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ECOLOGICAL EVALUATION OF
THE POTENTIAL ROCHELLE HILLS RESEARCH NATURAL AREA
WITHIN THE THUNDER BASIN NATIONAL GRASSLAND,
WESTON COUNTY, WYOMING

Prepared for
Nebraska National Forest,
USDA Forest Service

By

George P. Jones

Wyoming Natural Diversity Database
The Nature Conservancy
1604 Grand Avenue
Laramie, Wyoming 82070

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TABLE OF CONTENTS

INTRODUCTION	1
Land Management Planning	1
OBJECTIVES	1
PRINCIPAL DISTINGUISHING FEATURES	2
LOCATION	2
Boundary	2
Area	3
Elevation	3
Access	3
Ecoregion	3
Maps	3
AREA BY COVER TYPES	4
The Vegetation	4
Area by Type	5
PHYSICAL AND CLIMATIC CONDITIONS	6
Physical Setting	6
DESCRIPTION OF VALUES	6
Vegetation Types	6
Flora	7
Threatened, Endangered, and Sensitive Plant Species	7
Plant Species List	7
Fauna	10
Threatened, Endangered, and Sensitive Vertebrates	10
Geology	10
Lands	11
SUITABILITY FOR RESEARCH NATURAL AREA SELECTION	11
Quality	11
Condition	12
Viability	15
Defensibility	16
Degree to Which the Potential RNA Meets Criteria	16
IMPACTS AND POSSIBLE CONFLICTS	17
Mineral Resources	17
Grazing	17
Timber	17
Watershed Values	17
Recreation Values	17
Wildlife and Plant Values	18
Transportation Values	18
MANAGEMENT CONCERNS	18
REFERENCES	18

Appendix 1. Maps of the potential Rochelle Hills Research Natural Area.	21
Appendix 2. Canopy cover of plants in plots in the potential Rochelle Hills Research Natural Area.	25
Appendix 3. Explanations of ranks used by the Wyoming Natural Diversity Database.	34
Appendix 4. Plant community types in the potential Rochelle Hills Research Natural Area	36

ECOLOGICAL EVALUATION OF
THE POTENTIAL ROCHELLE HILLS RESEARCH NATURAL AREA
WITHIN THE THUNDER BASIN
CAMPBELL COUNTY, WYOMING

INTRODUCTION

The potential Rochelle Hills Research Natural Area (RNA) is located in the Cheyenne River Basin in northeastern Wyoming. The area contains mixed-grass grassland, riparian graminoid meadows, and ponderosa pine woodland. The potential RNA is in the Thunder Basin National Grassland and is currently used primarily for livestock grazing and recreational hunting.

In 1996, The Nature Conservancy entered a contract with the USDA Forest Service, Nebraska National Forest, to prepare ecological evaluations of areas in the Thunder Basin National Grassland and other national grasslands for use by the Forest Service in examining the suitability of the areas as research natural areas. The evaluation of the Rochelle Hills area was done by the Wyoming Natural Diversity Database. This report presents the results of that evaluation.

Land Management Planning

In 1996, an interdisciplinary team from the Thunder Basin National Grassland selected the Rochelle Hills 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 Rochelle Hills 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 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 feature of the potential Rochelle Hills RNA is the Rochelle Hills escarpment, supporting bunchgrass vegetation and scattered stands of ponderosa pine woodland. The center of the potential RNA, atop the escarpment, supports grassland, and the rolling hills and draws below the escarpment support grassland with scattered stands of four-wing saltbush and scattered stands of silver sagebrush. Byer et al. (1992, pp. 107-109) recognized the area containing the potential Rochelle Hills RNA as containing a noteworthy mix of substrates and vegetation types.

LOCATION

The potential Rochelle Hills RNA is located within the Thunder Basin National Grassland (Figure 1). The approximate center of the potential RNA is at latitude 43°33'50"N and longitude 105°03'40"W.

The potential RNA includes all or parts of the following sections: Township 41 North, Range 68 West (6th Principal Meridian), Sections 5, 6, 7, 8; Township 42 North, Range 68 West, Sections 30, 31, and 32.

Boundary (See Figure 2).

The proposed boundary of the potential RNA follows property lines and pasture boundaries. Starting at the point on the western section line of Section 30 (T42N, R68W) on the south side of the right-of-way of Weston County Road 17 (the Makey Road), the boundary extends northeast along the right-of-way and a pasture boundary ca. 0.2 mile (0.3 km) to a point in the SW1/4 NW1/4 of Sec 30; thence southeast and east ca. 0.9 mile (1.4 km) along a pasture boundary to the quarter-section point on the eastern section line of Sec 30; thence south 0.5 mile (0.8 km) along a pasture boundary to the southeastern corner of Sec 30; thence east 1 mile (1.6 km) along a pasture boundary to the northeastern corner of Sec 32 (T42N, R68W); thence south ca. 2 miles (3.2 km) along a pasture boundary to a point on the eastern section line of Sec 8 (T41N, R68W) ca. 250 feet (75 m) south of the northeastern corner of Sec 8; thence southwest ca. 0.8 mile (1.3 km) along a pasture boundary to a point in the NE1/4 SW1/4 Sec 8; thence south ca. 0.35 mile (0.6 km) along a pasture boundary to the quarter-section point on the southern boundary of Sec 8; thence northwest ca. 0.4 mile (0.6 km) along a pasture boundary to a point in the SW1/4 SW1/4 Sec 8; thence southwest ca. 0.1 mile (0.16 km) along a pasture boundary to a point in the SW1/4 SW1/4 Sec 8; thence northwest ca. 0.9 mile (1.4 km) to a point on a pasture boundary in the NE1/4 NW1/4 Sec 7 (T41N, R68W); thence north ca. 0.2 mile (0.3 km) along a pasture boundary to the quarter-section point on the southern section

line of Sec 6 (T41N, R68W); thence west 0.25 mile (0.4 km) along the boundary between National Grassland and private land to a point on the southern section line of Sec 6; thence north 0.25 mile (0.4 km) to a point in the SW 1/4 Sec 6; thence west 0.25 mile (0.4 km) along the boundary between National Grassland and private land to a point on the western section line of Sec 6; thence north ca. 2.5 miles (4 km) to the starting point.

Area

The total area of the potential Rochelle Hills RNA is 3679 acres (1489 ha).

Elevation

The elevation of the potential Rochelle Hills RNA ranges from ca. 4560 feet (1391 m) to ca. 5300 feet (1616 m) atop the Rochelle Hills escarpment.

Access

The potential Rochelle Hills RNA may be reached by public roads. From the intersection of Wyoming Highway 450 with Weston County Road 17, ca. 40 miles (64 km) west-southwest of Newcastle, Wyoming, travel south ca. 1 mile (1.6 km) to the intersection with Weston County Road 7A; thence west and south on Weston County Road 17 ca. 6.5 miles (10.4 km) to the intersection with a two-track road heading south. The eastern side of the potential RNA may be reached from that two-track road. To reach the northwestern corner of the potential RNA, continue on Weston County Road 17 west ca. 2 miles (3.2 km) from the intersection with the two-track road.

Ecoregion

The potential Rochelle Hills RNA lies within the Great Plains-Palouse Dry Steppe Province, Powder River Basin Section, Southern Powder River Basin-Scoria Hills Subsection (331Gf) of the ecoregion classification of Bailey et al. (1994) (Freeouf 1996).

Maps

USDA Forest Service 1/2 inch = 1 mile-scale map of the Thunder Basin National Grassland.

USDI Geological Survey 7.5 minute topographic Quadrangle Map: Piney Canyon SE, Wyo.

AREA BY COVER TYPES

The Vegetation

The potential Rochelle Hills RNA contains the following community types (plant associations from Johnston [1987] unless otherwise noted). Synonyms are shown in Appendix 4. Data from sample plots in the major types are shown in Appendix 2.

Upland vegetation

The rolling upland atop the escarpment supports grassland of the needle-and-thread/blue grama association with scattered ponderosa pine, especially near the escarpment. The slopes of the escarpment are primarily a mix of two grass types, the bluebunch wheatgrass/Sandberg bluegrass association and the little bluestem/sideoats grama association, with unvegetated bedrock and colluvium. Crested wheatgrass (Agropyron cristatum), an exotic species, has been sown in the area and dominates many stands of the bluebunch wheatgrass/Sandberg bluegrass type.

Woodlands of the ponderosa pine/bluebunch wheatgrass association grow on the escarpment, on slopes and in draws with a variety of aspects. Pines are sparse on south-facing and west-facing slopes, and thickest on north-facing slopes. The woodlands in steep, north-facing ravines include substantial amounts of Rocky Mountain juniper and belong to the ponderosa pine-Rocky Mountain juniper/bluebunch wheatgrass association. The pine stands merge into stands of the bluebunch wheatgrass/Sandberg bluegrass association and stands of the little bluestem/sideoats grama association.

Draws in the escarpment are vegetated primarily with the western wheatgrass/green needlegrass association. Intermediate wheatgrass (Elymus hispidus var. hispidus), an exotic species, has been sown in the area and dominates many of the draws and on the adjacent lower slopes. Sandy soils in draws at the foot of the escarpment support the prairie sandreed-western wheatgrass herbaceous vegetation (The Nature Conservancy 1997).

The rolling hills below the escarpment are vegetated with a mix of the blue grama/western wheatgrass association on finer soils and the needle-and-thread/blue grama association on coarser soils. Small patches of four-wing saltbush barrens (The Nature Conservancy 1997) occur on shale outcrops.

Riparian Vegetation

The potential RNA contains no perennial streams and the riparian vegetation consists only of the western wheatgrass/green needlegrass association throughout the area, with small areas of

basin silver sagebrush/western wheatgrass association in the draws among the rolling hills below the escarpment.

Area by Type

Complexes of communities were mapped on 1:24,000-scale topographic maps using aerial photos and field reconnaissance, and the area of each complex in the potential RNA was estimated from the maps. The vegetation maps show complexes because delineating stands of individual communities was impossible. The plant community types from Johnston (1987) listed in Table 2 are cross-referenced to plant community types from Thilenius et al. (1995) and The Nature Conservancy (1997) in Appendix 4. For each complex, the percentage of the land area covered by each plant association in the complex was estimated from the photos and from observations in the field, and was used to estimate the acreage of each plant association in the potential RNA. The relative importance of each plant association within each complex is indicated in the legend for Figure 3 (M = major association, m = minor association).

Table 1. Areas of Kuchler Types (Kuchler 1966) in the potential Rochelle Hills RNA. See Figure 2.

Cover Type	Acres	Hectares
Black Hills pine forest (16) (<u>Pinus</u>)	289	117
Grama-needlegrass-wheatgrass (57) (<u>Bouteloua-Stipa-Agrophyron</u>)	2939	1190
Wheatgrass-needlegrass (59) (<u>Agropyron-Stipa</u>)	451	182

Table 2. Areas of community types (plant associations from Johnston [1987] except where otherwise noted) in the potential Rochelle Hills RNA. See Figure 3. See synonyms in Appendix 4.

Community Types	Acres	Hectares
Ponderosa pine/Bluebunch wheatgrass	257	104
Ponderosa pine-Rocky Mountain juniper/Bluebunch wheatgrass	32	13
Little bluestem/Sideoats grama	586	237
Bluebunch wheatgrass/Sandberg bluegrass	554	224

Table 2 (continued). Areas of community types in the potential Rochelle Hills RNA. See Figure 3. See synonyms in Appendix 4.

Community Types	Acres	Hectares
Needle-and-thread/Blue grama	962	389
Blue grama/Western wheatgrass	758	307
Four-wing saltbush barrens (The Nature Conservancy 1997)	79	32
Prairie sandreed-Western wheatgrass (The Nature Conservancy 1997)	99	40
Western wheatgrass/Green needlegrass	273	110
Basin silver sagebrush/Western wheatgrass	79	32

PHYSICAL AND CLIMATIC CONDITIONS

Physical Setting

The potential Rochelle Hills RNA is centered on the Rochelle Hills, an east-facing escarpment in the Cheyenne River Basin. The steep escarpment ($>45^\circ$), ca. 500 feet (150 m) high, comprises bedrock outcrops, colluvial deposits, and slump blocks that occupy ca. half of the potential RNA. In the central part of the potential RNA, atop the escarpment, is a rolling upland with broad, shallow draws. Below the escarpment, along the northern, eastern, and southern edges of the area, are rolling hills and broad, shallow draws. Intermittent stream courses flow north, east, and south from the escarpment.

DESCRIPTION OF VALUES

Vegetation Types

See Table 1 for a list of the Kuchler (1964) vegetation types present in the area and the estimated acreage of each, and Table 2 for a list of the plant associations present and the estimated acreage of each.

Flora

Threatened, Endangered, and Sensitive Plant Species

No federally listed Threatened or Endangered plant species, or species on the USDA Forest Service Region 2 Sensitive Species List (Estill 1993), are known from the potential Rochelle Hills RNA. The following species endemic to the region is known near the potential RNA.

Astragalus barrii (Barr's milkvetch)

Heritage Rank: G3/S3. (Heritage ranks are explained in Appendix 3.)

Federal Status: None

Geographic Range: Southeastern Montana, northeastern Wyoming, southwestern South Dakota, and western Nebraska (Marriott 1992)

Habitat: Sparsely-vegetated slopes, often with outcrops of sandstone or siltstone (Marriott 1992)

Comments: This species is known from sites 5 miles (9 km) east of the potential RNA and 8 miles (13 km) west of the potential RNA. The Rochelle Hills appear to be suitable habitat and the species may occur in the potential RNA.

Plant Species List

The following species were identified during field work in the potential Rochelle Hills RNA.

Table 3. Vascular Plants of the potential Rochelle Hills RNA. Nomenclature for scientific names is based on Dorn (1992). Family acronyms are based on Weber (1982). Family taxonomy follows Dorn (1992).

<u>Scientific Name</u>	<u>Common Name</u>	<u>Family</u>
	TREES	
Juniperus scopulorum	Rocky Mountain juniper	PIN
Pinus ponderosa	Ponderosa pine	PIN
	SHRUBS & DWARF SHRUBS	
Artemisia cana var. cana	Basin silver sagebrush	AST
Artemisia tridentata var. wyomingensis	Wyoming big sagebrush	AST
Chrysothamnus nauseosus var. oreophilus	Rubber rabbitbrush	AST
Rhus trilobata	Skunkbush sumac	ANA
Ribes cereum	Wax currant	GRS

Table 3 (continued). Vascular Plants of the potential Rochelle Hills RNA.

<u>Scientific Name</u>	<u>Common Name</u>	<u>Family</u>
GRAMINOIDS		
Agropyron cristatum	Crested wheatgrass	POA
Andropogon scoparius	Little bluestem	POA
Aristida purpurea var. fendleriana	Purple three-awn	POA
Bouteloua gracilis	Blue grama	POA
Bromus japonicus	Japanese brome	POA
Bromus tectorum	Cheatgrass	POA
Calamovilfa longifolia	Prairie sandreed	POA
Carex filifolia	Threadleaf sedge	CYP
Carex pensylvanica	Sun sedge	CYP
Elymus hispidus var. hispidus	Intermediate wheatgrass	POA
Elymus smithii	Western wheatgrass	POA
Elymus spicatus	Bluebunch wheatgrass	POA
Festuca octoflora	Sixweeks fescue	POA
Koeleria macrantha	Prairie junegrass	POA
Muhlenbergia richardsonis	Mat muhly	POA
Oryzopsis hymenoides	Indian ricegrass	POA
Poa secunda	Sandberg bluegrass	POA
Stipa comata	Needle-and-thread	POA
Stipa viridula	Green needlegrass	POA
FORBS		
Achillea millefolium	Common yarrow	AST
Antennaria microphylla	Small-flowered pussytoes	AST
Arenaria hookeri	Hooker's sandwort	CRY
Artemisia frigida	Fringed sagewort	AST
Artemisia ludoviciana	Lousiana sagewort	AST
Aster falcatus	Creeping white aster	AST
Besseyia wyomingensis	Wyoming kittentails	SCR
Brickellia eupatorioides var. corymbulosa	False boneset	AST
Cerastium arvense	Field chickweed	CRY
Cirsium pulcherrimum ?	Pretty thistle	AST
Cirsium vulgare	Bull thistle	AST
Collomia linearis	Narrowleaf collomie	PLM
Cryptantha sp.	Cryptantha	BOR
Dalea sp.	Prairie-clover	FAB
Erigerion sp.	Fleabane	AST
Geum triflorum	Prairie smoke	ROS

Table 3 (continued). Vascular Plants of the potential Rochelle Hills RNA.

<u>Scientific Name</u>	<u>Common Name</u>	<u>Family</u>
<i>Grindelia squarrosa</i>	Curleycup gumweed	AST
<i>Gutierrezia sarothrae</i>	Broom snakeweed	AST
<i>Haplopappus nuttallii</i>	Gumweed aster	AST
<i>Haplopappus spinulosus</i>	Spiny goldenweed	AST
<i>Heterotheca villosa</i>	Hairy golden-aster	AST
<i>Hymenopappus</i> sp.	Cutleaf	AST
<i>Lactuca serriola</i>	Prickly lettuce	AST
<i>Lappula</i> sp.	Stickseed	BOR
<i>Leptodactylon pungens</i>	Sharp prickly-phlox	PLM
<i>Liatris punctata</i>	Dotted gayfeather	AST
<i>Lupinus pusillus</i>	Dwarf lupine	FAB
<i>Lygodesmia juncea</i>	Rush skeletonplant	AST
<i>Machaeranthera canescens</i>	Hoary aster	AST
<i>Melilotus officinalis</i>	Yellow sweetclover	FAB
<i>Mentzelia laevicaulis</i>	Beautiful blazingstar	LOA
<i>Opuntia polyacantha</i>	Plains pricklypear	CAC
<i>Pediomelum argophyllum</i>	Silver scurfpea	FAB
<i>Penstemon</i> sp.	Beardtongue	SCR
<i>Phlox hoodii</i>	Hood's phlox	PLM
<i>Potentilla</i> sp.	Cinquefoil	ROS
<i>Ratibida columnifera</i>	Prairie coneflower	AST
<i>Sisyrinchium</i> sp.	Blue-eyed grass	IRI
<i>Solidago</i> sp.	Goldenrod	AST
<i>Solidago missouriensis</i> var. <i>fasciculata</i>	Missouri goldenrod	AST
<i>Thermopsis</i> sp.	Golen pea	FAB
<i>Tragopogon dubius</i>	Yellow salsify	AST
<i>Yucca glauca</i>	Soapwell, yucca	LIL
	FERNS & ALLIES	
<i>Cystopteris fragilis</i>	Brittle bladder-fern	ASL
<i>Selaginella densa</i>	Compact spike-moss	SEL

Fauna

Threatened, Endangered, and Sensitive Vertebrates

The following Threatened species is known from the area.

Haliaeetus leucocephalus (Bald eagle)

Heritage Rank: G4/S2S3B, S3N

Federal Status: USFWS Listed Threatened, USDA Forest Service Region 2 Sensitive

Geographic Range: Winters throughout the continental United States; nests in the continental U.S., Canada, and southeastern Alaska.

Habitat: Roosts in trees near open water.

Comments: One winter roost site is known from the ponderosa pine woodland along the western side of the potential RNA, in the SW1/4 NW1/4 Section 6. A second winter roost site is known from the same woodland within 1/4 mile of the western boundary of the potential RNA, in the NW1/4 SE1/4 Section 1.

The following USDA Forest Service Region 2 Sensitive Species (Estill 1993) is known from the vicinity of the potential RNA.

Falco columbarius (Merlin)

Heritage Rank: G5/S2B, SZN

Federal Status: USDA Forest Service Region 2 Sensitive

Geographic Range: Widespread in western U.S. and in Canada

Habitat: Nests in woodlands and on forest edges, winters in prairies

Comments: Nests are known in ponderosa pine woodlands near the potential Rochelle Hills RNA, one (occurrence 31) in Sunny Draw ca. 6 mile (9.6 km) southwest and another (occurrence 34) ca. 9 miles (14 km) north. The ponderosa pine woodland in the potential RNA may provide suitable nesting habitat as well.

Animal Species List

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

Geology

The bedrock in the potential Rochelle Hills RNA consists of the sediments of the Paleocene-aged Fort Union Formation, Lebo Member (Love and Christiansen 1985). The Rochelle Hills escarpment is formed in shales and sandstones, capped by beds of resistant scoria (porcellanite) that weathers to blocky talus. The escarpment presents a complex mix of substrates, from fine textured through coarse textured, mantled in places with scoria talus. Slump blocks are common.

The hills below the escarpment consist of shales and sandstone. The stream valleys in the area have bottoms of alluvium derived from the surrounding sedimentary bedrock.

Lands

The potential Rochelle Hills RNA is National Grassland. The potential RNA is bounded on the north, east, and south primarily by National Grassland, on the southwest by private land, and on the west by state land and National Grassland.

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 five major vegetation types in the potential RNA -- the ponderosa pine woodlands (comprising the ponderosa pine/bluebunch wheatgrass association and the ponderosa pine-Rocky Mountain juniper/bluebunch wheatgrass association), the bluebunch wheatgrass/Sandberg bluegrass association, the needle-and-thread/ blue grama association, the blue grama/western wheatgrass association, and the western wheatgrass/green needlegrass association -- grow over a variety of topographic positions, and within each type, the stands exhibit a range in species composition. But the degree to which the potential Rochelle Hills RNA represents those types depends on how much each has been affected by the exotic grasses planted in the area.

A 1988 fire (Marnie McWilliams, USDA Forest Service, personal communication) in the ponderosa pine woodlands converted some of this type to bluebunch wheatgrass/Sandberg bluegrass vegetation, and much of this grass vegetation now is dominated by crested wheatgrass. If the pines re-establish on the burned sites and the crested wheatgrass decreases to a minor understory species, the fire will have maintained the variability in structure of this type. In that case, the potential Rochelle Hills RNA would represent the ponderosa pine woodlands well.

In the bluebunch wheatgrass/Sandberg bluegrass stands, a substantial area appears to be dominated by crested wheatgrass (on the drier sites) and intermediate wheatgrass (on the more mesic sites occupied by this vegetation type) following the sowing of those exotic species in the potential RNA after the 1988 fire (Marnie McWilliams, USDA Forest Service, personal

communication). Similarly, the stands of the western wheatgrass/green needlegrass association in the draws on the escarpment are now heavily dominated by intermediate wheatgrass. Hence the area may no longer represent these types well.

Stands of the little bluestem/sideoats grama association appear to have been affected less by the exotic grass species planted in the area. The same can be said for the needle-and-thread/blue grama association, which is widespread above and below the escarpment. The potential RNA apparently represents both types well.

Although the prairie sandreed-western wheatgrass herbaceous vegetation occupies only a small part of the potential RNA, the stands exhibit variation in species composition. Furthermore, the small stands in sandy draws appear to be typical of the way this type occurs in the region. Hence the potential Rochelle Hills RNA can be considered a good area to represent the type.

The degree to which the area represents the four-wing saltbush barrens type is unclear. This type occupies only a small part of the potential RNA, on shale outcrops. On the one hand, Byer et al. (1992, page 36) report that shrubland containing four-wing saltbush (among other species) is a major type in the Cheyenne River Basin, which suggests that the small stands in the potential Rochelle Hills RNA do not represent the type well. On the other hand, observations by the author and by Marnie McWilliams, USDA Forest Service range conservationist (personal communication) indicate that the four-wing saltbush barren type occurs in the region as small stands, and that the potential RNA does represent the type well.

This small stands of the silver sagebrush/western wheatgrass association in the potential RNA probably do not represent this type well, because large stands of it are common in draws elsewhere.

Condition: the degree to which the potential RNA has been altered from presettlement conditions.

The potential RNA has been altered from its presettlement condition by the introduction of exotic species, changes in the ecological processes that shaped the area's ecosystems, and construction of structures such as roads, fences, and reservoirs. These causes of change are interrelated and a complete discussion is impossible; the information here is largely restricted to observations made during field survey. Locations of the plots referred to are shown on Figure 3 and data from those plots is shown in Appendix 2.

-- Exotic species

Exotic plants are present throughout the potential RNA. Two winter annual brome grasses, cheatgrass or downy brome (Bromus tectorum) and, apparently, meadow brome (B. commutatus) are common in the grasslands and the ponderosa pine woodlands. Cheatgrass is a major species in many stands of the bluebunch wheatgrass/Sandberg bluegrass association, and meadow brome contributes substantial cover (and may codominate) in stands of the mesic grasslands -- i.e., the western wheatgrass/green needlegrass and prairie sandreed-western wheatgrass associations. Kentucky bluegrass (Poa pratensis) also is widespread in the mesic grasslands, and provides substantial cover in some stands.

Two exotic forbs, yellow salsify (Tragopogon dubius) and yellow sweetclover (Melilotus officinalis) are widespread, especially in the vegetation on the escarpment, but generally contribute little cover to the vegetation. A third forb, Canada thistle (Cirsium arvense), which is classified as a noxious weed in Wyoming, was observed in two patches on talus slopes of the escarpment, one in the NW1/4 NW1/4 Section 5 (T41N, R68W) (ca. 75 square meters, ca. 50 stems) and the other in the SW1/4 SW1/4 Section 32 (T42N, R68W) (ca. 300 square meters and ca. 100 stems). This species undoubtedly occurs elsewhere in the potential RNA. Bull thistle (Cirsium vulgare) was observed with the Canada thistle and probably also occurs elsewhere.

Regarding the exotic species listed above, the potential Rochelle Hills RNA is not unusual in the amount of exotic plants present in the vegetation. The annual brome grasses and Kentucky bluegrass are ubiquitous in the Great Plains, and dominance or codominance of patches of vegetation by these species is a common condition in the region. Canada thistle is a common riparian species in the region, and salsify and sweetclover are widespread.

The potential RNA is unusual, though, in the amount of two other exotic species present in the vegetation. Crested wheatgrass and intermediate wheatgrass were sown in the area following a fire in 1988 (Marnie McWilliams, USDA Forest Service, personal communication), and both are now major species in the area. Crested wheatgrass occurs in much of the bluebunch wheatgrass/Sandberg bluegrass vegetation on drier slopes, and dominates some areas. Intermediate wheatgrass dominates the western wheatgrass/green needlegrass vegetation in many of the draws in the escarpment, and some of the bluebunch wheatgrass/Sandberg bluegrass stands on the adjacent lower slopes. These two exotic grasses have debased the condition of these two major types over much of the potential RNA.

-- Structures (Figure 2)

Two reclaimed petroleum drill holes are located in the potential RNA. Two-track roads run through the northeastern corner, the southern end, and the central and west-central parts of the area. The area contains 8 reservoirs, two spring developments, and one artesian well. A barbed-wire fence runs along much of the potential RNA boundary, across the center of the area from east to west, and from the southern end of the area north to the center.

-- Ecological processes

Grazing by large mammals was undoubtedly a major ecological factor influencing the composition of the vegetation in the Cheyenne River Basin before white settlement. Bison abounded in eastern Wyoming (Dorn 1986, Long 1965), but free-ranging bison were gone from the area by the latter 19th century. Elk were present in the Cheyenne River Basin before white settlement (Dorn 1986), but probably were much less abundant than were bison (Long 1965) and hence had less influence on the ecosystems. Elk now inhabit parts of the Cheyenne River Basin, but probably in smaller numbers than during presettlement times. Pronghorn were abundant in eastern Wyoming in presettlement times (Long 1965) and still are common. In the potential Rochelle Hills RNA, large mammals probably grazed before white settlement primarily on the rolling upland atop the escarpment and in the rolling hills on the periphery.

Domestic livestock graze the potential RNA now and may influence the composition of the vegetation, but the extent to which domestic livestock have replaced bison and elk as an ecological factor is unclear. No areas with obvious heavy impacts from livestock grazing were noted during field work.

Black-tailed prairie dogs (Cynomys ludovicianus) exert a strong influence on the species composition and the processes in grassland ecosystems in the Great Plains (Coppock et al. 1983). The species occurs throughout eastern Wyoming (Clark and Stromberg 1987). The part of the potential RNA on and near the Rochelle Hills escarpment is unsuitable prairie dog habitat, and if the animals had an effect on the vegetation in the area, it was primarily in the rolling hills on the edge of the area.

Outbreaks of grasshoppers are a disturbance known to have large effects on the grasslands of the Great Plains (Knight 1994, Chapter 5). Although no information was encountered regarding grasshoppers in the potential Rochelle Hills RNA or the immediate area, grasshopper outbreaks are known from northeastern Wyoming (Allred 1941) and undoubtedly affected the potential RNA. The effects that grasshopper control programs have had on the potential RNA are unknown.

Fires are known to have burned in the Cheyenne River Basin before white settlement (Dorn 1986) and fires undoubtedly influenced the ecosystems in the potential RNA. Wildfires still burn in the Great Plains of eastern Wyoming, and in 1988, a wildfire burned through the potential Rochelle Hills RNA (Marnie McWilliams, USDA Forest Service, personal communication). In part of the area, the fire burned as a crown fire in the ponderosa pine woodlands (Figures 2 and 3). In other woodlands, the fire burned as a ground fire and had less effect on the vegetation. Nevertheless, fire suppression is the general policy in the region, and the degree to which that policy has altered the ecosystems in the potential Rochelle Hills RNA is unclear.

Viability: 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. Long-term maintenance of the ecosystems in a condition similar to presettlement 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 grazing by large mammals, burrowing and grazing by prairie dogs, outbreaks of grasshoppers, and fire. The relatively small size (3679 acres, or 1489 ha) will complicate management of these processes. The area is too small to support populations of pronghorn, elk, and mule deer (and their predators), which will use the potential RNA as part of a larger range. Similarly, when considered as livestock range, the potential RNA must be viewed as part of a larger area containing other pastures.

The Rochelle Hills escarpment, which constitutes approximately half of the potential RNA, appears to be unsuitable as habitat for black-tailed prairie dogs; prairie dog habitat is found on the northern, eastern, and southern periphery of the area. A policy of restricting prairie dogs to the periphery of the potential RNA is almost certainly unrealistic, and should prairie dogs be allowed to operate as an ecological factor in the potential RNA, they will also affect adjoining lands.

Allowing outbreaks of grasshoppers to exert an influence on the ecosystems of the potential RNA will also be a problem for managers. The area is too small to contain this ecological process, and allowing grasshoppers to affect a larger area may be impracticable.

Given the size of the potential RNA and the location of the ponderosa pine woodlands in the center of the area, managers may be able to delineate woodland burn units entirely within the area. The topography of the area may also allow delineation of

small burn units in the grasslands above and below the escarpment. The presence of the annual brome grasses will complicate the use of fire as a tool to maintain the ecosystems in the potential RNA, because these species may increase or decrease in abundance, depending on the season of burning (The Nature Conservancy 1989). Consequently, while fire may promote the viability of some ecosystems in the potential RNA, it may also constitute a threat to the viability of others by promoting the increase in exotic plants.

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 1996 field work. Two-track roads provide ready access for vehicles, and a potential exists for damage from vehicle traffic during hunting seasons in the fall. Maintenance and repair of the dams and springs may be necessary but probably will have a minor effect on the ecosystems of the area and the ecological processes operating there.

Degree to Which the Potential RNA Meets Criteria

The potential Rochelle Hills RNA contains occurrences of four associations typical of escarpments in the Cheyenne River Basin: the ponderosa pine/bluebunch wheatgrass and ponderosa pine-Rocky Mountain juniper/bluebunch wheatgrass associations, the little bluestem/sideoats grama association, and the bluebunch wheatgrass/Sandberg bluegrass association. Were the occurrences of the ponderosa pine woodlands and the bluebunch wheatgrass/Sandberg bluegrass association free of the planted exotic grasses (crested wheatgrass and intermediate wheatgrass), the potential RNA would be a good representative of the escarpment plant associations in the region.

Three other grassland associations -- the needle-and-thread/blue grama, blue grama/western wheatgrass, and western wheatgrass/green needlegrass associations -- are represented by large occurrences in the potential RNA. Unfortunately the western wheatgrass/green needlegrass vegetation in the draws on the escarpment is largely dominated by intermediate wheatgrass and therefore in poor condition.

The occurrences of the four-wing saltbush barrens and the prairie sandreed-western wheatgrass herbaceous vegetation within the potential Rochelle Hills RNA consist of small stands, but they may represent these types as they occur in the region. The degree to which the potential RNA represents the silver sagebrush/western wheatgrass association, which also is a minor type in the area, is unclear.

The viability of the major ecosystem types in the potential RNA can probably be assured if livestock continue to be managed to prevent repeated, excessive grazing; if wildlife are allowed to use the area; and if a prescribed fire program can be implemented. The area is isolated enough that fire may pose little threat to private structures, but the tracts of private land and state land on the boundaries of the potential RNA may pose a problem for fire management.

Given the isolation of the potential RNA and the absence of recreational attractions, it probably faces little threat from damaging vehicle use.

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

Two drill holes from past mineral exploration are present in the area, but they appear to have little impact.

Grazing

The potential Rochelle Hills RNA is within grazing allotments #268 and #272 and is now grazed primarily in the fall, with some summer use (USDA Forest Service records). Establishment of a research natural area might conflict with livestock grazing, although large mammal grazing was an important ecological process in the grassland and shrub-steppe ecosystems before white settlement, so grazing *per se* should not be viewed as an unacceptable impact.

Timber

There are no merchantable stands of timber in the potential RNA.

Watershed Values

Eight small reservoirs are located in the area, but they appear to have little impact. The use of heavy equipment to maintain or repair the dams impounding these reservoirs might conflict with management of the area as a research natural area.

Recreation Values

The potential RNA contains no developed recreation areas. Recreational use apparently is limited to hunting in the fall, which would not conflict with management of the area as an RNA.

Wildlife and Plant Values

Management of the Rochelle Hills area as a research natural area apparently would not conflict with the wildlife or plant values therein, and might provide increased protection for wildlife and plant values.

Transportation Values

Establishment of a Rochelle Hills RNA could conflict with use of the two-track roads in the area, although the roads apparently are used primarily during fall hunting seasons and have no obvious impacts on the area.

MANAGEMENT CONCERNS

Establishment of a Rochelle Hills RNA could require a change in grazing management and conflict with possible future mineral development. The inclusion of the Rochelle Hills area in two grazing allotments with adjoining lands probably would complicate grazing management. Similarly, fire management could be complicated because of concerns about fire spreading to lands outside the RNA.

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