

ECOLOGICAL EVALUATION OF
THE POTENTIAL SHEEP MESA RESEARCH NATURAL AREA
WITHIN THE SHOSHONE NATIONAL FOREST,
PARK COUNTY, WYOMING

Prepared for the
Shoshone National Forest,
USDA Forest Service

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INTRODUCTION

The potential Sheep Mesa Research Natural Area (RNA) is located in the valley of the North Fork of the Shoshone River in northwestern Wyoming. The area includes alpine plateaus and cirques, conifer forests, and barren cliffs and talus slopes. The potential RNA is in the Shoshone National Forest and is used primarily for recreation, watershed protection, and wildlife habitat.

In 1997, The Nature Conservancy entered a contract with the USDA Forest Service, Shoshone National Forest, to prepare ecological evaluations of areas in the Forest for use by the Forest Service in examining the suitability of the areas as research natural areas. The evaluation of the Sheep Mesa area was done by the Wyoming Natural Diversity Database. This report presents the results of that evaluation.

LAND MANAGEMENT PLANNING

In 1997, Sheep Mesa 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 Sheep Mesa 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; 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 potential Sheep Mesa RNA are alpine plateaus and cirques, high-elevation forests of whitebark pine, Engelmann spruce, and lodgepole pine, and mid-elevation forests of Douglas-fir. Three perennial streams flow northward from Sheep Mesa at the southern end of the area to the North Fork of the Shoshone River at the northern end. Eight rare vascular plant species occur in the alpine zone on Sheep Mesa and on sparsely-vegetated slopes in the northern part of the area.

LOCATION

The potential Sheep Mesa RNA is located within the Shoshone National Forest in northwestern Wyoming. The approximate center of the potential RNA is at latitude 44°23'50"N and longitude 109°47'40"W.

The potential RNA includes all or parts of the following sections (all on the 6th Principal Meridian): Township 50 North, Range 108 West, Section 1; T51N, R107W, Sections 5, 6, 7, 8, 9, 10, 11, 16, 17, 18, 19, 20, 21, 29, 30, 31; T51N, R108W, Sections 1, 2, 11, 12, 13, 14, 15, 23, 24, 25, 26, 35, 36; T52N, R107W, Sections 28, 29, 30, 31, 32; T52N, R108W, Section 26.

BOUNDARY

See Figure 1.

The proposed boundary of the potential RNA follows drainage divides and other topographical features. Starting at a point at the south side of the floodplain of the North Fork of the Shoshone River ca. 400 feet (122 m) west of the mouth of Mesa Creek, the boundary follows the drainage divide between Mesa Creek and Sheep Creek on the east (both inside the potential RNA) and Fishhawk Creek on the west (outside the area), south to Fortress Mountain at the southern tip of the potential RNA; thence northeast along the drainage divide between Blackwater Creek on the west (inside the potential RNA) and tributaries to the Elk Fork to the east (outside the area) to a point ca. 0.35 mile (0.6 km) southwest of the summit of Clayton Mountain; thence west and north (primarily along ridges) across the valleys of Blackwater Creek and the West Fork of Blackwater Creek to a point on the drainage divide between the West Fork of Blackwater Creek on the east and Sheep Creek on the west; thence northeast along that divide to the south side of the floodplain of the North Fork of the Shoshone River; thence west along the south side of the floodplain to the starting point.

AREA

The total area of the potential Sheep Mesa RNA is ca. 15,675 acres (6346 ha).

ELEVATION

The elevation of the potential Sheep Mesa RNA ranges from ca. 6350 feet (1935 m) on the North Fork of the Shoshone River at the northern end to 12,085 feet (3683 m) on Fortress Mountain at the southern end.

ACCESS

The potential Sheep Mesa RNA may be reached on public roads. From Cody, Wyoming, travel on U.S. Highway 14/16/20 west ca. 40 miles (64 km) to the Shoshone National Forest Blackwater Pond Picnic Area. To reach the eastern half of the potential RNA from the picnic area, travel south ca. 1.5 miles (2.5 km) on Low Standard Forest Road 435, then south an additional 1 mile (1.6 km) on Forest Trail 758 to the intersection with Forest Trail 775, then south an additional ca. 0.75 mile (1.2 km) on Forest Trail 775 to the northern boundary of the potential RNA. To reach the western half of the potential RNA from the Blackwater Pond Picnic Area, cross the Shoshone River on Low Standard Forest Road 435, then pick a route west ca. 3 miles (4.8 km) to the mouth of Sheep Creek and Forest Trail 789. The western half of the potential RNA may also be reached by traveling west on U.S. Highway 14/16/20 ca. 7 miles (11 km) to Low Standard Forest Road 446, then picking a route east on the south side of the Shoshone River ca. 4 miles to the mouth of Sheep Creek and Forest Trail 789.

ECOREGION

The potential Sheep Mesa RNA lies within the Southern Rocky Mountain Steppe-Open Woodland-Coniferous Forest-Alpine Meadow Province, Yellowstone Highlands Section (M331A) of the ecoregion classification of Bailey et al. (1994) (Freeouf 1996).

MAPS

USDA Forest Service 1/2 inch = 1 mile scale map of the Shoshone National Forest.

USDI Geological Survey 7.5 minute topographic Quadrangle Maps: Clayton Mountain., Wyo.; Chimney Rock, Wyo.; Sheep Mesa, Wyo.

VEGETATION

DESCRIPTION

The potential Sheep Mesa RNA contains the following plant associations: Engelmann spruce/field horsetail, Engelmann spruce/gooseberry currant, Douglas-fir/Rocky Mountain maple, Douglas-fir/common snowberry, Douglas-fir/shinyleaf spiraea,

Thinleaf alder/field horsetail, Mountain big sagebrush/Idaho fescue, Idaho fescue-King spikefescue, Nelson's needlegrass, Mesic alpine, Ross's avens-Clover. Synonyms are shown in Appendix 5. Data from sample plots and descriptions of vegetation at various locations are given in Appendix 3.

Upland vegetation

In the southern quarter of the potential RNA, the upland vegetation is a mosaic of the Ross's avens-clover species community on drier and windblown sites (especially on the broad plateau of Sheep Mesa and on slopes), and the mesic alpine vegetation type on protected sites (especially in the bottoms of cirques). In the remainder of the area, the vegetation is conifer woodland and forest. The central third of the area supports a mix of whitebark pine/gooseberry currant forest at upper timberline on west-facing slopes; Engelmann spruce/gooseberry currant forest at timberline on some north- and east-facing slope; and lodgepole pine forest (either the lodgepole pine/grouse whortleberry or the lodgepole pine/heartleaf arnica community types) from timberline down to 8,000-9,000 feet (2438-2743 m). These forest types merge with each other, and in many stands, the overstory includes all three tree species, along with Douglas-fir at the lower elevations. Barren cliffs and scree slopes are common in this part of the potential RNA.

In roughly the northern third of the area, below an elevation of 8,000-9,000 feet (2438-2743 m), depending on aspect, the upland vegetation is a mix of Douglas-fir forest, shrubland, and grassland, with a large component of sparsely-vegetated cliffs and scree slopes. Over much of the area, the Douglas-fir forest belongs to the Douglas-fir/shinyleaf spiraea community (with a sparse understory), interspersed mainly with sparsely-vegetated openings. On the eastern side of the potential RNA, approximately 164 acres (66 ha) of this vegetation mosaic is seral vegetation recovering from a 1930s fire.

In valley bottoms, the Douglas-fir vegetation apparently belongs to the Douglas-fir/common snowberry community, with dense understories. Both of these Douglas-fir forest types merge with lodgepole pine and Engelmann spruce forests at higher elevations.

At the north end of the potential RNA, north-facing slopes support species-rich stands of the Douglas-fir/Rocky Mountain maple community.

The denser grasslands in the potential RNA, growing on a variety of slopes, belong to the Idaho fescue-King spikefescue community. On many of the slopes throughout the central and northern part of the area, the vegetation is very sparse (<10%

canopy cover), and the major species are needlegrasses (*Stipa nelsonii* and *S. lettermanii*) and a variety of forbs. This vegetation is so sparse that the areas supporting it may best be considered sparsely-vegetated slopes, rather than representatives of a plant community. Both the Idaho fescue-King spikefescue grassland and the sparsely-vegetated slopes merge with stands of forest, primarily of the Douglas-fir/shinyleaf spiraea community.

A limited area in the northern part of the potential RNA supports stands of the mountain big sagebrush/Idaho fescue community. These stands grow primarily on mesic slopes, interspersed with stands of Douglas-fir forest.

Riparian vegetation

Riparian vegetation is limited in the potential RNA. A fringe of Engelmann spruce/field horsetail forest grows along the streams above ca. 8200 feet (2450 m), bordered by lodgepole pine forest at higher elevations and by Douglas-fir/common snowberry forest at lower elevations. Below ca. 8200 feet (2450 m) elevation, the thinleaf alder/field horsetail community forms a fringe along the larger streams, and is bordered mainly by the Douglas-fir/common snowberry forests. Balsam poplar (*Populus balsamifera*) grows in some of the lower riparian areas, as scattered individual trees and small groves of several trees.

AREA BY TYPE

Complexes of Kuchler vegetation types (Kuchler 1966) were mapped on 1:24,000-scale topographic maps using aerial photographs and field reconnaissance, and the area of each complex was estimated from the maps by use of a digital planimeter. (The vegetation map shows complexes because delineating stands of individual vegetation types was impossible.) The proportion of a complex accounted for by each vegetation type was estimated from the aerial photographs and field survey. Areas of the individual vegetation types (Table 1) were then estimated by multiplying the area of the complex by the proportion of the complex accounted for by the vegetation type.

Areas of complexes of plant community types (Table 2) were estimated in the same manner. Areas of the individual plant community types were not estimated, however, because estimates of the proportion of each type in each complex were unavailable, given the difficulty of distinguishing between the closely-related plant communities from aerial photos and the limited extent of the field survey.

Table 1. Areas of Kuchler Types (Kuchler 1966) in the potential Sheep Mesa RNA. See Figure 1.

Cover Type	Acres	Hectares
11 Douglas fir forest (Pseudotsuga)	4361	1765
14 Western spruce-fir forest (Picea-Abies)	3632	1470
43 Fescue-wheatgrass (Festuca-Agropyron)	628	254
45 Alpine meadows and barren (Agrostis, Carex, Festuca, Poa)	3808	1542
50 Wheatgrass-needlegrass shrubsteppe (Agropyron, Stipa, Artemisia)	628	254
Sparsely-vegetated slopes	2618	1060

Table 2. Areas of SAF cover types (Eyler 1980) in the potential Sheep Mesa RNA. See Figure 1.

Cover Type	Acres	Hectares
Interior Douglas fir (210)	4361	1765
Engelmann spruce-subalpine fir (206)	3632	1470
Other non-SAF types	7683	3112

Table 3. Areas of complexes of plant community types in the potential Sheep Mesa RNA. Major communities in each complex are indicated by "(M)" following the community names, and minor communities by "(m)". Appendix 5 contains synonyms.

Complex	Acres	Hectares
Douglas-fir/shinyleaf spiraea (M) & Idaho fescue-King spikefescue (M) & Mountain big sagebrush/Idaho fescue (M) & Sparsely-vegetated cliffs & slopes (M)	4571	1851
		Unburned
	404	164
		Burned
Lodgepole pine/heartleaf arnica(M) & Lodgepole pine/grouse whortleberry(M) & Engelmann spruce/field horsetail(m)	3950	1599
Ross's avens-Clover spp.(M)& Mesic alpine(m)	3809	1542
Engelmann spruce/gooseberry currant	1032	418
Douglas-fir/common snowberry(M) & Thinleaf alder/field horsetail(m)	1001	405
Whitebark pine/gooseberry currant	605	245
Douglas-fir/common snowberry	303	123

PHYSICAL AND CLIMATIC CONDITIONS

PHYSICAL SETTING

The potential Sheep Mesa RNA is located in the valley of the North Fork of the Shoshone River, and includes parts or all of the valleys of three tributary streams (Mesa Creek, Sheep Creek, and Blackwater Creek) flowing into the river from the south. The southern third of the area contains gently-rolling alpine surfaces and cirques, with over 1,000 feet (305 m) of relief. The northern two-thirds of the area consists of valleys of the northward-flowing streams, with moderately-steep side slopes punctuated by cliffs and talus deposits. Local relief in the valleys is 1,000 feet to 2,000 feet (300 m to 600 m).

GEOLOGY

The bedrock in the proposed RNA is Tertiary volcanic rock (Love and Christiansen 1985). In the northern half of the area,

this rock is the andesitic Wapiti Formation. In the southern half of the area, the rock consists of younger volcanics lying atop the Wapiti Formation: trachyandesite of the Trout Peak Formation, and the conglomerate and tuff of the Wiggins Peak Formation.

DESCRIPTION OF VALUES

VEGETATION TYPES

See Table 1 for a list of the Kuchler (1966) vegetation types present in the area and the estimated acreage of each, and Table 2 for a list of the plant associations present.

FLORA

Threatened, Endangered, and Sensitive Plant Species

There are no federally listed Threatened or Endangered plant species found in the potential Sheep Mesa RNA. One USDA Forest Service Region 2 Sensitive plant species (*Townsendia condensata* var. *anomala*) is found in the area (Estill 1993; Fertig 1997). Seven other plants listed as "species of special concern" or "watch list" species by WYNDD (Fertig and Beauvais 1999) are also known from the potential RNA. The status of each of these species is briefly summarized below. Complete Element Occurrence Records and location maps for each population are included in Appendix A.

Castilleja crista-gallii (Cock's-comb paintbrush)

Heritage Rank: G3/S2.

Federal Status: None.

Geographic Range: Regional endemic of northwestern Wyoming, south-central Montana, and eastern Idaho (Hitchcock et al. 1959).

Habitat: Dry montane slopes and meadows, often on clay or volcanic soils.

Comments: One small colony was observed by W. Fertig on the divide between Sheep and Blackwater creeks in 1997 (Fertig 1998). This species is currently known from 19 extant and 2 historical populations in Wyoming, twelve of which are in designated wilderness areas or Yellowstone National Park. Cock's-comb paintbrush may be of hybrid origin, possibly between *Castilleja miniata* and *C. linariifolia* (Hitchcock et al. 1959), although recent biosystematic studies by Mathews and Lavin (1998) suggest that *C. crista-galli* is as genetically distinct as any other *Castilleja* species.

Castilleja nivea (Snow paintbrush)

Heritage Rank: G3/S2 (WYNDD watch list).

Federal Status: None.

Geographic Range: Regional endemic of central and southern Montana and northwestern Wyoming (Hitchcock *et al.* 1959). In Wyoming, known from the Absaroka and Beartooth mountains.

Habitat: Rocky upper montane to alpine ridges and meadows on calcareous or volcanic substrates.

Comments: The authors discovered a small colony of snow paintbrush along the divide between Sheep Creek and the west fork of Blackwater Creek in 1997 (Fertig 1998). This species is known from about 20 occurrences in Wyoming, most of which are in rugged or inaccessible locations and minimally threatened. It is considered a "watch list" species because of its limited distribution.

Draba crassa (Thick-leaf whitlow-grass)

Heritage Rank: G3/S2 (WYNDD watch list).

Federal Status: None.

Geographic Range: Rocky Mountains from southern Montana to northeast Utah and central Colorado (Scott 1997). In Wyoming, it is known from the Absaroka, Teton, Gros Ventre, and Wind River ranges.

Habitat: Alpine fellfields, cliffs, talus, and scree (Scott 1997).

Comments: Erwin Evert collected this species on Sheep Mesa in 1984. Thick-leaf whitlow-grass is currently known from 13 occurrences in Wyoming, most of which are protected in designated wilderness areas or in Grand Teton National Park (Fertig 1998). Recent surveys in western Wyoming have found this species to be more widespread than once suspected, prompting WYNDD to drop it to the "watch list" category in 1999 (Fertig and Beauvais 1999).

Gayophytum humile (Low ground-smoke)

Heritage Rank: G5/S1.

Federal Status: None.

Geographic Range: In North America, low ground-smoke ranges from Washington to Montana and south to California and Utah. The species reoccurs in central Chile and Argentina. In Wyoming, it is known from the Absaroka Range and Yellowstone Plateau in Fremont, Park, and Teton counties.

Habitat: Occurs in moist to dry hills, meadows, and slopes in the montane and subalpine zones.

Comments: A small colony of low ground-smoke was discovered

along the divide between Sheep and Blackwater creeks by Fertig and Jones in 1997 (Fertig 1998). The species is currently known from 5 extant and 1 historical record in Wyoming, 3 of which occur in wilderness or national parks.

Papaver kluanense (Alpine poppy)

Synonym: *Papaver lapponicum* var. *occidentale*; *P. radicum* ssp. *kluanensis*.

Heritage Rank: G3?Q/S2.

Federal Status: None.

Geographic Range: Southeast Alaska south in the Rocky Mountains to northern New Mexico (Kiger and Murray 1997).

Habitat: Alpine scree slopes, rocky ledges, and high mountain passes, rarely below 11,000 feet (Scott 1997).

Comments: The authors discovered a small population of 20-50 individuals in the alpine cirque at the head of the west fork of Blackwater Creek (Fertig 1998). This species is known from 9 extant locations in the state, including four in designated wilderness areas. Known populations in the state are small and highly restricted to specialized habitats.

Penstemon absarokensis (Absaroka beardtongue)

Heritage Rank: G2/S2.

Federal Status: None.

Geographic Range: Endemic to the Absaroka and northeast Wind River Range in Fremont and Park counties, Wyoming.

Habitat: Loose, volcanic scree and talus slopes in sparsely-vegetated openings in Douglas-fir/limber pine woodlands on steep slopes and creek bottoms (Mills and Fertig 1996).

Comments: W. Fertig discovered four small colonies of Absaroka beardtongue on the divide between Blackwater Creek and the North Fork of the Shoshone River in 1997 (Fertig 1998). These populations consisted of widely scattered individuals and were restricted to semi-barren volcanic scree slopes. This species is currently known from 20 occurrences world-wide, with a total population of 8000-15,000 individuals (Fertig 1997). Although a number of occurrences are protected in wilderness areas, low-elevation colonies are at some risk from road construction, recreational activity, mining, and competition from weeds (Fertig 1997).

Potentilla uniflora (One-flower cinquefoil)

Heritage Rank: G5/S2.

Federal Status: None.

Geographic Range: Siberia and Alaska south intermittently in the Rocky Mountains to Montana, northwest Wyoming, and Colorado. In Wyoming, it is known from the Absaroka, Gros Ventre, and

Beartooth ranges in Fremont, Hot Springs, Park, Sublette, and Teton counties (Scott 1997).

Habitat: Alpine fellfields and tundra.

Comments: Erwin Evert collected this species at the headwaters of Blackwater Creek (near Sheep Mesa) in 1982 (WYNDD records). This population was not relocated in 1997. One-flower cinquefoil is known from at least 5 extant locations on Shoshone National Forest, including an occurrence in the potential Twin Lakes RNA (Fertig and Bynum 1994). This species may be more widespread and abundant in Wyoming than currently known.

Townsendia condensata* var. *anomala (North Fork Easter-daisy)

Heritage Rank: G4T2/S2.

Federal Status: USFS Region 2 Sensitive.

Geographic Range: Endemic to the Absaroka Range in Park County, Wyoming (Fertig et al. 1994).

Habitat: Sparsely vegetated, barren ridges and slopes in openings in Douglas-fir/limber pine woodlands on volcanic andesite scree and talus (Fertig 1997).

Comments: This species is found in 7 small colonies in the potential RNA scattered along the divide between Sheep and Blackwater creeks and on the ridges above the North Fork Shoshone River. Colonies range from 30 to nearly 400 individuals, making the pRNA one of the largest known populations (Fertig 1997). The North Fork Easter-daisy is known from 20 occurrences, 11 of which are found in designated wilderness areas on Shoshone National Forest. This species is largely unthreatened due to the ruggedness of its habitat and low rates of grazing (Fertig 1997).

Habitat may also exist for *Lomatium attenuatum* (Absaroka biscuitroot) on andesite cliffs at the north end of the potential RNA. No populations were located during 1997 surveys, although the species is known from the slopes of Clayton Mountain, approximately 1.5 miles to the southwest (Fertig 1997). Four other rare plants formerly tracked by WYNDD also occur within the pRNA: *Carex bipartita*, *Conimitella williamsii*, *Gentianella tenella*, and *Senecio fuscatus* (these species are now known to more widespread than originally suspected).

Plant Species List

The following species checklist is based on field surveys conducted by the authors in mid-August 1997. For more information on the vascular flora of the Absaroka Range, consult Evert (1991), Kirkpatrick (1987), and Snow (1992-94). 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). Non-native species are indicated by “!” before the species name.

Trees

Scientific Name	Common Name	Fam.
<i>Abies lasiocarpa</i>	Subalpine fir	PIN
<i>Picea engelmannii</i>	Engelmann spruce	PIN
<i>Pinus albicaulis</i>	Whitebark pine	PIN
<i>Pinus contorta</i> var. <i>latifolia</i>	Lodgepole pine	PIN
<i>Pinus flexilis</i>	Limber pine	PIN
<i>Populus balsamifera</i>	Balsam poplar	SAL
<i>Populus tremuloides</i>	Quaking aspen	SAL
<i>Pseudotsuga menziesii</i> var. <i>glauca</i>	Douglas-fir	PIN
<i>Salix lasiandra</i> var. <i>caudata</i>	Whiplash willow	SAL

Shrubs

<i>Acer glabrum</i>	Rocky Mountain maple	ACE
<i>Alnus incana</i> var. <i>occidentalis</i>	Mountain alder	BET
<i>Artemisia tridentata</i> var. <i>vaseyana</i>	Mountain big sagebrush	AST
<i>Chrysothamnus nauseosus</i> var. <i>nauseosus</i>	Rubber rabbitbrush	AST
<i>Chrysothamnus viscidiflorus</i> var. <i>viscidiflorus</i>	Green rabbitbrush	AST
<i>Juniperus communis</i> var. <i>depressa</i>	Common juniper	CUP
<i>Juniperus scopulorum</i>	Rocky Mountain juniper	CUP
<i>Mahonia repens</i>	Creeping Oregon-grape	BER
<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 oxycanthoides</i>	Northern gooseberry	GRS
<i>Rosa sayi</i>	Prickly rose	ROS
<i>Rosa woodsii</i>	Woods' rose	ROS
<i>Rubus idaeus</i> var. <i>aculeatissimus</i>	American red raspberry	ROS
<i>Rubus parviflorus</i>	Thimbleberry	ROS
<i>Salix arctica</i> var. <i>petraea</i>	Arctic willow	SAL
<i>Salix bebbiana</i>	Bebb willow	SAL
<i>Salix reticulata</i> var. <i>nana</i>	Snow willow	SAL
<i>Sambucus racemosa</i>	Red elderberry	CPR
<i>Shepherdia canadensis</i>	Canada buffaloberry	ELE
<i>Symphoricarpos oreophilus</i> var. <i>utahensis</i>	Mountain snowberry	CPR
<i>Spiraea betulifolia</i> var. <i>lucida</i>	Shiny-leaf spirea	ROS
<i>Vaccinium scoparium</i>	Grouse whortleberry	ERI

Forbs

<i>Achillea millefolium</i>	Common yarrow	AST
<i>Actaea rubra</i>	Baneberry	RAN
<i>Agoseris glauca</i> var. <i>dasycephala</i>	Short-beaked agoseris	AST
<i>Agoseris glauca</i> var. <i>laciniata</i>	Short-beaked agoseris	AST
<i>Allium brevistylum</i>	Short-style onion	LIL
<i>Allium cernuum</i>	Nodding onion	LIL
<i>Allium textile</i>	Textile onion	LIL
<i>Androsace septentrionalis</i> var. <i>subulifera</i>	Northern rock jasmine	PRM
<i>Anemone patens</i> var. <i>multifida</i>	Pasqueflower	RAN
<i>Angelica</i> sp.	Angelica	API
<i>Antennaria lanata</i>	Woolly pussytoes	AST
<i>Antennaria media</i>	Alpine pussytoes	AST
<i>Antennaria racemosa</i>	Raceme pussytoes	AST
<i>Antennaria umbrinella</i>	Umber pussytoes	AST
<i>Apocynum androsaemifolium</i>	Spreading dogbane	APO
<i>Aquilegia flavescens</i>	Yellow columbine	RAN
<i>Arabis drummondii</i>	Drummond's rockcress	BRA

<i>Arabis holboellii</i>	Holboell's rockcress	BRA
<i>Arabis lyallii</i>	Lyall's rockcress	BRA
<i>Arenaria congesta</i> var. <i>congesta</i>	Ballhead sandwort	CRY
<i>Arenaria hookeri</i> var. <i>hookeri</i>	Hooker's sandwort	CRY
<i>Arenaria lateriflora</i> [<i>Moehringia lateriflora</i>]	Bluntleaf 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 rossii</i> [<i>Minuartia austromontana</i>]	Ross sandwort	CRY
<i>Arnica cordifolia</i>	Heartleaf arnica	AST
<i>Arnica gracilis</i>	Slender arnica	AST
<i>Arnica latifolia</i>	Mountain arnica	AST
<i>Arnica longifolia</i>	Seep-spring arnica	AST
<i>Arnica parryi</i>	Nodding arnica	AST
<i>Artemisia frigida</i>	Fringed sagewort	AST
<i>Artemisia michauxiana</i>	Michaux sagewort	AST
<i>Artemisia scopulorum</i>	Rocky Mountain sagewort	AST
<i>Aster ascendens</i>	Long-leaved aster	AST
<i>Aster conspicuus</i>	Showy aster	AST
<i>Aster foliaceus</i>	Leafy aster	AST
<i>Aster glaucodes</i>	Blueleaf aster	AST
<i>Aster perelegans</i>	Elegant aster	AST
<i>Astragalus agrestis</i>	Field milkvetch	FAB
<i>Astragalus alpinus</i>	Alpine milkvetch	FAB
<i>Astragalus australis</i> var. <i>glabriusculus</i>	Indian milkvetch	FAB
<i>Astragalus miser</i> var. <i>decumbens</i>	Sagebrush weedy milkvetch	FAB
<i>Astragalus miser</i> var. <i>hylophilus</i>	Weedy milkvetch	FAB
<i>Astragalus vexilliflexus</i>	Bent-flowered milkvetch	FAB
<i>Balsamorhiza sagittata</i>	Arrowleaf balsamroot	AST
<i>Besseyia wyomingensis</i>	Wyoming kittentails	SCR
<i>Bupleurum americanum</i>	American thoroughwax	API

<i>! Camelina microcarpa</i>	Littlepod flaseflax	BRA
<i>Campanula rotundifolia</i>	Scotch bellflower	CAM
<i>Campanula uniflora</i>	Arctic harebell	CAM
<i>Castilleja cristagalli</i>	Cock's-comb paintbrush	SCR
<i>Castilleja miniata</i>	Scarlet paintbrush	SCR
<i>Castilleja nivea</i>	Snow paintbrush	SCR
<i>Castilleja pulchella</i>	Showy paintbrush	SCR
<i>Castilleja rhexifolia</i>	Rhexia-leaved paintbrush	SCR
<i>Cerastium beeringianum</i> var. <i>capillare</i>	Alpine chickweed	CRY
<i>Chaenactis douglasii</i> var. <i>montana</i>	Hoary dusty-maiden	AST
<i>Chenopodium capitatum</i> var. <i>parvicapitatum</i> [<i>C. overi</i>]	Smallhead goosefoot	CHN
<i>Chimaphila umbellata</i> var. <i>occidentalis</i>	Common pipsissewa	ERI
<i>Cirsium scariosum</i>	Elk thistle	AST
<i>Cirsium eatonii</i>	Eaton's thistle	AST
<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>Collomia tenella</i>	Diffuse collomia	PLM
<i>Comandra umbellata</i> var. <i>pallida</i>	Pale bastard toadflax	SAN
<i>Conimitella williamsii</i>	Williams conimitella	SAX
<i>Crepis acuminata</i>	Mountain hawkbeard	AST
<i>Cryptantha celosioides</i>	Cockscomb cryptantha	BOR
<i>Cryptantha torreyana</i>	Torrey's cryptantha	BOR
<i>Cymopterus acaulis</i>	Plains spring-parsley	API
<i>Cymopterus nivalis</i>	Snowline spring-parsley	API
<i>Cymopterus terebinthinus</i> var. <i>albiflorus</i>	Turpentine rock parsley	API
<i>Delphinium nuttallianum</i>	Nuttall's larkspur	RAN
<i>Descurainia incana</i>	Mountain tansymustard	BRA
<i>Disporum trachycarpum</i>	Wartberry fairybell	LIL
<i>Dodecatheon pulchellum</i>	Pretty shooting-star	PRM
<i>Draba crassa</i>	Thick-leaf whitlow-grass	BRA

<i>Draba crassifolia</i>	Thickleaved draba	BRA
<i>Draba ventosa</i>	Wind River draba	BRA
<i>Epilobium angustifolium</i>	Fireweed	ONA
<i>Epilobium brachycarpum</i>	Autumn willowherb	ONA
<i>Erigeron caespitosus</i>	Tufted fleabane	AST
<i>Erigeron compositus</i> var. <i>discoideus</i>	Cut-leaved daisy	AST
<i>Erigeron eatonii</i>	Eaton's daisy	AST
<i>Erigeron peregrinus</i> var. <i>scaposus</i>	Wandering fleabane	AST
<i>Erigeron rydbergii</i>	Rydberg's daisy	AST
<i>Erigeron simplex</i>	Alpine daisy	AST
<i>Eriogonum ovalifolium</i>	Cushion buckwheat	PLG
<i>Eriogonum umbellatum</i> var. <i>majus</i>	Sulfur buckwheat	PLG
<i>Eriophyllum lanatum</i>	Woolly yellow daisy	AST
<i>Eritrichium nanum</i> var. <i>elongatum</i>	Pale alpine forget-me-not	BOR
<i>Erysimum asperum</i> var. <i>arkansanum</i> [<i>E. capitatum</i>]	Western wallflower	BOR
<i>Fragaria vesca</i>	Woods strawberry	ROS
<i>Fritillaria atropurpurea</i>	Checker-lily	LIL
<i>Galium aparine</i>	Cleavers	RUB
<i>Gayophytum diffusum</i> var. <i>strictipes</i>	Spreading groundsmoke	ONA
<i>Gentianella tenella</i>	Slender gentian	GEN
<i>Geum macrophyllum</i> var. <i>perincisum</i>	Large-leaved avens	ROS
<i>Geum rossii</i> var. <i>turbinatum</i>	Alpine avens	ROS
<i>Geum triflorum</i>	Prairie smoke	ROS
<i>Hackelia floribunda</i>	Many-flowered stickseed	BOR
<i>Hackelia patens</i>	Spreading stickseed	BOR
<i>Haplopappus acaulis</i>	Stemless goldenweed	AST
<i>Haplopappus lyallii</i>	Lyall's goldenweed	AST
<i>Hedysarum occidentale</i>	Western sweetvetch	FAB
<i>Heracleum sphondylium</i>	Cow-parsnip	API
<i>Heuchera cylindrica</i> var. <i>suksdorfii</i>	Roundleaf alumroot	SAX
<i>Hieracium albiflorum</i>	White hawkweed	AST

<i>Hieracium gracile</i>	Alpine hawkweed	AST
<i>Linnaea borealis</i>	Western twinflower	CPR
<i>Linum lewisii</i>	Blue flax	LIN
<i>Lomatium cous</i>	Cous biscuitroot	API
<i>Lomatium dissectum</i>	Fern-leaved biscuitroot	API
<i>Lupinus argenteus</i> var. <i>argenteus</i>	Silvery lupine	FAB
<i>Machaeranthera canescens</i>	Hoary aster	AST
<i>Maianthemum racemosum</i>	False spikenard	LIL
<i>Mentzelia dispersa</i>	Small-flowered stickleaf	LOA
<i>Mentzelia laevicaulis</i>	Beautiful blazingstar	LOA
<i>Mertensia alpina</i>	Alpine bluebells	BOR
<i>Mertensia ciliata</i>	Ciliate bluebells	BOR
<i>Mertensia viridis</i>	Green bluebells	BOR
<i>Microsteris gracilis</i>	Pink microsteris	PLM
<i>Mimulus guttatus</i>	Yellow monkeyflower	SCR
<i>Mimulus lewisii</i>	Lewis' monkeyflower	SCR
<i>Mimulus suksdorfii</i>	Suksdorf's monkeyflower	SCR
<i>Moneses uniflora</i>	Woodnymph	ERI
<i>Monotropa hypopithys</i>	Pinesap	ERI
<i>Montia chamissoi</i>	Water montia	POR
<i>Myosotis alpestris</i>	Wood forget-me-not	BOR
<i>Oenothera cespitosa</i> var. <i>cespitosa</i>	Tufted evening-primrose	ONA
<i>Orthilia secunda</i> [<i>Pyrola secunda</i>]	Sidebells pyrola	ERI
<i>Osmorhiza depauperata</i>	Blunt-fruit sweet-cicely	API
<i>Oxyria digyna</i>	Mountain sorrel	PLG
<i>Oxytropis besseyi</i>	Bessey's locoweed	FAB
<i>Oxytropis campestris</i> var. <i>cusickii</i>	Yellow locoweed	FAB
<i>Oxytropis sericea</i>	White locoweed	FAB
<i>Papaver kluanense</i> [<i>P. radicum</i> ssp. <i>k.</i>]	Alpine poppy	PAP

<i>Pedicularis bracteosa</i> var. <i>paysoniana</i>	Payson's bracted lousewort	SCR
<i>Pedicularis groenlandica</i>	Elephant-head	SCR
<i>Penstemon absarokensis</i>	Absaroka beardtongue	SCR
<i>Penstemon attenuatus</i> var. <i>pseudoprocerus</i>	Taper-leaved beardtongue	SCR
<i>Penstemon deustus</i>	Hot-rock beardtongue	SCR
<i>Penstemon eriantherus</i> var. <i>eriantherus</i>	Crested beardtongue	SCR
<i>Penstemon procerus</i>	Small-flower beardtongue	SCR
<i>Penstemon radicosus</i>	Matroot beardtongue	SCR
<i>Penstemon whippleanus</i>	Whipple's beardtongue	SCR
<i>Phacelia hastata</i>	Silverleaf phacelia	HYD
<i>Phacelia sericea</i>	Silky phacelia	HYD
<i>Phlox hoodii</i>	Hood's phlox	PLM
<i>Phlox multiflora</i>	Many-flowered phlox	PLM
<i>Phlox pulvinata</i>	Cushion phlox	PLM
<i>Physaria didymocarpa</i>	Common twinpod	BRA
<i>Polemonium viscosum</i>	Sky-pilot	PLM
<i>Polygonum bistortoides</i>	American bistort	PLG
<i>Polygonum douglasii</i> var. <i>douglasii</i>	Douglas' knotweed	PLG
<i>Polygonum douglasii</i> var. <i>austinae</i>	Austin's knotweed	PLG
<i>Polygonum viviparum</i>	Alpine bistort	PLG
<i>Potentilla arguta</i>	Glandular cinquefoil	ROS
<i>Potentilla diversifolia</i> var. <i>diversifolia</i>	Vari-leaf cinquefoil	ROS
<i>Potentilla glandulosa</i>	Sticky cinquefoil	ROS
<i>Potentilla gracilis</i>	Slender cinquefoil	ROS
<i>Potentilla nivea</i>	Snow cinquefoil	ROS
<i>Potentilla ovina</i> var. <i>ovina</i>	Sheep cinquefoil	ROS
<i>Potentilla uniflora</i>	One-flower cinquefoil	ROS
<i>Pyrola chlorantha</i>	Greenish wintergreen	ERI
<i>Ranunculus eschscholtzii</i>	Subalpine buttercup	RAN
<i>Ranunculus gmelinii</i>	Small yellow water buttercup	RAN

<i>Ranunculus pedatifidus</i> var. <i>affinis</i>	Birdfoot buttercup	RAN
<i>Rumex paucifolius</i>	Mountain dock	PLG
<i>Saxifraga bronchialis</i> var. <i>austromontana</i>	Spotted saxifrage	SAX
<i>Saxifraga cernua</i>	Nodding saxifrage	SAX
<i>Saxifraga cespitosa</i> var. <i>minima</i>	Tufted saxifrage	SAX
<i>Saxifraga odontoloma</i>	Brook saxifrage	SAX
<i>Saxifraga rhomboidea</i>	Diamondleaf saxifrage	SAX
<i>Saxifraga rivularis</i>	Pygmy saxifrage	SAX
<i>Sedum integrifolium</i>	Roseroot	CRS
<i>Sedum lanceolatum</i>	Lance-leaved stonecrop	CRS
<i>Senecio canus</i>	Woolly groundsel	AST
<i>Senecio fremontii</i>	Fremont's groundsel	AST
<i>Senecio fuscatus</i>	Twice-hairy groundsel	AST
<i>Senecio integerrimus</i>	Western groundsel	AST
<i>Senecio serra</i>	Butterweed groundsel	AST
<i>Senecio streptanthifolius</i>	Cleft-leaved groundsel	AST
<i>Senecio triangularis</i>	Arrowleaf groundsel	AST
<i>Sibbaldia procumbens</i>	Creeping sibbaldia	ROS
<i>Silene drummondii</i>	Drummond's campion	CRY
<i>Silene hitchguirei</i>	Hitchguire's campion	CRY
<i>Smelowskia calycina</i> var. <i>americana</i>	Alpine smelowskia	BRA
<i>Solidago multiradiata</i> var. <i>scopulorum</i>	Northern goldenrod	AST
<i>Stellaria longipes</i>	Longstalk starwort	CRY
<i>Stellaria monantha</i>	One-flower starwort	CRY
<i>Stephanomeria tenuifolia</i>	Slender wirelettuce	AST
* <i>Taraxacum laevigatum</i>	Red-seeded dandelion	AST
<i>Thalictrum fendleri</i>	Fendler's meadowrue	RAN
<i>Townsendia condensata</i> var. <i>anomala</i>	North Fork Easter-daisy	AST
! <i>Tragopogon dubius</i>	Yellow salsify	AST
<i>Trifolium haydenii</i>	Hayden's clover	FAB
<i>Trifolium nanum</i>	Tundra clover	FAB

<i>Trifolium parryi</i> var. <i>montanense</i>	Parry's clover	FAB
! <i>Trifolium pratense</i>	Red clover	FAB
! <i>Trifolium repens</i>	White clover	FAB
<i>Urtica dioica</i>	Stinging nettle	URT
<i>Valeriana dioica</i>	Northern valerian	VAL
<i>Veronica americana</i>	American brooklime	SCR
<i>Veronica wormskjoldii</i>	American alpine speedwell	SCR
<i>Viola purpurea</i> var. <i>venosa</i>	Goosefoot violet	VIO
<i>Zauschneria garrettii</i> [<i>Epilobium canum</i>]	Hummingbird flower	ONA

Graminoids

<i>Bromus anomalus</i>	Nodding brome	POA
<i>Bromus ciliatus</i>	Fringed brome	POA
<i>Bromus inermis</i> var. <i>purpurascens</i>	Pumpelly brome	POA
! <i>Bromus tectorum</i>	Cheatgrass	POA
<i>Calamagrostis canadensis</i>	Bluejoint reedgrass	POA
<i>Calamagrostis rubescens</i>	Pine reedgrass	POA
<i>Carex bipartita</i>	Two-parted sedge	CYP
<i>Carex elynoides</i>	Kobresia-like sedge	CYP
<i>Carex haydeniana</i>	Hayden's sedge	CYP
<i>Carex macloviana</i>	Maclovian sedge	CYP
<i>Carex paysonis</i>	Payson's sedge	CYP
<i>Carex petasata</i>	Liddon's sedge	CYP
<i>Carex rossii</i>	Ross sedge	CYP
<i>Carex scopulorum</i>	Rocky Mountain sedge	CYP
<i>Deschampsia cespitosa</i>	Tufted hairgrass	POA
<i>Elymus elymoides</i> [<i>Sitanion hystrix</i>]	Bottlebrush squirreltail	POA
<i>Elymus glaucus</i>	Blue wildrye	POA
<i>Elymus scribneri</i>	Scribner wheatgrass	POA
<i>Elymus spicatus</i>	Bluebunch wheatgrass	POA
<i>Elymus trachycaulus</i>	Bearded wheatgrass	POA
<i>Festuca brachyphylla</i> [<i>F. ovina</i> var. <i>brevifolia</i>]	Alpine sheep fescue	POA
<i>Festuca idahoensis</i>	Idaho fescue	POA

<i>Festuca saximontana</i> [<i>F. ovina</i> var. <i>rydbergii</i>]	Rocky Mountain sheep fescue	POA
<i>Glyceria striata</i>	Fowl mannagrass	POA
<i>Juncus drummondii</i>	Drummond's rush	JUN
<i>Koeleria micrantha</i>	Prairie junegrass	POA
<i>Leucopoa kingii</i>	Spike-fescue	POA
<i>Luzula parviflora</i>	Smallflowered woodrush	JUN
<i>Luzula spicata</i>	Spiked woodrush	JUN
<i>Oryzopsis exigua</i>	Little ricegrass	POA
<i>Oryzopsis hymenoides</i>	Indian ricegrass	POA
<i>Phleum alpinum</i>	Alpine timothy	POA
<i>Poa arctica</i> var. <i>grayana</i>	Arctic bluegrass	POA
<i>Poa cusickii</i> var. <i>epilis</i>	Skyline bluegrass	POA
<i>Poa interior</i>	Inland bluegrass	POA
<i>Poa nervosa</i> var. <i>wheeleri</i>	Wheeler 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 bleugrass	POA
<i>Poa secunda</i> var. <i>incurva</i>	Curly bluegrass	POA
<i>Stipa nelsonii</i> var. <i>dorei</i>	Nelson's needlegrass	POA
<i>Stipa occidentalis</i>	Western needlegrass	POA
<i>Trisetum spicatum</i>	Spike trisetum	POA

Ferns and Fern Allies

<i>Botrychium simplex</i>	Little grapefern	OPH
<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>Selaginella densa</i>	Compact spike-moss	SEL

FAUNA

Threatened, Endangered, and Sensitive Vertebrates

The Grizzly bear (*Ursos arctos*), a species listed as Threatened by the USDI Fish and Wildlife Service, is known to occupy the potential Sheep Mesa RNA at times, and is especially likely to be found during the summer and fall feeding in the

alpine zone at the southern end of the area (Larry Roop, Wyoming Game and Fish Department, personal communication, August 1997).

Animal Species List

The field work in the potential Sheep Mesa RNA did not include identification of the animal species present.

LANDS

The potential Sheep Mesa RNA is National Forest System land and is surrounded by National Forest System land of the Wapiti Ranger District of the Shoshone National Forest. Approximately half of the area lies within the Washakie Wilderness Area.

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

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

The potential RNA contains the major ecosystem types (as indicated by Kuchler vegetation types) ascribed to the Yellowstone Highlands section (McNab and Avers 1994): a mosaic of montane Douglas-fir woodlands, grasslands, shrublands, and barren slopes at low elevations; subalpine lodgepole pine, Engelmann spruce, and whitebark pine forests at the intermediate elevations; and alpine turf at the highest elevations.

The information in Appendix 3 indicates that the Douglas-fir forests exhibit a range in species composition and vegetation structure of the understory. Generally, these forests appear to represent, in dominant species and in their relationships to non-forest vegetation types, the vegetation of the Douglas-fir habitat types in northwestern Wyoming and southern Montana (Steele et al. 1983, pp. 21-22). The aerial photographs of the potential RNA show a wide range in density of trees in the Douglas-fir forests. Composition and vegetation cover of the grasslands also vary widely, from very sparse stands of needlegrass and forbs to dense Idaho fescue grassland.

At higher elevations, the Douglas-fir forests merge with subalpine forests composed primarily of lodgepole pine, which exhibit variation in species composition and structure of the overstory and species composition of the understory (Appendix 3).

These forests in turn merge upward with the Engelmann spruce forests and whitebark pine forests, which are of more limited extent and may show less variation. At timberline, these high-elevation subalpine forests form a mosaic with alpine vegetation.

The alpine zone in the potential RNA is vegetated primarily with *Geum* turf on the gently-rolling, windswept plateaus, but mesic and wet communities also are present in depressions.

A significant feature of the potential RNA, then, is a sequence of ecosystems along an elevation gradient from valley bottom to alpine tundra. This sequence of ecosystem types appears to represent the array of ecosystem types along an elevation gradient typical of the region, and the individual vegetation types exhibit a range in species composition and vegetation structure.

CONDITION

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

Exotic plant species are so rare that they can be said to have caused little change from the pre-settlement conditions in the potential RNA. Similarly, direct human alterations, such as the construction of trails, has been so limited that it apparently has had little effect on the area.

Suppression of fires may have caused some alteration in the ecosystems of the area, especially in the low-elevation mosaic of Douglas-fir forest and grasslands and in the mid-elevation lodgepole pine forests. The pre-settlement fire regime in most of the Yellowstone Highlands section was one of low-intensity, low-severity, patchy fires and infrequent high-intensity, severe, continuous fires, but fire suppression in the section has decreased the frequency of the mild fires and increased the frequency of the severe fires (McNab and Avery 1994). On the *Pseudotsuga menziesii*/*Spiraea betulifolia* habitat type and the *P. menziesii*/*Symphoricarpos albus* habitat type (*S. albus* phase) in central Montana, fire suppression has led to an increase in tree density and fuel loads, with a resulting increase in flammability (Fischer and Clayton 1983). Much of the subalpine forest in the potential RNA seems to belong to Fischer's and Clayton's (1983) fire group seven, in which the pre-settlement fire return interval ranged from ca. 100 years to ca. 500 years.

In the subalpine forests of eastern Yellowstone National Park, within ca. 30 miles (48 km) west of the potential RNA, Barrett has estimated fire return intervals of 150 to 250 years (Barrett and Arno 1995). These estimates suggest that fire suppression may have had less effect on the subalpine forest than in the lower-elevation Douglas-fir forests in the potential RNA. Given the small size of fires in the highest elevation whitebark pine stands (Fischer and Clayton 1984), fire suppression probably has had little effect there.

VIABILITY

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

As is true throughout the Rocky Mountains (Peet 1988), fire has no doubt been a major factor in shaping the vegetation of the potential RNA. A stand-replacing fire burned in the eastern part of the potential RNA in the 1930s, but insufficient information was gathered during the field survey to reveal the fire history of the rest of the area. The role of fire may be inferred, though, by reference to studies in similar vegetation types in Montana (Fischer and Clayton 1983). In the montane zone, the fire interval may have been 5 to 20 years in the dry, upland forests (fire group 4) and twice that in the moist forests (fire group 6). Fire in this zone probably maintained relatively open Douglas-fir stands and maintained areas of grassland and shrubland in the vegetation mosaic. In the subalpine forests (fire group seven), stand-replacing fires probably maintained lodgepole pine as a co-dominant or dominant overstory species.

If this interpretation is correct, then maintenance over the long term of the montane vegetation mosaic and the subalpine lodgepole pine forests will require fire. The potential RNA may be small enough that, for the purpose of fire management, it may need to be treated as part of a larger management unit.

DEFENSIBILITY

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 threats to the ecosystems in the potential RNA were obvious during the 1997 field work. The lack of easy access to much of the area, and the prohibition on motor vehicles, will greatly reduce the number of visitors. A potential exists for the spread of exotic plants into the area by horses using the trails (especially up Blackwater Creek).

DEGREE TO WHICH THE POTENTIAL RNA MEETS CRITERIA

The potential Sheep Mesa RNA contains high-quality examples of the montane, subalpine, and alpine ecosystems representative of the region. The condition of the ecosystems in the potential RNA probably has been altered somewhat from pre-settlement conditions by fire suppression, particularly in the montane zone.

The viability of the ecosystems in the potential RNA can probably be assured if a prescribed fire program can be implemented. Given the inaccessibility of the area and the prohibition on use of motor vehicles, the area probably can be protected easily from undesirable human impacts.

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 evidence was observed during field survey to suggest that mineral resources would conflict with RNA designation.

GRAZING

No evidence of livestock grazing was observed during field survey.

TIMBER

Approximately half of the potential Sheep Mesa RNA is within the Washakie Wilderness Area, where timber harvest is prohibited. Slopes throughout the remainder of the potential RNA are steep enough that the area may be unsuitable for timber harvest. During the 1997 field survey, several trees in a Douglas-fir stand at the northern end of the potential RNA T52N, R107W, Sec 29, NE1/4 NW1/4) were observed with orange flagging and orange and blue paint on them. It was unclear whether the flagging and paint were related to timber management.

WATERSHED VALUES

The potential RNA includes the entire drainage basins of Mesa Creek and Sheep Creek, most of the drainage basin of the West Fork of Blackwater Creek, and the upper portion of the drainage basin of Blackwater Creek. All of these are perennial streams flowing north from the alpine zone on Sheep Mesa to the North Fork of the Shoshone River. No evidence was observed during field survey to suggest that RNA designation would conflict with watershed values.

RECREATION VALUES

The field survey of the area suggests that it receives little recreational use, although two numbered national forest trails are located in the potential RNA, one up Sheep Creek and the other up the West Fork of Blackwater Creek. Fishing in Sheep Creek and West Fork of Blackwater Creek during summer and fall, and hunting in the fall, probably are the main uses of the area. The portion of the potential RNA outside of the Washakie Wilderness is open to snowmobile use, but the topography of the area probably makes it unattractive to snowmobiles. Hence RNA designation apparently would have little effect on recreational use of the area.

WILDLIFE AND PLANT VALUES

No evidence was observed during field survey to suggest that RNA designation would conflict with management of the area for wildlife and plant values. The potential RNA contains nine species of vascular plants of limited distribution in the region that grow predominantly (though not exclusively) on volcanic

rocks of the Absaroka Mountains, and RNA designation can be said to benefit the populations of these species growing outside of the Washakie Wilderness Area. Grizzly bears feed in the alpine zone on Sheep Mesa, especially around the snowfields north of Fortress Mountain at the south end of the potential RNA. Use of the rest of the alpine zone and the forests of the potential RNA is sporadic (Larry Roop, Wyoming Game and Fish Department, personal communication, August 1997).

TRANSPORTATION VALUES

The potential RNA contains two maintained Forest Service trails, #789 up Sheep Creek and most of #785 (the Natural Bridge Trail) up the West Fork of Blackwater Creek. Observations made during the 1997 field survey suggest that maintenance of these trails consists only of cutting overhanging branches, clearing fallen logs, and installing water diversion bars on slopes.

All but the northernmost ca. 1 mile (1.6 km) of trail #789 is within the Washakie Wilderness Area and hence is closed to all motor vehicle use. The northernmost mile of the trail is within an area of the Shoshone National Forest in which motorized vehicles can be used only on trails shown on the Shoshone National Forest map. Trail #789 is not shown on the map, so motorized vehicles apparently cannot be used on any of that trail. Trail #785 is outside the Wilderness Area but is closed to motorized vehicles. Hence, RNA designation apparently would not conflict with use of the trails in the area.

MANAGEMENT CONCERNS

The only evidence observed during the 1997 field survey to suggest possible conflicts between RNA designation and current management of the area were the orange flagging and the orange and blue paint on several trees at the northern boundary of the area (T57N, R107W, Sec 29, NE1/4 NW1/4). The purpose of this marking, and the management concerns it might raise, are unclear from the field survey.

REFERENCES

Anderson, M., P. Bourgeron, M.T. Bryer, R. Crawford, L. Engelking, D. Faber-Langendoen, M. Gallyoun, K. Goodin, D.H. Grossman, S. Landaal, K. Metzler, K.D. Patterson, M. Pyne, M. Reid, L. Sneddon, and A.S. Weakley. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume II: the national vegetation classification system: list of types. The Nature Conservancy, Arlington VA, USA.

Bailey, R. G. et al. 1994. Ecoregions and subregions of the United States. 1:7,500,000-scale map. USDA Forest Service.

Barrett, Stephen W. and Stephen F. Arno. 1995. Three contrasting fire regimes in Yellowstone National Park. Pp. 157-158 in: Brown, James K., Robert W. Mutch, Charles W. Spoon, and Ronald H. Wakimoto (technical editors). 1995. Proceedings: symposium on fire in wilderness and park management, March 30-April 1 1993. USDA Forest Service General Technical Report INT-GTR-320. Intermountain Research Station, Ogden UT. 283 pp.

Dorn, R. D. 1992. Vascular Plants of Wyoming, second edition. Mountain West Publishing, Cheyenne, WY. 340 pp.

Estill, E. 1993. Interim directive 2600-93-1. USDA Forest Service Region 2, Denver, CO. (Interim directive establishing Sensitive species in Region 2).

Evert, E. F. 1991. Annotated checklist of the vascular plants of the North Fork Shoshone River drainage, northwest Wyoming. Unpublished report. 64 pp.

Federal Geographic Data Committee. 1997. National vegetation classification standard. FGDC-STD-005. Vegetation subcommittee, June 1997.

Fertig, W. 1997. Plant species of special concern on Shoshone National Forest: 1996 survey results. Report prepared for Shoshone National Forest by the Wyoming Natural Diversity Database, Laramie, WY. 283 pp.

Fertig, W. 1998. The status of rare plants on Shoshone National Forest: 1995-97 survey results. Report prepared by the Wyoming Natural Diversity Database, Laramie, WY.

Fertig, W. and G. Beauvais. 1999. Wyoming Plant and Animal Species of Special Concern. Wyoming Natural Diversity Database, Laramie, WY.

Fertig, W. and M. Bynum. 1994. Biological report on the proposed Twin Lakes Research Natural Area. Report prepared for Shoshone National Forest by the Wyoming Natural Diversity Database, Laramie, WY. 33 pp. + app.

Hitchcock, C. L. and A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle, WA. 730 pp.

Fischer, William C. and Bruce D. Clayton. 1983. Fire ecology of Montana forest habitat types east of the Continental Divide. USDA Forest Service General Technical Report INT-141. Intermountain Forest and Range Experiment Station, Ogden UT. 83 pp.

Freeouf, Jerry A. (editor). 1996. Ecoregions and subregions of Region 2 - subsections, State of Wyoming. 1:1,000,000-scale map prepared by USDA Forest Service, Natural Resource Information Team. Revised May 1996.

Johnston, B.C. 1987. Plant Associations of Region Two. Edition 4. USDA Forest Service Rocky Mountain Region. R2-ECOL-87-2. Lakewood CO. 429 pp.

Kiger, R. W. and D. F. Murray. 1997. *Papaver*. In: Flora of North America Editorial Committee. Flora of North America North of Mexico, Volume 3: Magnoliophyta: magnoliidae and Hamamelidae. Oxford Univ. Press, New York. 590 pp.

Kirkpatrick, R. S. 1987. A flora of the southeastern Absarokas, Wyoming. Unpublished Master's Thesis, University of Wyoming, Laramie, WY.

Kuchler, A. W. 1966. Potential natural vegetation. Pp. 90-91 in: Gerlach, A. D. (ed.). 1970. The national atlas of the United States of America. USDI Geological Survey, Washington, DC.

Love, J. D. and A. C. Christiansen. 1985. Geologic Map of Wyoming. USDI Geological Survey, Reston, VA. 1:500,000 scale.

McNab, W. Henry and Peter E. Avers (compilers). 1994. Ecological subregions of the United States: section descriptions. USDA Forest Service administrative publication WO-WSA-5. 267 pp.

Mills, S. and W. Fertig. 1996. Field guide to rare and sensitive plants of the Shoshone National Forest. Unpublished report prepared by the Wyoming Natural Diversity Database, Laramie, WY. No pagination.

Peet, Robert K. 1988. Forests of the Rocky Mountains. Chapter 3 in: Barbour, Michael G. and William Dwight Billings (editors). 1988. North American terrestrial vegetation. Cambridge University Press. 434 pp.

Porsild, A. E. and W. J. Cody. 1980. Vascular Plants of Continental Northwest Territories, Canada. National Museums of Canada, Ottawa. 667 pp.

Scott, R. W. 1997. The Alpine Flora of the Rocky Mountains. Volume 1: The Middle Rockies. University of Utah Press, Salt Lake City. 901 pp.

Snow, N. 1992-1994. The vascular flora of southeastern Yellowstone National Park and the headwaters region of the Yellowstone River, Wyoming. *The Wasmann Journal of Biology* 50(1-2): 52-95.

Steele, Robert, Stephen V. Cooper, David M. Ondov, David W. Roberts, and Robert D. Pfister. 1983. Forest habitat types of eastern Idaho - western Wyoming. USDA Forest Service General Technical Report INT-144. Intermountain Forest and Range Experiment Station, Ogden UT. 122 pp.

Tweit, Susan J. and Kent E. Houston. 1980. Grassland and shrubland habitat types of the Shoshone National Forest. USDA Forest Service, Shoshone National Forest, Cody WY. 143 pp.

USDA Forest Service Region 2. 1993. Research Natural Area Guide for the Rocky Mountain Region, USDA Forest Service, review draft. Rocky Mountain Region, Lakewood, CO. 38 pp.

Weber, W. A. 1982. Mnemonic three-letter acronyms for the families of vascular plants: a device for more effective herbarium curation. *Taxon* 31 (1): 74-88.

APPENDIXES

APPENDIX 1. MAPS OF THE POTENTIAL SHEEP MESA RESEARCH NATURAL
AREA.

Figure 1. Contour map showing Kuchler (1966) vegetation types and SAF cover type (Eyre 1980) in the potential Sheep Mesa RNA.

<u>Kuchler/SAF Types</u>	<u>Map Symbol</u>
Douglas fir forest (=SAF Interior Douglas fir) (M) with Wheatgrass-needlegrass shrub-steppe (m), Fescue-wheatgrass (m), and sparsely-vegetated slopes	11
Western spruce-fir forest (= SAF Engelmann spruce-subalpine fir) (M) with cliffs and sparsely-vegetated slopes (M)	14
Alpine meadows and barren	45

Figure 2. Contour map showing complexes of plant community types in the potential Sheep Mesa RNA. Synonyms for community names are listed in Appendix 5.

<u>Communities</u>	Map	<u>Symbol</u>
Ross's avens-Clover spp. (M) & Mesic alpine (m)	1	
Whitebark pine/gooseberry currant	2	
Engelmann spruce/gooseberry currant	3	
Lodgepole pine/heartleaf arnica (M) & Lodgepole pine/grouse whortleberry (M) & Engelmann spruce/field horsetail (m)	4	
Douglas-fir/shinyleaf spiraea (M) & Idaho fescue-King spikefescue (M) & Mountain big sagebrush/Idaho fescue (M) & Sparsely-vegetated cliffs & slopes (M)		Unburned 5a Burned 5b
Douglas-fir/common snowberry (M) & Thinleaf alder/field horsetail (m)	6	
Douglas-fir/Rocky Mountain maple	7	
Locations of vegetation descriptions		
Locations of sample plots		

APPENDIX 2. PHOTOGRAPHS FROM THE POTENTIAL SHEEP MESA RNA

Photo WF1

View south up West Fork of Blackwater Creek, showing landscape typical of the potential RNA below the alpine zone. W. Fertig photo, June 28, 1997.

Photo WF2

Valley of Sheep Creek, northern part of the potential RNA. Vegetation is a mosaic of Douglas-fir woodland with openings of Idaho fescue grassland, Nelson's needlegrass grassland, and mountain big sagebrush shrubland. Walter F. photo, June 28, 1997.

Photo 97GJ4.23

Sheep Creek Valley, west-central part of area. Vegetation is mosaic of Engelmann spruce forest types with whitebark pine woodland at higher elevations, mixed with bare cliffs and talus slopes. G. Jones photo, August 13, 1997.

Photo 97GJ4.14

Timberline mosaic of Engelmann spruce forest with forb-rich herbaceous openings, head of Blackwater Creek in southeastern part of area. G. Jones photo, August 13, 1997.

Photo 97GJ4.16

West side of cirque at head of Blackwater Creek, southern end of area. Bright green vegetation is mesic alpine tundra; duller green is Ross's avens-clover tundra. G. Jones photo, August 13, 1997.

Photo 97GJ4.18

Summit of Sheep Mesa, southeastern part of area. Vegetation is Ross's avens-clover tundra. G. Jones photo, August 13, 1997.

APPENDIX 3. CANOPY COVER OF PLANTS IN PLOTS IN THE POTENTIAL SHEEP MESA 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.

Table 3-1. Canopy cover (and height, for trees) of plants in sample plots from the potential Sheep Mesa RNA. Single numbers in cells are canopy cover values; for trees, numerators are canopy cover values, and denominators are height in meters.

	1	2	3	4
	Pincon/ Vacsko	Pincon/ Arncor	Pinalb/	Psemen/
Species				
TREES				
<i>Abies lasiocarpa</i>	3/30			3/35
<i>Picea engelmannii</i>	3/40	3/40	3/30	3/40
<i>Pinus albicaulis</i>	3/35	10/40	50/30	
<i>Pinus contorta</i>	40/40	40/40		3/35
<i>Pseudotsuga menziesii</i>			3/30	50/40
SHRUBS				
<i>Abies lasiocarpa</i>	20	10	10	
<i>Juniperus scopulorum</i>				1
<i>Pinus albicaulis</i>	1			
DWARF SHRUBS				
<i>Juniperus communis</i>		1		1
<i>Ribes montigenum</i>			1	
<i>Rosa woodsii</i>				10
<i>Shepherdia canadensis</i>				1
<i>Spiraea betulifolia</i>				1
<i>Symphoricarpos albus</i>				10
GRAMINOIDS				
<i>Bromus anomalus</i>	1			1
<i>Carex rossii</i>	1	1		
<i>Elymus elymoides</i>			1	
<i>Poa interior</i>			1	
<i>Poa nervosa</i>		1		
FORBS				
<i>Antennaria racemosa</i>	3	1		
<i>Arnica cordifolia</i>	20	30	10	3
<i>Artemisia michauxiana</i>			1	
<i>Aster conspicuus</i>	1	1		80
<i>Aster foliaceus</i>	1	20	10	
<i>Astragalus miser</i>		3		
<i>Campanula rotundifolia</i>				1
<i>Disporum trachycarpum</i>				1
<i>Epilobium angustifolium</i>	3		1	

Erigeron sp.	1			
Fragaria virginiana		1	3	3
Hieracium albiflorum	1		1	
Linnaea borealis				1
Lupinus argenteus	3			
Mahonia repens		1		1
Orthilia secunda	1	1		
Osmorhiza depauperata	1	1	1	3
Pyrola chlorantha			1	
Valeriana dioica			3	
Vaccinium scoparium	70			
GROUND COVER				
Bare ground	1	1	1	1
Gravel				
Rock	1	1	1	
Litter	73	91	84	81
Wood	10	3	10	7
Moss	5	1	1	1
Basal vegetation	10	3	3	10

Association acronyms:

Piceng/Vascso = Pinus contorta/Vaccinium scoparium = Lodgepole pine/grouse whortleberry

Pincon/Arncor = Pinus contorta/Arnica cordifolia = Lodgepole pine/heartleaf arnica

Pinalb/Ribmon = Pinus albicaulis/Ribes montigenum = Whitebark pine/gooseberry currant

Psemen/?? = Pseudotsuga menziesii/?? = Douglas-fir/??

Notes

Plot 1: 25 m x 25 m, in woodland at foot of NE-facing slope.
Photos: 97GJ4.21 & 4.22.

Plot 2: 10 m x 10 m, in woodland on steep, E-facing slope.
Photo: none.

Plot 3: 10 m x 20 m, upper treeline on W-facing ridge. Photo:
97GJ4.25.

Plot 4: 10 m x 20 m, relatively open patch on E-facing slope.
Photo: none.

Table 3-2. Size-class structure of trees in sample plots.

Plot 1; 25 m x 25 m			DBH,	INCHES	
SPECIES	<Breast Height	<5"	<9"	<14"	<21"
<i>A. lasiocarpa</i> , live	115	50	2	1	
<i>A. lasiocarpa</i> , dead	5	10	1	2	
<i>Picea engelmannii</i> , live	2	7	2	1	
<i>Pinus albicaulis</i> , live		1	1	1	
<i>Pinus albicaulis</i> , dead		1			
<i>Pinus contorta</i> , live	24	5	5	8	3
<i>Pinus contorta</i> , dead		1	2	3	1

Plot 2; 10 m x 10 m			DBH,	INCHES	
SPECIES	<Breast Height	<5"	<9"	<14"	<21"
<i>A. lasiocarpa</i> , live	57	28			
<i>A. lasiocarpa</i> , dead		2			
<i>Picea engelmannii</i> , live					1
<i>Pinus albicaulis</i> , live		5	7		
<i>Pinus albicaulis</i> , dead		1			
<i>Pinus contorta</i> , live			4	4	
<i>Pinus contorta</i> , dead		3	2	3	

Plot 3; 10 m x 20 m				DBH,	INCHES	
SPECIES	<Breast Height	<5"	<9"	<14"	<21"	
<i>A. lasiocarpa</i> , live	5	3				
<i>Picea engelmannii</i> , live			1	1		
<i>Picea engelmannii</i> , dead		1				
<i>Pinus albicaulis</i> , live	1	8	17	7		
<i>Pinus albicaulis</i> , dead		13	2			
<i>Pseudotsuga menziesii</i> , live						1

Plot 4; 10 m x 20 m				DBH,	INCHES	
SPECIES	<Breast Height	<5"	<9"	<14"	<21"	<36"
<i>Picea engelmannii</i> , live	5	2				
<i>Pinus contorta</i> , live				1		
<i>Pinus contorta</i> , dead		1				
<i>Pseudotsuga menziesii</i> , live	40	10	8	8		1
<i>Pseudotsuga menziesii</i> , dead		12	2			

VEGETATION DESCRIPTIONS

LOCATION #1. West Fork Blackwater Creek, ca. 1 mile (1.6 km) upstream from confluence with main stem Blackwater Creek.
VEGETATION TYPE: Douglas fir/common snowberry
ELEVATION: 7800 feet (2379 meters). ASPECT: Southeast
TOPOGRAPHIC POSITION: Lower slope & foot of slope
DESCRIPTION: *Pseudotsuga menziesii* forms overstory above patchy shrub layer and dense herbaceous layer.
Trees: *Pseudotsuga menziesii*, mostly 6" - 12" (15 cm - 30 cm) dbh) with clumps of smaller trees.
Shrubs: *Shepherdia canadensis* patches common.
Dwarf Shrubs: *Spiraea betulifolia*, *Symphoricarpos spp.* (*albus* & *oreophilus*)
Graminoids & Forbs: *Elymus trachycaulus*, *Poa pratensis*
NOTES: Merges with lodgepole pine forest at ca. 8600 feet (2623 m) elevation.

LOCATION 2a. Cirque at head of West Fork Blackwater Creek
VEGETATION TYPE: Mesic alpine
ELEVATION: 10,000-11,000 feet (3050-3355 meters).
ASPECT: Various
TOPOGRAPHIC POSITION: Gentle slopes and swales
DESCRIPTION: Low, dense alpine vegetation of graminoids and forbs.
Trees:
Shrubs:
Dwarf Shrubs:
Graminoids & Forbs: *Poa arctica* (15%), *Carex scopulorum* (10%), *Potentilla sp.* (gray) (20%)
NOTES: This is the matrix vegetation in the bottom of the cirque and perhaps on the walls of the cirque, where it is mixed with *Geum rossii*-*Trifolium nanum* vegetation.

LOCATION 2b. Sheep Mesa and slopes of cirque at head of West Fork Blackwater Creek.
VEGETATION TYPE: *Geum rossii*-*Trifolium spp.* association
ELEVATION: 10,000-11,000 feet (3050-3355 meters).
ASPECT: Various
TOPOGRAPHIC POSITION: Slopes and flats
DESCRIPTION: Low, moderately-dense to dense, alpine vegetation of forbs with some grasses and sedges. *Geum rossii* is dominant throughout and *Trifolium nanum* is present throughout, but the sub-dominant species varies: *T. nanum* is the sub-dominant species on gently-sloping, windward sites; but *T. nanum* shares sub-dominance with *Minuartia obtusiloba* and *Carex paysonii* on steeper slopes and on protected sites.
Trees: none
Shrubs: none

Dwarf Shrubs: none

Graminoids & Forbs: *Geum rossii*, *Trifolium nanum*, *Minuartia obtusiloba*, *Carex paysonii*, *Carex nardina* or *C. elynoides*

NOTES: This type is the matrix on Sheep Mesa, and grows mixed with the Payson's sedge type on the walls of the cirque below.

LOCATION 3. Ridge between Sheep Creek and West Fork of Blackwater Creek

VEGETATION TYPE: Nelson's needlegrass

ELEVATION: 8800 feet (2684 meters). ASPECT: East

TOPOGRAPHIC POSITION: Upper slope

DESCRIPTION: Sparse vegetation on shallow soils with rock outcrops. *Stipa* spp. are the most common species; forbs are present in patches.

Trees:

Shrubs:

Dwarf Shrubs:

Graminoids & Forbs: *Stipa nelsonii*, *S. lettermanii*, *Aster ascendens*, *Aster glaucodes*

NOTES: This type occurs as small to large patches between stands of lodgepole pine woodland and Douglas-fir woodland.

LOCATION 4. West Fork Blackwater Creek ca. 2 miles (3.2 km) upstream from confluence with main branch Blackwater Creek

VEGETATION TYPE: Engelmann spruce/mountain bluebells

ELEVATION: 8200-8400 feet (2500-2562 meters). ASPECT: north-northeast

TOPOGRAPHIC POSITION: Riparian zone in valley bottom

DESCRIPTION: Engelmann spruce forms a scattered canopy above a herbaceous layer, with few alder shrubs present.

Trees: *Picea engelmannii*

Shrubs: *Alnus incana* (scattered)

Dwarf Shrubs:

Graminoids & Forbs: *Equisetum arvense*, *Mertensia ciliata*

NOTES: This type forms a narrow fringe along the stream, in a matrix of lodgepole pine forest or (at higher elevations) Engelmann spruce-subalpine fir forest. Observations from the ridge east of Sheep Creek suggest that it is also the riparian vegetation there.

LOCATION 5. West Fork Blackwater Creek ca. 2 miles (3.2 km) upstream from confluence with main branch Blackwater Creek

VEGETATION TYPE: Thinleaf alder/field horsetail

ELEVATION: 8000-8200 feet (2440-2500 meters). ASPECT: North-northeast

TOPOGRAPHIC POSITION: Riparian zone in valley bottom

DESCRIPTION: Scattered Engelmann spruce and subalpine fir grow above an open shrub layer of alder and a few shorter red-

osier dogwood. The herbaceous layer consists of field horsetail with other forbs.

Trees:

Shrubs: *Alnus incana*, *Cornus stolonifera* (latter uncommon)

Dwarf Shrubs:

Graminoids & Forbs: *Equisetum arvense*

NOTES: This type forms long, narrow patches along the West Fork of Blackwater Creek and the main stem of Blackwater Creek, in a matrix of Douglas-fir woodland. It merges at higher elevations with the riparian Engelmann spruce/mountain bluebells woodland.

LOCATION 6. Timberline at head of West Fork Blackwater Creek

VEGETATION TYPE: Engelmann spruce/gooseberry currant

ELEVATION: 9600-9800 feet (2928-2990 meters). ASPECT: East

TOPOGRAPHIC POSITION: East-facing slope on valley wall.

DESCRIPTION: This type consists of patches of woodland interspersed with meadow vegetation. Engelmann spruce dominates the overstory in most of the woodland stands, and subalpine fir and whitebark pine are sub-dominant species. Some woodland stands are pure whitebark pine. Gooseberry currant forms a patchy shrub layer, and heartleaf arnica and grouse whortleberry form a patchy herbaceous layer in the woodland.

Trees: *Picea engelmannii* (9"-14" dbh)

Shrubs: *Ribes montigenum*, *Abies lasiocarpa* saplings

Dwarf Shrubs: *Vaccinium scoparium*

Graminoids & Forbs: *Arnica cordifolia*

NOTES:

Location 7. North-facing slopes south of the Shoshone River, across the River from the mouth of Newton Creek.

Vegetation Type: Douglas-fir/Rocky Mountain maple

Elevation: 6,400 feet (1,951 meters). Aspect: North-northeast

Topographic position: Steep slopes

General description: Dense, species rich forest with an overstory of Douglas-fir, a tall shrub layer of Rocky Mountain maple and Rocky Mountain juniper, and a herbaceous understory of forbs and some grasses.

TREES: *Pseudotsuga menziesii*

SHRUBS: *Acer glabrum*, *Juniperus scopulorum*

DWARF SHRUBS:

GRAMINOIDS & FORBS: *Astragalus miser*, *Aster conspicuus*, *Aster siberica*, *Arnica cordifolia*, *Poa nervosa*

NOTES: This type apparently merges with stands of the Douglas-fir/shinyleaf spiraea type.

Location 8. North-facing slopes south of the Shoshone River, across the River from The Palisades.

Vegetation Type: Mountain big sagebrush/Idaho fescue

Elevation: 6500 feet (1981 meters). Aspect: Northeast
Topographic position: Slopes
General description: Sagebrush shrubland with species-rich
herbaceous layer.

TREES:

SHRUBS: *Artemisia tridentata* ssp. *vaseyana*

DWARF SHRUBS:

GRAMINOIDS & FORBS: *Festuca idahoensis*, *Koeleria macrantha*,
Elymus spicatus, *Poa secunda*; numerous forbs.

NOTES: Patches of this shrubland type occur in a mosaic with
Douglas-fir/shinyleaf spiraea woodlands and sparsely-
vegetated cliffs and slopes.

Location 9. South of the Shoshone River, on the divide between
Blackwater Creek and Sheep Creek.

Vegetation Type: Douglas-fir/shinyleaf spiraea

Elevation: 7400 feet (2255 meters). Aspect: North

Topographic position: Slopes

General description: Woodland with sparse understory.

TREES: *Pseudotsuga menziesii*

SHRUBS:

DWARF SHRUBS: *Spiraea betulifolia*

GRAMINOIDS & FORBS: *Antennaria racemosa*, *Astragalus miser*

NOTES: *Arnica cordifolia* and *Vaccinium scoparium* are lacking.

Location 10. South of the Shoshone River, on the divide between
Blackwater Creek and Sheep Creek.

Vegetation Type: Idaho fescue-King spikefescue

Elevation: 7400 feet (2255 meters). Aspect: West

Topographic position: Upper slope

General description: Relatively dense grassland, with scattered
shrubs.

TREES:

SHRUBS: *Chrysothamnus viscidiflorus*

DWARF SHRUBS:

GRAMINOIDS & FORBS: *Festuca idahoensis*, *Leucopoa kingii*,
Astragalus agrestis, *Arenaria congesta*, *Artemisia frigida*

APPENDIX 4. 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 5. PLANT COMMUNITY TYPES IN THE POTENTIAL SHEEP MESA RESEARCH NATURAL AREA

The communities are listed by common name. Citations following the common names refer to these sources:

- Johnston (1987): equivalent plant association from the list for USDA Forest Service Region 2;
- Anderson et al. (1998): equivalent plant association from the National Vegetation Classification;
- Tweit and Houston (1980): equivalent grassland or shrubland habitat type (if any);
- Steele et al. (1983): equivalent forest habitat 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).

Whitebark pine/Mountain currant?

- Johnston (1987): Unknown
- Anderson et al. (1998): Whitebark pine/mountain currant?
- Tweit and Houston (1980): None
- Steele et al. (1983): *Abies lasiocarpa* habitat type, *Ribes montigenum* phase
- 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): Western spruce-fir forest
- Eyre (1980): Whitebark pine

Engelmann spruce/field horsetail

- Johnston (1987): *Picea engelmannii*/*Equisetum arvense* plant association?
- Anderson et al. (1998): *Picea engelmannii*/*Equisetum arvense* forest
- Tweit and Houston (1980): None
- Steele et al. (1983): *Picea engelmannii*/*Equisetum arvense* habitat type
- Federal Geographic Data Committee (1997): I.A.8.N.f.; seasonally-flooded, natural/semi-natural, temperate or subpolar, needle-leaved, evergreen, closed canopy forest
- Kuchler (1966): Western spruce-fir forest (*Picea-Abies*)
- Eyre (1980): Engelmann Spruce-Subalpine Fir

Engelmann spruce/gooseberry currant

- Johnston (1987): *Abies lasiocarpa*-*Picea engelmannii*/*Ribes* spp. plant association
- Anderson et al. (1998): *Picea engelmannii*/*Ribes montigenum* forest
- Tweit and Houston (1980): None
- Steele et al. (1983): *Picea engelmannii*/*Ribes montigenum* habitat type
- Federal Geographic Data Committee (1997): I.A.8.N.c.; conical-crowned, natural/semi-natural, temperate or subpolar, needle-leaved, evergreen, closed canopy forest
- Kuchler (1966): Western spruce-fir forest (*Picea*-*Abies*)
- Eyre (1980): Engelmann Spruce-Subalpine Fir

Douglas-fir/Rocky Mountain maple

- Johnston (1987): *Pseudotsuga menziesii*/*Acer glabrum* plant association
- Anderson et al. (1998): *Pseudotsuga menziesii*/*Acer glabrum* forest
- Tweit and Houston (1980): none
- Steele et al. (1983): *Pseudotsuga menziesii*/*Acer glabrum* habitat type?
- Federal Geographic Data Committee (1997): I.A.8.N.d.; rounded-crowned, natural/semi-natural, temperate or subpolar, needle-leaved, evergreen, closed-canopy forest
- Kuchler (1966): Douglas fir forest (*Pseudotsuga*)
- Eyre (1980): Interior Douglas-fir

Douglas-fir/common snowberry

- Johnston (1987): *Pseudotsuga menziesii*/*Symphoricarpos albus* plant association
- Anderson et al. (1998): *Pseudotsuga menziesii*/*Symphoricarpos albus* forest
- Tweit and Houston (1980): none
- Steele et al. (1983): *Pseudotsuga menziesii*/*Symphoricarpos albus* habitat type
- Federal Geographic Data Committee (1997): I.A.8.N.d.; rounded-crowned, natural/semi-natural, temperate or subpolar, needle-leaved, evergreen, closed-canopy forest
- Kuchler (1966): Douglas fir forest (*Pseudotsuga*)
- Eyre (1980): Interior Douglas-fir

Douglas-fir/shinyleaf spiraea

- Johnston (1987): *Pseudotsuga menziesii*/*Spiraea betulifolia* plant association
- Anderson et al. (1998): *Pseudotsuga menziesii*/*Spiraea betulifolia* forest
- Tweit and Houston (1980): none
- Steele et al. (1983): *Pseudotsuga menziesii*/*Spiraea betulifolia* habitat type

- Federal Geographic Data Committee (1997): I.A.8.N.b.; rounded-crowned, natural/semi-natural, temperate or subpolar, needle-leaved, evergreen, closed-canopy forest
- Kuchler (1966): Douglas fir forest (*Pseudotsuga*)
- Eyre (1980): Interior Douglas-fir

Thinleaf alder/field horsetail

- Johnston (1987): Unknown
- Anderson et al. (1998): *Alnus incana*/*Equisetum arvense* shrubland
- Tweit and Houston (1980): None
- Steele et al. (1983): None
- Federal Geographic Data Committee (1997): III.B.2.N.d.; temporarily-flooded, natural/semi-natural, cold-deciduous shrubland
- Kuchler (1966): None
- Eyre (1980): None

Mountain big sagebrush/Idaho fescue

- Johnston (1987): *Artemisia tridentata*/*Festuca idahoensis* plant association
- Anderson et al. (1998): *Artemisia tridentata* ssp. *vaseyana*/*Festuca idahoensis* shrub herbaceous vegetation
- Tweit and Houston (1980): *Artemisia tridentata* ssp. *vaseyana*/*Festuca idahoensis* habitat type
- Steele et al. (1983): 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): Wheatgrass-needlegrass shrubsteppe (*Agropyron*-*Stipa*-*Artemisia*)
- Eyre (1980): none

Idaho fescue-King spikefescue

- Johnston (1987): *Festuca idahoensis*/*Leucopoa kingii* plant association?
- Anderson et al. (1998): *Festuca idahoensis*-*Festuca kingii* herbaceous vegetation
- Tweit and Houston (1980): Unknown
- Steele et al. (1983): None
- Federal Geographic Data Committee (1997): V.A.5.N.h.; dry, short alpine or subalpine bunch, natural/semi-natural, temperate or subpolar, perennial graminoid vegetation
- Kuchler (1966): Fescue-wheatgrass (*Festuca*-*Agropyron*)
- Eyre (1980): None

Nelson's Needlegrass

- Johnston (1987): Unknown
- Anderson et al. (1998): Unknown
- Tweit and Houston (1980): Unknown

- Steele et al. (1983): None
- Federal Geographic Data Committee (1997): VII.C.3.N.B.; dry, natural/semi-natural, sparsely-vegetated soil slopes.
- Kuchler (1966): Wheatgrass-needlegrass shrubsteppe (Agropyron-Stipa-Artemisia)
- Eyre (1980): None

Mesic alpine

- Johnston (1987): Unknown
- Anderson et al. (1998): Unknown
- Tweit and Houston (1980): Unknown
- Steele et al. (1983): None
- Federal Geographic Data Committee (1997): V.A.5.N.g.; short, alpine or subalpine, natural/semi-natural, temperate or subpolar, perennial graminoid vegetation
- Kuchler (1966): Alpine meadows and barren (Agrostis,Carex, Festuca,Poa)
- Eyre (1980): None

Ross' avens-Clover

- Johnston (1987): Acromastylis rossii/Trifolium nanum plant association
- Anderson et al. (1998): Geum rossii-Trifolium spp. herbaceous vegetation
- Tweit and Houston (1980): Geum rossii turf community type
- Steele et al. (1983): None
- Federal Geographic Data Committee (1997): V.B.2.N.b.; low, natural/semi-natural, temperate or subpolar, perennial forb vegetation
- Kuchler (1966): Alpine meadows and barren (Agrostis,Carex, Festuca,Poa)
- Eyre (1980): None

APPENDIX 6. ELEMENT OCCURRENCE RECORDS FOR PLANT SPECIES OF
SPECIAL CONCERN IN THE POTENTIAL SHEEP MESA RNA.