic plants have significantly altered the ecosystems of the area, they appear to have done so only in the sagebrush shrub vegetation. Even there, this evaluation did not reveal any overt signs of the degree to which Kentucky bluegrass and other exotics are affecting the biotic or abiotic processes in the ecosystem. Exotic plants cannot be removed from the potential RNA, but the abundance of plants in various places can probably be reduced with the appropriate management tools, if further research suggests that this is necessary. Exotics that apparently are not present in the area, such as knapweed, could pose a threat, and a monitoring program to detect them would be useful.

Long-term maintenance of the ecosystems in a condition similar to pre-settlement condition will require that the ecological processes that shaped those ecosystems continue to exert an influence. Of those processes, the ones that managers are most likely to control are fire, and grazing and browsing by large mammals. The accounts reviewed by Dorn (1986) suggest that grazing animals were present before European settlement. The grass and sagebrush shrub vegetation on the north side of Pumpkin Creek appear to provide substantial forage, but the woodlands

that cover most of the potential RNA provide so little forage that grazing probably was of minor importance in most of the area.

Fire apparently will be important to the viability of some of the ponderosa pine forests in the potential RNA. The mesic ponderosa pine/shinyleaf spiraea association may contain substantial amounts of Douglas-fir (Appendix 5, Table 3-3, plot 17b) and apparently is growing on a Douglas-fir habitat type. Fischer and Clayton (1983) note that seral ponderosa pines on the drier Douglas-fir habitat types (such as occur in the potential RNA) disappear in the absence of fire, and the stands change to Douglas-fir forests. The drier ponderosa pine/bluebunch wheatgrass woodlands apparently will not be converted to other types in the absence of fire, although their structure may change.

Few tree species other than Douglas-fir were observed in the Douglas-fir forests that cover most of the potential RNA, suggesting that these are climax types and do not require fire for their maintenance, or that they have a very long interval between fires. The Douglas-fir/common juniper association grows on relatively dry sites and generally has little fuel in the understory. Fire in such sites may be important in maintaining the open structure of the forest (Bradley et al. 1992). In the more mesic Douglas-fir/mountain ninebark and Douglas-fir/shinyleaf spiraea associations, fire may be important in maintaining the limited amount of aspen in the overstory (Bradley et al. 1992).

The Engelmann spruce forests, the subalpine fir forests, and most of the limber pine woodlands in the potential RNA also appear to be climax, based on the absence of other trees in the stands. Fire may be important in preventing the more mesic grasslands and sagebrush shrublands from being converted to Douglas-fir woodland, although the observations in those types do not indicate imminent threat of that.

The Mann Creek potential RNA appears to be large enough, and contain enough fire breaks, that prescribed fires can be contained within it.

Viability of the aquatic and riparian ecosystems, and of the Yellowstone cutthroat trout population, depends on maintenance of adequate stream flows and water quality. Because the potential RNA does not include all of the drainage basins of Pumpkin Creek and Mann Creek, management of lands outside the potential RNA will be important in maintaining these ecosystems.

DEFENSIBILITY

Definition: the extent to which the area can be protected from extrinsic, anthropogenic factors that might worsen the condition of the area or threaten the viability of the ecosystems present.

No immediate anthropogenic threats to the ecosystems in the potential RNA were obvious during the field work, and the terrestrial ecosystems appear to be protected from potential threats. Public roads provide ready access to the margins of the area, but the steep, rough terrain and the lack of roads and trails within the potential RNA discourage vehicle or foot traffic. A trail provides access up the West Fork from the northeastern corner of the area, but it, too, is rough and discourages most travellers. The isolation of the area and the lack of obvious attractions also should reduce threats from humans.

Given the lack of forage in most of the potential RNA, the threat of unintended livestock grazing appears to be minimal. The grassland on the north side of the Pumpkin Creek Canyon is accessible to livestock.

Exotic plants, including Canada thistle, have become established around the potential RNA, and even if the populations inside the area are reduced, the populations outside will serve as sources for continued invasion. This may not be a problem for the species already there, but a monitoring program may be necessary to defend the potential RNA against the possible invasion by new, aggressive species (such as knapweeds and leafy spurge).

The aquatic ecosystems in the potential RNA may be harder to defend from undesirable disturbances, because the drainage basins of Pumpkin Creek and Mann Creek extend west and south (upstream) from the potential RNA. The relatively gentle terrain and the network of roads in those areas makes them readily accessible, and activities there could pose threats to the streams in the potential RNA.

DEGREE TO WHICH THE POTENTIAL RNA MEETS THE CRITERIA

The Mann Creek potential RNA contains a mix of plant associations (Douglas-fir/mountain ninebark, Douglas-fir/shinyleaf spiraea, Douglas-fir/common juniper, limber pine/common juniper, ponderosa pine/shinyleaf spiraea, ponderosa pine/bluebunch wheatgrass, Engelmann spruce/mountain ninebark, Engelmann spruce/red-osier dogwood, Engelmann spruce/field horsetail) that apparently represent well the landscape of canyons and lower slopes of the northeastern Bighorn Mountains.

The condition of the ecosystems in the potential RNA has been compromised to some degree by exotic grasses (principally Kentucky bluegrass and meadow brome), which contribute substantial cover to the vegetation in the mesic grasslands and sagebrush shrublands, where they codominate or dominate patches. The alteration of the major ecological processes that once affected the ecosystems in the region, especially fire and grazing by large mammals, certainly has had some effect on the condition of the potential RNA, but that effect is largely unknown.

The viability of the ecosystems in the potential RNA can probably be assured if populations of exotic plants (especially any new and aggressive weeds) are monitored and kept in check and if a prescribed fire program is implemented that recognizes the importance of fire in maintaining seral communities. The isolation of the area, the lack of roads and trails, and the rough topography combine to decrease the threat of unwanted human intrusion to the terrestrial ecosystems, but the future of the aquatic ecosystems depends to a greater extent on management of the areas to the south and west of the potential RNA.

IMPACTS AND POSSIBLE CONFLICTS

This section is limited to the conflicts obvious from field survey and from conversations with USDA Forest Service staff.

MINERAL RESOURCES

No signs of mineral claims or exploration were observed.

GRAZING

No current livestock grazing, or signs of excessive past livestock grazing, were observed. Livestock may use the grasslands and sagebrush shrublands in the northwestern part of the area, but most of the potential RNA appears to contain little forage.

TIMBER

No signs of past or pending timber harvest were observed. The small trees in most of the forests appear to offer little merchantable timber, and the steep slopes in the area appear to make logging impractical.

WATERSHED VALUES

The proposed boundary of the potential RNA includes parts of several watersheds, but the watersheds of the main streams extend west and south of the area. No water developments were observed that would conflict with establishment of a research natural area.

RECREATION VALUES

Modern fire rings and a cache of camping equipment (perhaps abandoned) were observed at Deer Park in August 1995 by Michele Girard of the Bighorn National Forest (personal communication). No constructed or maintained recreational facilities are shown on the 1996 Bighorn National Forest map (1:126,720-scale), and only one structure that might be related to recreation was observed during field survey, that being a small building on the south side of Pumpkin Creek, at the mouth of a small tributary valley running into the main valley from the south (Figure 1). Recreational use appears to be limited to fishing in the West Fork of the Little Bighorn River in the northeastern part of the area (Michele Girard, Bighorn National Forest, personal communication), and perhaps to big-game hunting in the western part of the area in the fall.

WILDLIFE AND PLANT VALUES

No structures or signs of activities associated with wildlife management (such as prescribed burns to improve habitat) were observed in the potential RNA. Establishment of an RNA apparently would not conflict with any efforts to maintain the population of Yellowstone cutthroat trout in the West Fork of the Little Bighorn River, in the northeastern part of the area.

TRANSPORTATION VALUES

The 1996 edition of the Bighorn National Forest map (1:126,720-scale) shows no maintained trails or roads in the potential RNA, and no maintained trails or roads were observed. A feature that may be a road on the south side of the canyon of Pumpkin Creek was observed from across the canyon (Figure 1).

MANAGEMENT CONCERNS

The only potential management concerns that might arise from observations made during the 1996 field survey are use of the small building in the canyon of Pumpkin Creek, and the possible road off of Crater Ridge into Cub Creek. These features should be investigated to determine whether management of the area as an RNA would conflict with their use.

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APPENDIX 1. MAPS OF THE MANN CREEK POTENTIAL RESEARCH NATURAL
AREA.

Figure 1. Society of American Foresters cover types (Eyre 1980) in the Mann Creek potential RNA.

<u>Cover Type</u>	<u>Map Symbol</u>
Engelmann Spruce-Subalpine Fir	206
Interior Douglas-fir (with small inclusions of shrub and grass vegetation)	210
Limber pine (with inclusions of Interior Douglas-fir)	219
Interior Ponderosa Pine (with substantial areas of grassland containing scattered pines)	237
Burned area	Burn

Figure 2. Plant associations in the Mann Creek potential RNA.

See Appendix 7 for synonyms for the plant association names. Numbers in squares refer to sample plots, and numbers in circles refer to locations of vegetation descriptions; see Appendix 5 for both.

<u>Map Symbol</u>	<u>Plant Associations</u>
Sf	Subalpine fir/heartleaf arnica
Es1	Engelmann spruce/mountain ninebark with minor amounts of Engelmann spruce/field horsetail
Es2	Engelmann spruce/mountain ninebark with minor amounts of Engelmann spruce/red-osier dogwood
Es3	Engelmann spruce/mountain ninebark and Engelmann spruce/shinyleaf spiraea with minor amounts of Engelmann spruce/red-osier dogwood
D-f1	Douglas-fir/mountain ninebark with minor amounts of Douglas-fir/shinyleaf spiraea, Douglas-fir/common juniper, Quaking aspen, Mountain ninebark, Water birch/red-osier dogwood, and unidentified meadow
D-f2	Douglas-fir/common juniper with minor amounts of Douglas-fir/mountain ninebark and Douglas-fir/shinyleaf spiraea
Lp	Limber pine/common juniper with minor amounts of Douglas-fir/common juniper
Pp	Ponderosa pine/bluebunch wheatgrass and Idaho fescue-bluebunch wheatgrass (each type ca. 50% of complex)
Sb	Mountain big sagebrush/Idaho fescue (ca. 40%) with Douglas fir/common juniper, Idaho fescue-bluebunch wheatgrass, and unidentified Idaho fescue grassland (each ca. 20%)
If	Idaho fescue grassland with Douglas-fir/mountain ninebark
Mb	Mountain bluebells and Prickly currant
Burn	Burned area

APPENDIX 2. ELEMENT OCCURRENCE RECORDS FOR BIGHORN NATIONAL
FOREST SENSITIVE SPECIES AND WYNDD SPECIES OF SPECIAL CONCERN
DOCUMENTED FROM THE MANN CREEK POTENTIAL RNA.

APPENDIX 3. WYOMING NATURAL DIVERSITY DATABASE SITE BASIC RECORD
FOR THE POTENTIAL MANN CREEK RNA.

APPENDIX 4. PHOTOGRAPHS FROM THE MANN CREEK POTENTIAL RNA.

APPENDIX 5. SAMPLE PLOTS AND VEGETATION DESCRIPTIONS FROM THE MANN CREEK POTENTIAL RESEARCH NATURAL AREA.

Estimates of canopy cover from sample plots are shown in tables. The cover values for species are midpoints of the following cover classes:

<u>Cover Value</u>	<u>Range of Canopy Cover</u>
1	<1%
3	1% - 5%
10	5% - 15%
20	15% - 25%
30	25% - 35%
40	35% - 45%
50	45% - 55%
60	55% - 65%
70	65% - 75%
80	75% - 85%
90	85% - 95%
97	95% - 100%

Vegetation descriptions are for parts of stands and were not made for formal sample plots. At each location, the species in each stratum of the vegetation are listed approximately in order from those with the most canopy cover to those with the least.

Locations of sample plots and of vegetation descriptions are shown on Figure 2.

SAMPLE PLOTS

Table 3-1. Canopy cover of plants in plots of the Engelmann spruce associations and the subalpine fir/heartleaf arnica association.

	Plot#/Association*			
	5c	7a	17	29
Species	Piceng/ Phymon	Piceng/ Phymon	Piceng/ Corser	Abilas/ Arncor
TREES				
<i>Abies lasiocarpa</i>				40
<i>Picea engelmannii</i>	50	50	50	40
<i>Pseudotsuga menziesii</i>	3			
SHRUBS				
<i>Abies lasiocarpa</i>				20
<i>Acer glabrum</i>			40	
<i>Betula occidentalis</i>			1	
<i>Cornus sericea</i>			70	
<i>Picea engelmannii</i>	10			
<i>Prunus virginiana</i>			1	
<i>Pseudotsuga menziesii</i>	3			
<i>Ribes oxycanthoides</i>			10	50
DWARF SHRUBS				
<i>Shepherdia canadensis</i>	1			
<i>Juniperus communis</i>	1		1	1
<i>Mahonia repens</i>		3		
<i>Physocarpus monogynus</i>	1	3		
<i>Spiraea betulifolia</i>	3	3		
GRAMINOIDS				
<i>Dactylis glomerata</i>			1	
<i>Calamagrostis canadensis</i>			1	
<i>Elymus glaucus</i>			3	
<i>Glyceria striata</i>			3	
<i>Phleum pratense</i>			3	
<i>Poa palustris</i>			1	
FORBS				
<i>Actaea rubra</i>	1		1?	
<i>Antennaria racemosa</i>			3	
<i>Arnica cordifolia</i>				40
<i>Arnica latifolia</i>				40
<i>Aster foliaceus</i>			3	
<i>Aster sp.</i>		1		

Aster conspicuous or A. meritus	3			
Cirsium arvense			1	
Clematis columbiana var. tenuiloba	3	3	1?	
Disporum trachycarpum	tr		1	
Equisetum laevigatum			1	
Fragaria sp.			1?	3
Galium aparine			10	
Galium boreale	1			3
Geranium richardsonii			3	
Heracleum sphondylium			3	
Linnaea borealis			1	
Maianthemum racemosum			3	
Maianthemum stellatum			3	
Mertensia ciliata			30	
Osmorhiza chilensis			1	3
Osmorhiza depauperata				3
Pedicularis racemosa var. alba	tr			
Senecio triangularis			1	
Sullivantia hapemanii			3	
Thalictrum occidentale	10	10	3	50
Valeriana dioica				1
Viola canadensis		1	30	

* Association acronyms:

Piceng/Phymon = Engelmann spruce/mountain ninebark

Abilas/Arcor = subalpine fir/heartleaf arnica

Plot Number	Description:
5a	Northeast-facing slope, upper part Trees to ca. 30 m tall, mostly 20-25 cm dbh Burned stumps and fallen trunks (some burned) common.
7a	Northwest-facing slope, lower 1/4. Trees mostly ca 25 m tall.
17	Valley bottom of limestone cobbles and boulders, along perennial stream channel. Trees ca. 40 m tall and 25 cm dbh.
29	Northeast-facing slope, lower part. Picea trees ca. 35 m tall and 50-90 cm dbh; Abies trees ca. 30 m tall and 15-30 cm dbh. Fallen trunks are common.

Table 3-2. Canopy cover of plants in plots in the Douglas-fir associations.

Plot#/Association*											
	5a	5b	7b	10a	10b	10c	15a	15b	47	34	37
Species	Psemen/ Spibet	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Juncom	Psemen/ Juncom
TREES											
<i>Picea engelmannii</i>	1	1	3								
<i>Pinus flexilis</i>										10	10
<i>Pseudotsuga menziesii</i>	60	50	40	50	50	50	50	50	70	50	20
SHRUBS											
<i>Abies lasiocarpa</i>		1									
<i>Acer glabrum</i>						1		3			
<i>Juniperus scopulorum</i>						1					
<i>Picea engelmannii</i>	1	1									
<i>Pinus flexilis</i>											3
<i>Prunus virginiana</i>							1	1			
<i>Pseudotsuga menziesii</i>	1	1					3?		3		
DWARF SHRUBS											
<i>Juniperus communis</i>	3		1		20	20	10	1	1	30	10
<i>Mahonia repens</i>	10	1	1	10			1?			3	
<i>Physocarpus monogynus</i>		3	10	50	20	30	10	3	60		
<i>Rosa sayi</i>								1	3		
<i>Shepherdia canadensis</i>				3	20			1			3
<i>Spiraea betulifolia</i>	10	3	3	3?	10	10	1?	3		3	
<i>Symphoricarpos</i> sp.				10		3	1	3			

Plot#/Association*

	5a	5b	7b	10a	10b	10c	15a	15b	47	34	37
Species	Psemen/ Spibet	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Juncom	Psemen/ Juncom
GRAMINOIDS											
<i>Carex geyeri</i>									1		
<i>Carex rossii</i>										1	1
<i>Elymus glaucus</i>				3							
<i>Elymus spicatus</i>											3
<i>Festuca idahoensis</i>									1		
<i>Leucopoa kingii</i>										1	
<i>Poa interior</i>									1		1
FORBS											
<i>Anemone multifida</i>		1							1		
<i>Antennaria microphylla</i>									1		
<i>Antennaria racemosa</i>				1	10	3		3			
<i>Apocynum androsaemifolium</i>					1						
<i>Arnica cordifolia</i>	3			10							
<i>Arnica lonchophylla</i>							tr	tr			
<i>Aster sp.</i>	5	1	1		1	3	1		1	3	
<i>Aster conspicuous</i> or <i>A. meritus</i>	3			10	1	3	1	1			
<i>Balsamorhiza sagittata</i>				1							20
<i>Clematis columbiana var. tenuiloba</i>	3	1	1	10	10	3		1	3		10
<i>Disporum trachycarpum</i>	tr	tr		3		1		1	1		

Plot#/Association*

	5a	5b	7b	10a	10b	10c	15a	15b	47	34	37
Species	Psemen/ Spibet	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Phymon	Psemen/ Juncom	Psemen/ Juncom
Fragaria sp.									1		
Galium boreale	3	1		10	1	1		1	1		3
Linnaea borealis								1			
Maianthemum stellatum				3							1
Osmorhiza chilensis					1						
Solidago multiradiata											3
Thalictrum occidentale	10	10									
Viola canadensis		1									
Zigadenus elegans									1		
MOSSES AND BRYOPHYTES											
Moss								60			

*Association acronyms:

- Psemen/Spibet = Douglas-fir/shinyleaf spiraea
- Psemen/Phymon = Douglas-fir/mountain ninebark
- Psemen/Juncom = Douglas-fir/common juniper

Plot Number

Description:

- 5a Northeast-facing slope, upper part
Trees to ca. 30 m tall, mostly 20-25 cm dbh
Burned stumps and fallen trunks (some burned) common.
- 5b Northeast-facing slope, middle part
Trees to ca. 30 m tall, mostly 25-30 cm dbh
Burned stumps and fallen trunks (some burned) common.

Plot Number	Description:
7b	Northwest-facing slope, middle part. Trees mostly 15-20 cm dbh, 10-15 m tall.
10a	Northeast-facing slope, near top. Trees 25 m tall and 20 cm dbh.
10b	Northeast-facing slope, upper 1/4 Trees ca. 20 m tall and 13 cm dbh.
10c	Northeast-facing slope, middle part. Trees 20 m tall and 15-20 cm dbh. Photo 96GJ3.13 is of this stand.
15a	West-facing slope, upper part. Trees ca. 20 m tall and 13 cm dbh. Burned stumps and burned, fallen logs common. Understory much more open than on north-facing slopes (plots 10a, 10b, 10c).
15b	West-northwest-facing slope, lower part. Trees ca. 15 m tall and 13 cm dbh. Burned stumps and burned, fallen logs common.
34	Southeast-facing slope, upper to lower part. Trees 10-12 m tall, 15-20 cm dbh.
37	South-facing slope, upper part. Pseudotsuga trees ca. 15 m tall and 10-20 cm dbh; Pinus flexilis trees ca. 12 m tall and 10-20 cm dbh. Tree layer is patchy. Merges downslope into Artemisia tridentata ssp. vaseyana shrubland; see plot 38.
47	North-facing slope on side of draw. Trees ca. 9 m tall and 20 cm dbh. Small grove of woodland in matrix of type represented by plot #45. Pocket gopher burrows common.

Table 3-3. Canopy cover of plants in plots in the limber pine and ponderosa pine associations.

Plot#/Association*						
	8	27	38	46	48	17b
Species	Pinfle/ Juncom	Pinfle/ Juncom	Pinfle/ Juncom	Pinfle/ Juncom	Pinfle/ Juncom	Pinpon/ Spibet
TREES						
<i>Abies lasiocarpa</i>				1		
<i>Pinus flexilis</i>	40	30	3	10	10	
<i>Pinus ponderosa</i>					3	30
<i>Pseudotsuga menziesii</i>	10	3			3	20
SHRUBS						
<i>Acer glabrum</i>		1				
<i>Juniperus scopulorum</i>					1	1
<i>Prunus virginiana</i>					1	1
<i>Pinus flexilis</i>	3					
<i>Pseudotsuga menziesii</i>	3			3		1
DWARF SHRUBS						
<i>Rhus trilobata</i>						1
<i>Juniperus horizontalis</i>					1	1
<i>Artemisia tridentata</i> <i>ssp. vaseyana</i>			3	1		
<i>Rosa sayi</i>	1		3			
<i>Physocarpus monogynus</i>	3			10		
<i>Shepherdia canadensis</i>	10	3			1	
<i>Spiraea betulifolia</i>		3	1		3	10
<i>Mahonia repens</i>		10	3		3	3
<i>Pentaphylloides</i> <i>floribunda</i>				20	1	
<i>Arctostaphylos uva-</i> <i>ursi</i>	10	10		1		
<i>Juniperus communis</i>	10	30	10	10	20	10
GRAMINOIDS						
<i>Bromus tectorum</i>						1
<i>Carex rossii</i>	1				3	1
<i>Carex scirpoidea</i>				3		
<i>Danthonia intermedia</i>				3		
<i>Elymus saxicolus?</i>						1
<i>Elymus spicatus</i>			10		10	
<i>Elymus trachycaulus</i> <i>var. trachycaulus</i>						1
<i>Festuca idahoensis</i>				20		3

Plot#/Association*

	8	27	38	46	48	17b
Species	Pinfle/ Juncom	Pinfle/ Juncom	Pinfle/ Juncom	Pinfle/ Juncom	Pinfle/ Juncom	Pinpon/ Spibet
<i>Koeleria macrantha</i>			1		1	1
<i>Leucopoa kingii</i>		3	3	1	1	
<i>Muhlenbergia cuspidata</i>						1
<i>Phleum pratense</i>						1
<i>Poa interior</i>	1			1		
<i>Poa pratensis</i>				1		
<i>Poa secunda</i>					1	1
<i>Stipa nelsonii</i>				3		1?
FORBS						
<i>Achillea millefolium</i>				3		
<i>Anemone multifida</i>			1	3		
<i>Antennaria microphylla</i>			1	1		
<i>Apocynum androsaemifolium</i>	1				3	10
<i>Artemisia dracunculus</i>						1
<i>Artemisia ludoviciana</i>						1
<i>Aster sp.</i>	3	1		1?	3	
<i>Astragalus miser</i>			1			
<i>Balsamorhiza sagittata</i>			10		3	3
<i>Bupleurum americanum</i>				1		
<i>Campanula rotundifolia</i>	1				1	1
<i>Castilleja linariifolia</i>	1					
<i>Cerastium arvense</i>				1		
<i>Clematis columbiana</i> var. <i>tenuiloba</i>	3			10		
<i>Comandra umbellata</i>			3		1	
<i>Fragaria sp.</i>				1		
<i>Galium boreale</i>	3		3	1	1	1
<i>Geranium richardsonii</i>						1
<i>Geranium viscosissimum</i>				1		
<i>Geum triflorum</i>				3		
<i>Hedysarum sulphurescens</i>	1		1	1		
<i>Heterotheca villosa</i>						1
<i>Hieracium umbellatum</i>	1					
<i>Liatris punctata</i>						1
<i>Linum lewisii</i>			1			
<i>Maianthemum racemosum</i>						1
<i>Maianthemum stellatum</i>		1			1	

Plot#/Association*

	8	27	38	46	48	17b
Species	Pinfle/ Juncom	Pinfle/ Juncom	Pinfle/ Juncom	Pinfle/ Juncom	Pinfle/ Juncom	Pinpon/ Spibet
<i>Monarda fistulosa</i>				3	1	
<i>Penstemon</i> sp. (35)					1	
<i>Phlox hoodii</i>			1		1	
<i>Senecio canus</i>			1			
<i>Silene menziesii</i>						1
<i>Solidago multiradiata</i>					1	
<i>Toxicodendron rydbergii</i>						3
<i>Tragopogon dubius</i>						1
<i>Zigadenus elegans</i>	1	1		1		

*Association Acronyms:

Pinfle/Juncom = Limber pine/common juniper

Pinpon/Spibet = Ponderosa pine/shinyleaf spiraea

Plot Number

Description:

- 8 West-facing slope, upper part.
Trees mostly ca. 15 cm dbh; *P. flexilis* ca. 8 m tall,
P. menziesii ca. 12 m tall.
Standing, burned trunks and fallen trunks (some
burned) common.
Ground cover ca. 40% limestone boulders and cobbles.
- 27 Steep, southwest-facing slope, upper part.
Trees 8-10 m tall, to 20 cm dbh.
Ground cover ca. 20% limestone talus.
Photos 96GJ3.17 + 18 show this stand from across the
valley to the north.
- 38 South-facing slope, upper part.
Trees are scattered, ca. 7 m tall and 12 cm dbh.
Merges laterally and upslope into *Pseudotsuga*
woodland (plot #37) and downslope into *Artemisia*
tridentata ssp. *vaseyana* shrubland (plot #39).
- 46 Northeast-facing slope, middle part, between draws.
Pinus flexilis trees ca. 8 m tall and 13 cm dbh;
Abies trees ca. 10 m tall and 15 cm dbh.
Pocket gopher burrows common.

- 48 East-facing canyon wall, upper part.
Pseudotsuga trees ca. 18 m tall and 18 cm dbh; Pinus ponderosa trees ca. 15 m tall and 20 cm dbh; Pinus flexilis trees ca. 12 m tall and 18 cm dbh.
- 17b East-southeast-facing slope, lower part.
Trees ca. 35 m tall and 30 cm dbh.
Photo 96GJ3.16 looks northeast through this stand.

Table 3-6. Canopy cover in plots in the quaking aspen and shrub associations.

	Plot #/Association*			
	13	12	11	33
	Poptre	Phymon	Betocc- Corser	Riblac/ Mercil
Species				
TREES				
<i>Picea engelmannii</i>			1	10
<i>Populus tremuloides</i>	40		1	
<i>Pseudotsuga menziesii</i>		1		
SHRUBS				
<i>Acer glabrum</i>	3		1	
<i>Betula occidentalis</i>		3	30	
<i>Cercocarpus ledifolius</i>		1		
<i>Cornus sericea</i>			60	
<i>Prunus virginiana</i>	1			
<i>Ribes lacustre</i>				20
<i>Sambucus racemosa</i>			1	
DWARF SHRUBS				
<i>Physocarpus monogynus</i>	80	40	3	
<i>Shepherdia canadensis</i>			3	
<i>Spiraea betulifolia</i>	1?		20	
<i>Symphoricarpos</i> sp.	1			
GRAMINOIDS				
<i>Elymus glaucus</i>	3			10
FORBS				
<i>Actaea rubra</i>			10	
<i>Arnica lonchophylla</i>		1		60
<i>Disporum trachycarpum</i>			3	
<i>Equisetum arvense</i>				10
<i>Galium aparine</i>	3			
<i>Galium boreale</i>	3			
<i>Galium triflorum</i>			3	
<i>Geranium richardsonii</i>	10			
<i>Geum aleppicum</i>	1			
<i>Heracleum sphondylium</i>	3			
<i>Maianthemum racemosum</i>	3		1	
<i>Mertensia ciliata</i>				30

	Plot #/Association*			
	13	12	11	33
	Poptre	Phymon	Betocc- Corser	Riblac/ Mercil
Species				
<i>Monarda fistulosa</i>	1			
<i>Osmorhiza chilensis</i>	10		3	
<i>Senecio triangularis</i>				1
<i>Thalictrum occidentale</i>	3		3	
<i>Viola canadensis</i>	20		10	

*Association acronyms:

Poptre = Quaking aspen woodland
 Phymon = Mountain ninebark shrubland
 Betocc/Corser = Water birch/red-osier dogwood
 Riblac/Mercil = Prickly currant/mountain bluebells

Plot Number

Description:

13 Bench on northeast-facing slope.
 12 West-facing, talus slope east of plot 11.
 11 Ephemeral channel on north-facing slope.
 33 Riparian zone along intermittent stream

Table 3-7. Canopy cover in plots in the mountain big sagebrush/Idaho fescue association.

	Plot #/Association*			
	30	39	42	42a
Species	Atv/	Atv/	Atv/	Atv/
	Fesida	Fesida	Fesida	Fesida
DWARF SHRUBS				
<i>Artemisia tridentata</i> ssp. <i>vaseyana</i>	20	40	40	50
<i>Juniperus communis</i>		3		1
<i>Rosa woodsii</i>				1
<i>Symphoricarpos</i> sp.		1		1
GRAMINOIDS				
<i>Bromus carinatus</i>			3	1?
<i>Bromus ciliatus</i>	10			1
<i>Carex hoodii</i>	10		1	3
<i>Carex petasata</i>			1	1
<i>Carex raynoldsii</i>	1		1	
<i>Carex rossii</i>		1		
<i>Carex rupestris</i> (40)			1	
<i>Danthonia intermedia</i>				10
<i>Elymus lanceolatus</i> var. <i>lanceolatus</i>			1	1
<i>Elymus trachycaulus</i> var. <i>trachycaulus</i>	10	10	20	1?
<i>Festuca idahoensis</i>	10	20	10	1
<i>Juncus</i> sp.	1			
<i>Leucopoa kingii</i>		3		
<i>Melica spectabilis</i>	3		1	
<i>Phleum alpinum</i>	3			
<i>Phleum pratense</i>		10	1	1?
<i>Poa cusickii</i>		3		
<i>Poa juncifolia</i> var. <i>ampla</i>				1
<i>Poa pratensis</i>		20	20	40
<i>Stipa nelsonii</i>	1		10	3
<i>Trisetum spicatum</i>	3			
FORBS				
<i>Achillea millefolium</i>	10		3	3
<i>Anemone multifida</i>				1?
<i>Antennaria microphylla</i>		1		
<i>Aster foliaceus</i>	3			
<i>Aster mollis</i>	3			1
<i>Balsamorhiza sagittata</i>		10		10
<i>Castilleja rhexifolia</i>	1			

Species	Plot #/Association*			
	30	39	42	42a
	Atv/ Fesida	Atv/ Fesida	Atv/ Fesida	Atv/ Fesida
<i>Eriogonum umbellatum</i>		1	1	1
<i>Fragaria</i> sp.	1			
<i>Galium boreale</i>	1		10	
<i>Geranium viscosissimum</i>			3	10
<i>Lithospermum ruderales</i>			3	1
<i>Lupinus argenteus</i>	10			
<i>Maianthemum stellatum</i>				1
<i>Monarda fistulosa</i>				30
<i>Perideridia montana</i>	1			
<i>Potentilla diversifolia</i>				3
<i>Solidago multiradiata</i>				1
<i>Thalictrum occidentale</i>	10			
<i>Valeriana dioica</i>	1			

*Association acronyms:

Atv/Fesida = Mountain big sagebrush/Idaho fescue

Plot Number	Description:
30	Northeast-facing slope, lower part. Pocket gopher digging common.
39	South southeast-facing slope, middle part. Merges upslope into <i>Pinus flexilis</i> woodland (plot #38), and laterally into <i>Festuca idahoensis</i> grassland (plot #40).
42	Gentle, east-southeast-facing slope, upper part. Merges with type characterized by plot #42a.
42a	Broad, gentle, east-southeast-facing draw. Merges with type characterized by plot #42.

Table 3-8. Canopy cover in plots in the grassland associations.

Species	Plot #/Association*								
	23 Fesida?	26 Fesida?	40 Fesida?	35 Fesida- Elytra	32 Fesida- Elytra	45 Fesida- Carsci	43 Fesida- Psespi	3a Broine	14 Unknown
TREES									
<i>Abies lasiocarpa</i>		3							
<i>Pinus flexilis</i>		1					3		
<i>Pseudotsuga menziesii</i>								10	
SHRUBS									
<i>Juniperus scopulorum</i>							3		
<i>Pinus flexilis</i>						1			
<i>Populus tremuloides</i>									10
DWARF SHRUBS									
<i>Amelanchier alnifolia</i>					1				
<i>Artemisia tridentata</i> <i>ssp. vaseyana</i>					3				
<i>Ceanothus velutinus</i>								3	
<i>Juniperus communis</i>			1		3	1	3	1	
<i>Mahonia repens</i>					3			3	
<i>Pentaphylloides</i> <i>floribunda</i>						10			
<i>Rosa woodsii</i>			1						
<i>Symphoricarpos</i> sp.					3			1	

Plot #/Association*

	23	26	40	35	32	45	43	3a	14
Species	Fesida?	Fesida?	Fesida?	Fesida- Elytra	Fesida- Elytra	Fesida- Carsci	Fesida- Psespi	Broine	Unknown
GRAMINOIDS									
<i>Bromus ciliatus</i>				1	10				
<i>Bromus inermis</i> var. <i>inermis</i>								40	
<i>Bromus japonicus</i>			1						
<i>Carex elynoides</i>	10			3					
<i>Carex hoodii</i>									1
<i>Carex rupestris</i> (40)			3						
<i>Carex scirpoidea</i>				10		20			
<i>Carex</i> sp.	1								
<i>Carex sprengellii</i>									50
<i>Danthonia intermedia</i>	3	3		3					
<i>Elymus albicans</i> var. <i>albicans</i>						1			
<i>Elymus lanceolatus</i> var. <i>lanceolatus</i>						10			
<i>Elymus spicatus</i>			1		1		10		
<i>Elymus trachycaulus</i> var. <i>trachycaulus</i>				10	10				
<i>Festuca idahoensis</i>	40	20	40	40	10	20	10		
<i>Koeleria macrantha</i>			1			3	1		
<i>Leucopoa kingii</i>					10	1			
<i>Luzula spicata</i>	3			1					
<i>Phleum pratense</i>			1					10	10

Plot #/Association*

	23	26	40	35	32	45	43	3a	14
Species	Fesida?	Fesida?	Fesida?	Fesida-	Fesida-	Fesida-	Fesida-	Broine	Unknown
				Elytra	Elytra	Carsci	Psespi		
<i>Poa bulbosa</i>						1			
<i>Poa cusickii</i>	1			1					
<i>Poa interior</i>				3					
<i>Poa pratensis</i>			1						
<i>Poa secunda</i>				1					
<i>Stipa nelsonii</i>		1	3	10	3	3			3
<i>Trisetum spicatum</i>	1								
FORBS									
<i>Achillea millefolium</i>		10		3	3				
<i>Alyssum alyssoides</i>			1						
<i>Anemone multifida</i>		1							
<i>Antennaria microphylla</i>		10	3						
<i>Antennaria umbrinella</i>	10								
<i>Apocynum androsaemifolium</i>					10		3		
<i>Arenaria congesta</i>	3		1				1		
<i>Arenaria obtusiloba</i>			3						
<i>Aster foliaceus</i>		1							
<i>Aster meritus</i>								20	
<i>Aster mollis</i>		1				1			
<i>Aster sp.</i>				1					1
<i>Astragalus miser</i>			3						

Plot #/Association*

	23	26	40	35	32	45	43	3a	14
Species	Fesida?	Fesida?	Fesida?	Fesida-	Fesida-	Fesida-	Fesida-	Broine	Unknown
				Elytra	Elytra	Carsci	Psespi		
Balsamorhiza incana			1	1		3			
Campanula rotundifolia		1		1					
Cerastium arvense			1	1		1			
Clematis columbiana var. tenuiloba					10				
Gaillardia aristata				1					
Galium boreale		30	3	3	3	1		10	
Geranium richardsonii									10
Geranium viscosissimum					3				
Geum triflorum	10			3		10			
Heterotheca villosa							1		
Ipomopsis spicata			1						
Lupinus argenteus	3	1		10					
Maianthemum stellatum					1				
Monarda fistulosa					10				20
Oxytropis sp.			1						
Penstemon sp. (35)				1					
Perideridia montana				1	1	1			
Phlox hoodii			20			3	1		
Phlox multiflora	10	20		1					
Potentilla diversifolia	3								
Senecio canus							1		
Sibbaldia procumbens	1								

Plot #/Association*

	23	26	40	35	32	45	43	3a	14
Species	Fesida?	Fesida?	Fesida?	Fesida-	Fesida-	Fesida-	Fesida-	Broine	Unknown
				Elytra	Elytra	Carsci	Psespi		
<i>Solidago multiradiata</i>			1						
<i>Solidago</i> sp. (35)				1					
<i>Swertia perennis</i>				1		1			
<i>Tragopogon dubius</i>									1
<i>Zigadenus elegans</i>						1			
MOSSES AND BRYOPHYTES									
<i>Selaginella densa</i>			3			10			

*Association acronyms:

Fesida? = Idaho fescue grassland of unknown plant association

Fesida-Elytra = Idaho fescue-slender wheatgrass

Fesida-Carsci = Idaho fescue-northern singlespike sedge

Fesida-Psespi = Idaho fescue-bluebunch wheatgrass

Broine = Smooth brome

Unknown = Plant association unknown

Plot Number

Description:

23 Gentle, north-facing slope, upper part.

Abies lasiocarpa grows in small groves, each ca. 50 square meters.

26 Gentle, southwest-facing slope, upper part.

Trees ca. 10 m tall.

Plot Number	Description:
35	Gentle, east-facing slope, upper and middle parts. Pocket gopher burrows are common, and <i>Cirsium arvense</i> grows on them. Cattle droppings are present.
40	Gentle, south southeast-facing slope, middle part. Merges laterally into <i>Artemisia tridentata</i> ssp. <i>vaseyana</i> shrubland (plot #39). Pocket gopher burrows common, and most exotic plants grow on them. Cattle droppings are present.
45	Northeast-facing dipslope, middle part. Pocket gopher burrows are common.
14	Meadow covering ca. 0.25 acre (0.1 ha). Photo 96GJ3.14 shows this plot in foreground.
3a	South-facing slope in burned area Trees to ca. 2 m tall Seeded to <i>Bromus inermis</i> var. <i>inermis</i>
32	South southeast-facing slope, foot.
43	Steep, south-facing slope, middle part, below cliff band. Trees ca. 10 m tall and 15 cm dbh. <i>Juniperus scopulorum</i> and <i>J. communis</i> shrubs 0.5 m tall or less.

VEGETATION DESCRIPTIONS

Location #1; Boyd Ridge, ca. 1 mile (1.6 km) north of Leaky Mountain.

Vegetation Type: Idaho fescue grassland (plant association unknown).

Elevation: 7900 feet (2413 meters). Aspect: West

Topographic position: Upper slope.

Description: Herbaceous vegetation with dead (mainly fallen) *Pinus flexilis* trunks and scattered *P. flexilis* saplings. Limestone gravel, cobbles, and boulders are common.

TREES:

SHRUBS:

DWARF SHRUBS:

GRAMINOIDS & FORBS: *Festuca idahoensis* and *Phlox multiflora* are the major species; *Leucopoa kingii*, *Koeleria macrantha*, *Poa interior*, *Carex rupestris*, *Carex rossii*, *Cerastium arvense*, *Clematis columbiana*, *Clematis hirsutissima*, *Zigadenus elegans*, *Hedysarum* sp., *Balsamorhiza incana*, *Aster mollis* are present.

Location #2a; east wall of Dark Canyon, at northward bend in Mann Creek.

Vegetation Type: Beaked sedge wetland

Elevation: 7900 feet (2413 meters). Aspect: Northwest

Topographic position: Upper slope

Description: Several small springs in limestone cobbles and boulders, surrounded by band of *Picea engelmannii* vegetation (described at location #2b).

TREES:

SHRUBS:

DWARF SHRUBS:

GRAMINOIDS & FORBS: *Carex rostrata*, *Saxifraga odontoloma*, *Mertensia ciliata*, *Arnica longifolia*

Location #2b; east wall of Dark Canyon, at northward bend in Mann Creek.

Vegetation Type: Engelmann spruce/shinyleaf spiraea woodland

Elevation: 7900 feet (2413 meters). Aspect: North-northwest

Topographic position: Alcove in upper slope

Description: Woodland of mixed conifers (dominated by Engelmann spruce) ca. 15 m tall and ca. 60% canopy cover.

TREES: *Picea engelmannii*, *Abies lasiocarpa*, *Pseudotsuga menziesii*, *Pinus flexilis*

SHRUBS:

DWARF SHRUBS: *Spiraea betulifolia*

GRAMINOIDS & FORBS: *Clematis columbiana*, *Galium boreale*.

Location #3; east wall of Dark Canyon, at northward bend in Mann Creek.

Vegetation Type: Mountain bluebells wetland

Elevation: 7400 feet (2257 meters). Aspect: North-northwest

Topographic position: Middle slope

Description: Narrow riparian zones along streams in cobble and boulder beds, on steep slope.

TREES:

SHRUBS: *Ribes oxycanthoides* var. *setosum*

DWARF SHRUBS: *Rubus idaeus*

GRAMINOIDS & FORBS: *Mertensia ciliata*, *Saxifraga odontoloma*,
Epilobium sp., *Glyceria striata*, *Carex* sp. *Parnassia*
fimbriata.

Location #3b; east wall of Dark Canyon, at northward bend in Mann Creek.

Vegetation Type: Douglas-fir/shinyleaf spiraea

Elevation: 7400 feet (2257 meters). Aspect: Northwest

Topographic position: Mid-slope

Description: Open woodland dominated by Douglas-fir (to ca. 100 feet [30 m] tall and ca. 40% cover) with subalpine fir (to ca. 25 feet [8 m] tall) and Engelmann spruce, on slope with grassland planted in burned woodlands (location #3a).

TREES: *Pseudotsuga menziesii* (ca 40% cover, ca. 30 m tall), *Abies lasiocarpa* (ca. 8 m tall), *Picea engelmannii*

SHRUBS:

DWARF SHRUBS: *Spiraea betulifolia*, *Mahonia repens*, *Juniperus communis*

GRAMINOIDS & FORBS: *Thalictrum occidentale*, *Disporum trachycarpum*, *Clematis columbiana*, *Aster* sp.

Location #4; west wall of Dark Canyon, in burn at northward bend of Mann Creek.

Vegetation Type: Smooth brome grassland

Elevation: 7200-7800 feet (2200-2380 meters). Aspect: East-southeast

Topographic position: Entire slope

Description: Seeded area in burned forest, bordered on north and south by Douglas-fir woodland

TREES:

SHRUBS:

DWARF SHRUBS: *Ceanothus velutinus*, *Prunus virginiana*, *Spiraea betulifolia*, *Arctostaphylos uva-ursi*

GRAMINOIDS & FORBS: *Bromus inermis*, *Phleum pratense* dominate strongly; *Monarda fistulosa*, *Galium boreale* common

Location #6; Mann Creek in Dark Canyon, ca. 0.2 mile (0.3 km) upstream from mouth of Crater Creek.

Vegetation Type: Engelmann spruce/field horsetail

Elevation: 6800-6900 feet (2074-2104 meters). Aspect: North

Topographic position: Riparian zone along perennial stream in bottom of Dark Canyon.

Description: Open canopy (ca. 40% cover) of Engelmann spruce above dense herbaceous vegetation.

TREES: *Picea engelmannii*

SHRUBS: *Ribes oxycanthoides*

DWARF SHRUBS:

GRAMINOIDS & FORBS: Along channel, *Mertensia ciliata*, *Equisetum arvense*, *Glyceria striata*, *Parnassia fimbriata*, *Carex aquatilis*, *Saxifraga odontoloma*, *Senecio triangularis*. Away from channel, *Galium boreale*, *Geranium* sp., *Heracleum sphondylium*, *Elymus cinereus*, *Bromus inermis*, *Dactylis glomerata*, *Thalictrum occidentale*, *Actaea rubra*, *Osmorhiza* sp., *Fragaria virginiana*, *Mertensia ciliata*, *Equisetum arvense*, *Equisetum laevigatum*.

Location #17a; West Fork, ca. 1 mile (1.6 km) downstream from confluence of Pumpkin Creek and Mann Creek.

Vegetation Type: Ponderosa pine/bluebunch wheatgrass?

Elevation: 5400-5600 feet (1647-1708 m). Aspect: East-southeast

Topographic position: Lower slope

Description: Open ponderosa pine woodland (trees ca. 8 inches [20 cm] dbh and ca. 65 feet [20 m] tall) along the foot of the northwestern wall of the canyon.

TREES: *Pinus ponderosa*

SHRUBS:

DWARF SHRUBS:

GRAMINOIDS & FORBS: *Elymus spicatus*, *Apocynum androsaemifolium*, *Balsamorhiza sagittata*, *Toxicodendron rydbergii*.

Location #17c; West Fork, ca. 1 mile (1.6 km) downstream from confluence of Pumpkin Creek and Mann Creek.

Vegetation Type: Engelmann spruce/mountain ninebark

Elevation: 5400 feet (1647 m). Aspect: Southeast & northwest

Topographic position: Lower slopes on both walls of canyon.

Description: Engelmann spruce forests above riparian zones.

TREES: *Picea engelmannii*

SHRUBS: *Acer glabrum* (sparse)

DWARF SHRUBS: *Physocarpus monogynus*, *Spiraea betulifolia*

GRAMINOIDS & FORBS:

Location #18a; Deer Park.

Vegetation Type: Unclassified grassland

Elevation: 5600 feet (1708 meters).

Aspect: South

Topographic position: Lower slope.

Description: Herbaceous (Deer Park) w/ scattered low shrubs.

TREES:

SHRUBS: *Prunus virginiana*

DWARF SHRUBS:

GRAMINOIDS & FORBS: *Phleum pratense*, *Poa pratensis*, *Carex petasata*

Location #18b; North wall Pumpkin Creek Canyon above Deer Park.

Vegetation Type: Ponderosa pine/shinyleaf spiraea?

Elevation: 6000-6500 feet (1830-1982 meters).

Aspect: South

Topographic position: Lower half of slope

Description: Ponderosa pine woodland, observed through binoculars from bottom of canyon below.

TREES: *Pinus ponderosa*

SHRUBS:

DWARF SHRUBS:

GRAMINOIDS & FORBS:

Location #19; north wall Pumpkin Creek Canyon ca. 0.25 mile (0.4 km) upstream from Deer Park.

Vegetation Type: Douglas-fir (plant association unknown)

Elevation: 5800-7000 feet (1770-2135 meters).

Aspect: East

Topographic position: Entire slope

Description: Woodland of Douglas-fir with some ponderosa pine. (Observed through binoculars from foot of slope.)

TREES: *Pseudotsuga menziesii*, *Pinus ponderosa*

SHRUBS:

DWARF SHRUBS:

GRAMINOIDS & FORBS:

Location #20a; east wall Dark Canyon, ca. 0.5 mile (0.8 km) upstream from confluence with Pumpkin Creek Canyon.

Vegetation Type: Douglas-fir/mountain ninebark

Elevation: 6000-6800 feet (1830-2074 meters).

Aspect: Northwest

Topographic position: Lower 2/3 of slope

Description: Woodland of small Douglas-fir trees with a sparse understory, depauperate compared to other stands. Burned logs and stumps are present throughout.

TREES: *Pseudotsuga menziesii*

SHRUBS:

DWARF SHRUBS: *Physocarpus monogynus*, *Spiraea betulifolia*

GRAMINOIDS & FORBS: *Antennaria racemosa*

Location #20b; east wall Dark Canyon, ca. 0.5 mile (0.8 km) upstream from confluence with Pumpkin Creek Canyon
Vegetation Type: Limber pine/common juniper
Elevation: 6800-7150 feet (2074-2181 meters). Aspect: Northwest
Topographic position: Upper 1/3 of slope
Description: Open woodland of limber pine with some Douglas-fir, and an understory with abundant (ca. 10% cover) common juniper and other shrubs.
TREES: *Pinus flexilis*, *Pseudotsuga menziesii*
SHRUBS:
DWARF SHRUBS: *Juniperus communis* dominates; *Physocarpus monogynus*, *Arctostaphylos uva-ursi* present
GRAMINOIDS & FORBS:

Location #21; west wall Dark Canyon, from mouth of Crater Creek downstream to confluence with Pumpkin Creek Canyon.
Vegetation Type: Idaho fescue-bluebunch wheatgrass?
Elevation: 6100-7000 feet (1860-2135 meters). Aspect: East
Topographic position: Entire slope
Description: Herbaceous vegetation with common juniper and scattered Douglas-fir, on west wall near mouth of Dark Canyon, observed with through binoculars from across canyon.
TREES: *Pseudotsuga menziesii* (scattered trees)
SHRUBS:
DWARF SHRUBS: *Juniperus communis*
GRAMINOIDS & FORBS: *Festuca idahoensis*, *Pseudoroegneria spicata*, *Balsamorhiza sagittata*

Location #22; Boyd Ridge, ca, 2.5 miles (4 km) east of intersection of Boyd Ridge Road with Sheep Mountain Road.
Vegetation Type: Subalpine fir/heartleaf arnica
Elevation: 9300 feet (2836 meters). Aspect: North
Topographic position: Upper part of gentle slope
Description: Forest of large Engelmann spruces with smaller subalpine fir in the canopy, and a subcanopy of subalpine fir. The stand has been logged.
TREES: *Abies lasiocarpa*, *Picea engelmannii*
SHRUBS:
DWARF SHRUBS:
GRAMINOIDS & FORBS: *Arnica longifolia*, *Arnica cordifolia*, *Lupinus argenteus*, *Antennaria racemosa*, *Taraxacum* sp.

Location #24; Crater Ridge, ca. 0.9 mile (1.4 km) southwest of Crater Spring.
Vegetation Type: Idaho fescue-slender wheatgrass grassland
Elevation: 8200 feet (2500 meters). Aspect: East
Topographic position: Upper part of gentle slope.
Description: Extension of large park (sampled with plot #35) into

lodgepole pine-Engelmann spruce woodland. Pocked gopher burrows are common.

TREES:

SHRUBS:

DWARF SHRUBS:

GRAMINOIDS & FORBS: *Elymus trachycaulus*, *Stipa nelsonii*, *Galium boreale* are the most common species; *Festuca idahoensis*, *Achillea millefolium*, *Perideridia montana* are present throughout.

Location #25; Crater Ridge, ca. 1.1 mile (1.8 km) southwest of Crater Spring.

Vegetation Type: Lodgepole pine/Grouse whortleberry

Elevation: 8400-8700 feet (2562-2635 meters). Aspect: Northeast

Topographic position: Middle and upper parts of gentle slopes above the walls of the canyon of Cub Creek

Description: Lodgepole pine and Engelmann spruce dominate the canopy; subalpine fir is present in the canopy and dominates the sapling layer. Shrubs are absent. Grouse whortleberry forms patches covering up to ca. 250 square meters each. Small clearcuts, each covering several hundred square meters, are common, and roads connect them.

TREES: *Pinus contorta*, *Picea engelmannii*, *Abies lasiocarpa*

SHRUBS:

DWARF SHRUBS:

GRAMINOIDS & FORBS: *Arnica cordifolia*, *Arnica latifolia*, *Antennaria racemosa*, *Vaccinium scoparium*.

Location #28; Mann Creek, ca. 2.75 miles (4.4 km) upstream from northward bend into Dark Canyon.

Vegetation Type: Mountain bluebells

Elevation: 8300 feet (2531 meters). Aspect: East-southeast

Topographic position: Channel of intermittent stream

Description: Patches of tall forbs in stream bed of limestone cobbles and boulders.

TREES:

SHRUBS:

DWARF SHRUBS:

GRAMINOIDS & FORBS: *Arnica longifolia*, *Mertensia ciliata*, *Senecio triangularis*, *Saxifraga odontoloma*

Location #31; south wall Mann Creek valley, for ca. 2 miles (3.2 km) upstream from northward bend into Dark Canyon.

Vegetation Type: Subalpine fir/heartleaf arnica?

Elevation: 7600-8400 feet (2318-2562 meters). Aspect: North

Topographic position: Entire slope

Description: Seen through binoculars from across the valley, the vegetation appears to be a forest of tall Engelmann spruce and subalpine firs, similar to the overstory in plot #29 ca.

1 mile (0.6 km) to the west.
TREES: *Abies lasiocarpa*, *Picea engelmannii*
SHRUBS:
DWARF SHRUBS:
GRAMINOIDS & FORBS:

Location #36; flat north of Pumpkin Creek Canyon, ca. 0.5 mile (0.8 km) west of mouth of Cub Creek.

Vegetation Type: Idaho fescue grassland (plant association unknown)

Elevation: 8500 feet (2592 meters). Aspect: East
Topographic position: Top of ridge and upper parts of gentle slopes

Description: Meadow vegetation adjoining stands of limber pine/common juniper woodland (plot #35) and Douglas-fir/common juniper woodland (plot #37).

TREES:
SHRUBS:
DWARF SHRUBS:
GRAMINOIDS & FORBS: *Festuca idahoensis*, *Galium boreale*

Location #41a; south wall of Pumpkin Creek Canyon, between mouth of Cub Creek and first tributary to west (upstream).

Vegetation Type: Douglas-fir/mountain ninebark?

Elevation: 7000-8000 feet (2135-2440 meters). Aspect: North
Topographic position: Upper 2/3 of slope

Description: Seen through binoculars from across the valley, Douglas-fir and Engelmann spruce dominate a tree layer that contains subalpine fir. The composition of the understory is unknown, but the forest on the lower 1/3 of the slope (location #41b) contains substantial amounts of mountain ninebark.

TREES: *Pseudotsuga menziesii* and *Picea engelmannii* are most common; *Abies lasiocarpa* is present.

SHRUBS:
DWARF SHRUBS:
GRAMINOIDS & FORBS:

Location #41b; south wall of Pumpkin Creek Canyon at mouth of Cub Creek.

Vegetation Type: Engelmann spruce/mountain ninebark

Elevation: 6400-7000 feet (1952-2135 meters). Aspect: North and northeast

Topographic position: Lower 1/3 of moderately-steep slope

Description: Engelmann spruce and patches of Douglas-fir form a tree layer above saplings of Douglas-fir. Mountain ninebark and common juniper form a sparse shrub layer.

TREES: *Picea engelmannii*, *Pseudotsuga menziesii*
SHRUBS: *Pseudotsuga menziesii*

DWARF SHRUBS: *Physocarpus monogynus*, *Juniperus communis*, *Spiraea betulifolia*

GRAMINOIDS & FORBS: *Aster* sp., *Antennaria racemosa*

Location #44; south wall of Pumpkin Creek Canyon at mouth of Cub Creek.

Vegetation Type: Engelmann spruce/red-osier dogwood

Elevation: 6400 feet (1952 meters). Aspect: East

Topographic position: Riparian zone along perennial stream in the bottom of a deep canyon.

Description: Engelmann spruce forms a tree layer above a dense tall shrub layer.

TREES: *Picea engelmannii* (ca. 40% cover, ca. 30 m tall)

SHRUBS: *Cornus sericea*, *Acer glabrum*

DWARF SHRUBS:

GRAMINOIDS & FORBS: *Thalictrum occidentale*, *Mertensia ciliata*, *Parnassia fimbriata*

APPENDIX 6. EXPLANATIONS OF RANKS USED BY THE WYOMING NATURAL DIVERSITY DATABASE.

As part of the North American network of natural heritage programs, the Wyoming Natural Diversity Database (WYNDD) uses the natural heritage element ranking system developed by The Nature Conservancy. In this system, each element (in this case, species) is assigned a two-part rank that reflects its rarity and security both globally (the G part of the rank) and within a state or province (the S part of the rank). Both the global rank and the state rank can range from 1 (extremely rare or threatened) to 5 (common and secure). Ranks are defined as follows:

Global Ranks

- G1: Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factors making it especially vulnerable to extinction.
- G2: Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals) or because of factors making it very vulnerable to extinction.
- G3: Either very rare and localized throughout its range, or found locally (and perhaps abundantly at some sites) throughout a restricted range, or vulnerable to extinction throughout its range.
- G4: Apparently secure globally, although it may be quite rare in parts of its range, especially at the periphery.
- G5: Demonstrably secure globally and essentially ineradicable under present conditions.
- T: A "T" following the global rank (G#T#) refers to a rank assigned to a subspecific taxon. The number following the "G" is the rank of the species, and the number following the "T" is the rank of the subspecific taxon.
- Q: Taxonomic questions or problems exist about the taxon; more information is needed. A "G#Q" rank implies that the taxonomic distinctiveness of the taxon may be of questionable validity. A "G#T#Q" rank implies that the taxonomic distinctiveness of the subspecific taxon is of questionable validity.

State Ranks

- S1: Critically imperiled in the state or province because of extreme rarity (5 or fewer occurrences or very few remaining individuals) or because of some factors making it especially vulnerable to extinction.
- S2: Imperiled in the state or province because of rarity (6 to 20 occurrences or few remaining individuals) or because of factors making it very vulnerable to extinction.
- S3: Rare or uncommon in the state (on the order of 21 to 100 occurrences).
- S4: Apparently secure in the state or province, with many occurrences.
- G5: Demonstrably secure in the state or province and essentially ineradicable under present conditions.
- SU: Possibly imperiled in the state but status is uncertain; more information needed before a numerical rank can be assigned.
- S?: Status uncertain due to lack of information. The "?" is usually combined with any of the numerical ranks, as in "S3?".

Migratory Ranks

- B: A "B" following a rank (e.g., S3B) indicates that the rank refers to the breeding status of the species within the state. B ranks are usually assigned to birds.
- N: An "N" following a rank (e.g., S3N) indicates that the preceding rank refers to the non-breeding status of the species in the state. N ranks are usually assigned to birds.

A state rank of S2BS5N indicates that the species is rare in the state as a breeder, but abundant as a non-breeder.

APPENDIX 7. PLANT COMMUNITY TYPES IN THE MANN CREEK POTENTIAL
RESEARCH NATURAL AREA.

The communities are listed by common name within physiognomic units from the National Vegetation Classification Standard (Federal Geographic Data Committee 1998). Citations following the common names refer to these sources:

- Johnston (1987): equivalent plant association from the list for USDA Forest Service Region 2;
- The Nature Conservancy (1997): equivalent plant association from the classification of the network of state Natural Heritage Programs and The Nature Conservancy;
- Hoffman and Alexander (1976): habitat type (if any);
- Girard et al. (1997): equivalent riparian community or ecosystem type (if any);
- Federal Geographic Data Committee (1997): type in the hierarchy of the National Vegetation Classification Standard to which the association belongs;
- Kuchler (1966): Kuchler vegetation type to which the association belongs;
- Eyre (1980): Society of American Foresters forest cover type to which the association belongs (if any).

CONIFEROUS FORESTS AND WOODLANDS

Subalpine fir/heartleaf arnica

(Plot 29; locations 22, 31)

- Johnston (1987): *Abies lasiocarpa*-*Picea engelmannii*/*Arnica cordifolia* plant association
- The Nature Conservancy (1997): *Abies lasiocarpa*/*Arnica cordifolia* forest
- Hoffman and Alexander (1976): *Abies lasiocarpa*/*Arnica cordifolia* habitat type
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): I.A.8.N.d.;
Cylindrical-crowned, natural/semi-natural, temperate or subpolar, needle-leaved, evergreen, closed tree canopy forest
- Kuchler (1966): Western spruce-fir forest (14)
- Eyre (1980): Engelmann Spruce-Subalpine Fir (206)

Engelmann spruce/red-osier dogwood

(Location 6)

- Johnston (1987): no equivalent plant association
- The Nature Conservancy (1997): *Picea engelmannii*/*Cornus sericea* woodland
- Hoffman and Alexander (1976): none
- Girard et al. 1997): none

- Federal Geographic Data Committee (1997): II.A.4.N.d.;
Temporarily flooded, natural/semi-natural, temperate or
subpolar, needle-leaved, evergreen woodland with open tree
canopy.
- Kuchler (1966): Western spruce-fir forest (14)
- Eyre (1980): Engelmann Spruce-Subalpine Fir (206)

Engelmann spruce/field horsetail

(Plot 17; location 44)

- Johnston (1987): *Picea engelmannii*-*Picea pungens*/*Equisetum*
arvense plant association
- The Nature Conservancy (1997): *Picea engelmannii*/*Equisetum*
arvense forest
- Hoffman and Alexander (1976): none
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): I.A.8.N.f.;;
Seasonally-flooded, natural/semi-natural, temperate or
subpolar, needle-leaved, evergreen forest with closed tree
canopy
- Kuchler (1966): Western spruce-fir forest (14)
- Eyre (1980): Engelmann Spruce-Subalpine Fir (206)

Engelmann spruce/mountain ninebark

(Plots 5c, 7a; locations 17c, 41b)

(This vegetation type apparently is transitional between the
Engelmann spruce types of riparian zones and the Douglas-
fir/mountain ninebark forests on the slopes above.)

- Johnston (1987): No apparent equivalent
- The Nature Conservancy (1997): No apparent equivalent.
- Hoffman and Alexander (1976): none
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): I.A.8.N.c.; Conical-
crowned, natural/semi-natural, temperate or subpolar,
needle-leaved, evergreen forest with closed tree canopy
- Kuchler (1966): Western spruce-fir forest (14)
- Eyre (1980): Engelmann Spruce-Subalpine Fir (206)

Douglas-fir/common juniper

(Plots 34, 37; location 36)

- Johnston (1987): *Pseudotsuga menziesii*/*Juniperus communis*
plant association
- The Nature Conservancy (1997): *Pseudotsuga*
menziesii/*Juniperus communis* forest
- Hoffman and Alexander (1976): *Pseudotsuga menziesii*/*Berberis*
repens habitat type, *Juniperus communis* phase
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): I.A.8.N.b.; rounded-
crown, natural/semi-natural, temperate or subpolar, needle-

- leaved, evergreen, closed-canopy forest
- Kuchler (1966): Douglas-fir forest (11)
- Eyre (1980): Interior Douglas-fir (210)

Douglas-fir/mountain ninebark

- (Plots 5b, 7b, 10a, 10b, 10c, 15a, 15b, 47; locations 20a, 41)
- Johnston (1987): *Pseudotsuga menziesii*/*Physocarpus monogynus* plant association
 - The Nature Conservancy (1997): *Pseudotsuga menziesii*/*Physocarpus monogynus* forest
 - Hoffman and Alexander (1976): *Pseudotsuga menziesii*/*Physocarpus monogynus* habitat type
 - Girard et al. 1997): none
 - Federal Geographic Data Committee (1997): I.A.8.N.b.; rounded-crown, natural/semi-natural, temperate or subpolar, needle-leaved, evergreen, closed-canopy forest
 - Kuchler (1966): Douglas-fir forest (11)
 - Eyre (1980): Interior Douglas-fir (210)

Douglas-fir/shinyleaf spiraea

- (Plot 5a; location 3b)
- Johnston (1987): *Pseudotsuga menziesii*/*Spiraea betulifolia* plant association
 - The Nature Conservancy (1997): *Pseudotsuga menziesii*/*Spiraea betulifolia* forest
 - Hoffman and Alexander (1976): *Pseudotsuga menziesii*/*Berberis repens* habitat type
 - Girard et al. 1997): none
 - Federal Geographic Data Committee (1997): I.A.8.N.b.; rounded-crown, natural/semi-natural, temperate or subpolar, needle-leaved, evergreen, closed-canopy forest
 - Kuchler (1966): Douglas-fir forest (11)
 - Eyre (1980): Interior Douglas-fir (210)

Ponderosa pine/shinyleaf spiraea

- (Plot 17b; location 18b)
- Johnston (1987): *Pinus ponderosa*/*Spiraea betulifolia* plant association
 - The Nature Conservancy (1997): *Pinus ponderosa*/*Spiraea betulifolia* forest
 - Hoffman and Alexander (1976): *Pseudotsuga menziesii*/*Berberis repens* habitat type, *Juniperus communis* phase
 - Girard et al. 1997): none
 - Federal Geographic Data Committee (1997): I.A.8.N.c.; Conical-crowned, natural/semi-natural, temperate or subpolar, needle-leaved, evergreen forest with closed tree canopy
 - Kuchler (1966): Douglas-fir forest (11)
 - Eyre (1980): Interior Ponderosa Pine (237)

Ponderosa pine/bluebunch wheatgrass

(Location 17a)

- Johnston (1987): *Pinus ponderosa/Roegneria spicata* plant association
- The Nature Conservancy (1997): *Pinus ponderosa/Pseudoroegneria spicata* woodland
- Hoffman and Alexander (1976): *Pinus ponderosa/Agropyron spicatum* habitat type
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): II.A.4.N.a.; Rounded-crown, natural/semi-natural, temperate or subpolar, needle-leaved, evergreen woodland with open tree canopy
- Kuchler (1966): Douglas-fir forest (11)
- Eyre (1980): Interior Ponderosa Pine (237)

Limber pine/common juniper

(Plots 8, 27, 38, 46, 48; location 20b)

- Johnston (1987): *Pinus flexilis/Juniperus communis* plant association
- The Nature Conservancy (1997): *Pinus flexilis/Juniperus communis* woodland
- Hoffman and Alexander (1976): *Pseudotsuga menziesii/Berberis repens* habitat type, *Juniperus communis* phase?
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): II.A.4.N.a.; Rounded-crown, natural/semi-natural, temperate or subpolar, needle-leaved, evergreen woodland with open tree canopy
- Kuchler (1966): Douglas-fir forest (11)
- Eyre (1980): Limber pine (219)

DECIDUOUS WOODLAND

Quaking aspen woodland

(Plot 13)

- Johnston (1987): unknown
- The Nature Conservancy (1997): unknown
- Hoffman and Alexander (1976): unknown
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): II.B.2.N.a.; Natural/semi-natural, cold-deciduous woodland with open tree canopy
- Kuchler (1966): Douglas-fir forest (11)
- Eyre (1980): Interior Douglas-fir (210)

DECIDUOUS SHRUB

Water birch/red-osier dogwood

(Plot 11)

- Johnston (1987): no equivalent plant association
- The Nature Conservancy (1997): *Betula occidentalis/Cornus sericea* shrubland
- Hoffman and Alexander (1976): none
- Girard et al. (1997): *Betula occidentalis/Cornus stolonifera* community type
- Federal Geographic Data Committee (1997): III.B.2.N.d.;
Temporarily-flooded, natural/semi-natural, cold-deciduous shrubland
- Kuchler (1966): Douglas-fir forest (11)?
- Eyre (1980): none

Prickly currant shrubland

(Plot 33)

- Johnston (1987): no equivalent plant association
- The Nature Conservancy (1997): *Ribes lacustre/Mertensia ciliata* shrubland
- Hoffman and Alexander (1976): none
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): III.B.2.N.a.;
Temperate, natural/semi-natural, cold-deciduous shrubland
- Kuchler (1966): Western spruce-fir forest (14)?
- Eyre (1980): none

Mountain ninebark shrubland

(Plot 12)

- Johnston (1987): no equivalent plant association
- The Nature Conservancy (1997): no equivalent plant association
- Hoffman and Alexander (1976): *Pseudotsuga menziesii/Physocarpus monogynus* habitat type
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): III.B.2.N.a.;
Temperate, natural/semi-natural, cold-deciduous shrubland
- Kuchler (1966): Douglas-fir forest (11)?
- Eyre (1980): none

EVERGREEN SHRUB

Mountain big sagebrush/Idaho fescue

(Plots 30, 39, 42, 42a)

- Johnston (1987): *Artemisia tridentata*/*Festuca idahoensis* plant association
- The Nature Conservancy (1997): *Artemisia tridentata* ssp. *vaseyana*/*Festuca idahoensis* shrub herbaceous vegetation
- Hoffman and Alexander (1976): none
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): V.A.7.N.e.; Medium-tall, natural/semi-natural, temperate or subpolar, perennial grassland with a sparse shrub layer.
- Kuchler (1966): Sagebrush steppe (49)
- Eyre (1980): none

HERBACEOUS

Idaho fescue-northern singlespike sedge

(Plot 45)

- Johnston (1987): *Festuca idahoensis*-*Carex obtusata* plant association?
- The Nature Conservancy (1997): *Festuca idahoensis*-*Carex scirpoidea* herbaceous vegetation
- Hoffman and Alexander (1976): none
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): V.A.5.N.h.; Short alpine or subalpine, natural/semi-natural, temperate or subpolar, perennial grassland
- Kuchler (1966): Fescue-wheatgrass (*Festuca*-*Agropyron*) (43)
- Eyre (1980): none

Idaho fescue-slender wheatgrass

(Plot 32, 35; location 24)

- Johnston (1987): *Festuca idahoensis*-*Elymus trachycaulus* plant association
- The Nature Conservancy (1997): *Festuca idahoensis*-*Elymus trachycaulus* herbaceous vegetation
- Hoffman and Alexander (1976): none
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): V.A.5.N.d.; Medium-tall bunch, natural/semi-natural, temperate or subpolar, perennial grassland
- Kuchler (1966): Fescue-wheatgrass (*Festuca*-*Agropyron*) (43)
- Eyre (1980): none

Idaho fescue-bluebunch wheatgrass

(Plot 43; location 21)

- Johnston (1987): *Festuca idahoensis*-*Roegneria spicata* plant association
- The Nature Conservancy (1997): *Festuca idahoensis*-*Pseudoroegneria spicata* herbaceous vegetation
- Hoffman and Alexander (1976): none
- Girard et al. 1997): none
- Federal Geographic Data Committee (1997): V.A.5.N.d.; Medium-tall bunch, natural/semi-natural, temperate or subpolar, perennial grassland
- Kuchler (1966): Fescue-wheatgrass (*Festuca*-*Agropyron*) (43)
- Eyre (1980): none

Smooth brome

(Plot 3a; location 4)

- Johnston (1987): no equivalent plant association
- The Nature Conservancy (1997): no equivalent plant association
- Hoffman and Alexander (1976): *Pseudotsuga menziesii*/*Berberis repens* habitat type, *Juniperus communis* phase?
- Girard et al. 1997): none

- Federal Geographic Data Committee (1997): V.A.5.C.; Planted/cultivated, temperate or subpolar, perennial grassland
- Kuchler (1966): Douglas-fir forest (11)?
- Eyre (1980): none

Mountain bluebells

(Locations 3, 28)

- Johnston (1987): No apparent equivalent
 - The Nature Conservancy (1997): *Mertensia ciliata* herbaceous vegetation
 - Hoffman and Alexander (1976): none
 - Girard et al. 1997): none
 - Federal Geographic Data Committee (1997): V.B.2.N.a.; Tall, natural/semi-natural, temperate or subpolar, perennial forb vegetation
 - Kuchler (1966): Western spruce-fir forest (14)?
 - Eyre (1980): none
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