# ECOLOGICAL EVALUATION OF THE POTENTIAL CHEYENNE RIVER RESEARCH NATURAL AREA WITHIN THE THUNDER BASIN NATIONAL GRASSLAND, CONVERSE COUNTY, WYOMING

Prepared for
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TABLE OF CONTENTS

# ECOLOGICAL EVALUATION OF THE POTENTIAL CHEYENNE RIVER RESEARCH NATURAL AREA WITHIN THE THUNDER BASIN NATIONAL GRASSLAND CONVERSE COUNTY, WYOMING

## INTRODUCTION

The potential Cheyenne River Research Natural Area (RNA) is located in the Cheyenne River Basin of northeastern Wyoming. The area includes a reach of the Cheyenne River (a perennial stream), plains cottonwood woodlands, grasslands of prairie sandreed and western wheatgrass, and wet meadows of leafy bulrush and alkali cordgrass. The potential RNA is in the Thunder Basin National Grassland and is currently used primarily for livestock grazing. northeastern Wyoming.

In 1997, 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 Cheyenne River area was done by the Wyoming Natural Diversity Database. This report presents the results of that evaluation.

### Land Management Planning

In 1997, an interdisciplinary team from the Thunder Basin National Grassland selected the Cheyenne River area 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 Cheyenne River 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 features of the potential Cheyenne River RNA are the aquatic ecosystem and the terrestrial ecosystem associated with the Cheyenne River.

## LOCATION

The potential Cheyenne River RNA is located within the Thunder Basin National Grassland in northeastern Wyoming (Figure 1). The approximate center of the potential RNA is at latitude 43°26'35"N and longitude 104°59'20"W.

The potential RNA includes all or parts of the following sections (all on the 6th Principal Meridian): Township 40 North, Range 67 West, Sections 6 & 7; T40N, R68W, Sections 1, 11, 12, 13, 14, 15, 21, 22.

Boundary (See Figure 1).

Two possible boundaries are shown for the potential RNA, encompassing the same reach of the Cheyenne River and including only National Grassland. The first boundary (shown as a dashed line on Figure 1) was drawn before the field survey and excludes much of the area of flood-plain landforms (sensu Driscoll et al. 1984) associated with the Cheyenne River. The second boundary (drawn as a dotted line) is based on information gathered during the field survey and includes the area on National Grassland within which the Cheyenne River meanders.

On the eastern and southern sides of the potential RNA, the two possible boundaries differ very little. On the northern side, the second boundary includes more floodplain.

Area

Boundary #1 outlines a potential Cheyenne River RNA of ca. 1021 acres (413 ha). The second possible boundary outlines an area of 1466 acres (594 ha).

Elevation

The elevation of the potential Cheyenne River RNA ranges from ca. 4220 feet (1287 m) to 4300 feet (1311 m).

Access

The potential Cheyenne River RNA may be reached on public roads. From the intersection of Wyoming Highway 59 with Converse

County Road 38 (the Dull Center Road) at Bill, Wyoming, travel east and north on County Road 38 ca. 21 miles (34 km) to the intersection with Grassland Road 933, then north ca. 4 miles (6.4 km) across the Cheyenne River to the intersection with a four-wheel drive road leading to the east, then east on that four-wheel drive road ca. 5 miles (9 km) to the Cheyenne River and the northern end of the potential RNA. The entire RNA may be reached via a two-track road running along the western side of the Cheyenne River.

A two-track road running east from Grassland Road 933 ca. 1.5 miles (2.4 km) north of the Cheyenne River appears to provide access to the southwestern end of the potential RNA, but a gully made this road impassable during the 1997 field survey.

Ecoregion

The potential Cheyenne River 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 ½ inch = 1 mile scale map of the Thunder Basin National Grassland.

USDI Geological Survey 7.5 minute topographic Quadrangle Maps:
Fiddleback Ranch, Wyo. and Wagonhound Creek, Wyo.

## VEGETATION

Description

The potential Cheyenne River RNA contains the following plant associations. Synonyms are shown in Appendix 4. Data from sample plots are shown in Appendix 3.

The vegetation types in the potential RNA form a mosaic shaped in large part by soil texture and height of the ground surface above the water table. The lowest fluvial surfaces, closest to the channel, support long, narrow stands of the leafy bulrush type, often growing in saturated soils. Stands of this type on slightly higher surfaces often contain groves of cottonwood seedlings and saplings. In a few spots, this leafy bulrush type gives way to small meadows of the alkali cordgrass community type growing on slightly higher, drier surfaces. Groves of plains cottonwood saplings and poles (usually of the plains cottonwood/western wheatgrass community type) also occur on the surfaces above the leafy bulrush stands.

Patches of sandbar willow, each covering less than an acre, grow on point bars near the channel at several locations. The herbaceous understory usually includes creeping spikerush, foxtail barley, alkali bluegrass, leafy bulrush, and alkali cordgrass. These stands represent the sandbar willow/mesic graminoid community type.

Intermediate surfaces support groves of cottonwood poles and trees, with a range in tree size and density and in understory composition. Most of the understories are dominated by western wheatgrass and Kentucky bluegrass (an exotic), and belong to the plains cottonwood/western wheatgrass community type. Prairie sandreed co-dominates the understory in a few stands that are intermediate between the plains cottonwood/western wheatgrass type and the plains cottonwood/prairie sandreed type.

The cottonwood woodland in the potential RNA exhibits the structure typical of plains cottonwood stands (Friedman et al. 1997): linear and arcuate groves of trees, parallel to the stream channel, with each grove consisting of trees of nearly uniform size. Groves of cottonwood seedlings, saplings, poles, and trees are all common in the area, indicating that the cottonwood trees are reproducing successfully and the woodland is viable. In a number of places in the potential RNA, the cottonwood stands form a clear sequence on point bars at increasing distance from (and height above the channel): seedlings grow on the lowest point bar, backed by a cut-off channel of herbaceous vegetation, then a stand of cottonwood saplings on the next bar, then another cut-off channel with herbaceous vegetation, then a stand of cottonwood poles or small trees on the highest point bar.

Sandy soils at intermediate height above the channel support stands of the prairie sandreed - needle-and-thread community type, in which the major species are prairie sandreed, lance-leaf scurfpea, and needle-and-thread. Over much of the area, cheatgrass now dominates this vegetation type. On finer-textured soils, the vegetation belongs to the western wheatgrass community type. Throughout much of the potential RNA, annual bromes now dominate this vegetation.

Area by Type

Complexes of community types were mapped on a 1:24,000-scale topographic map using aerial photos and field reconnaissance, and the area of each complex in the potential RNA was estimated from the map with a digital planimeter. (The vegetation map shows complexes because delineating stands of individual community types was impossible.) For each complex, the plant community

types that contribute substantial cover are marked by "M" after the type name in Table 2 and Figure 1, and types contributing little cover by "m".

The area of each Kuchler (1966) type or complex of types was estimated by summing the area of the plant community types belonging to that Kuchler type.

In both tables, estimates are given for the area of the type encompassed by each of the two possible boundaries. See page ? for a discussion of the boundaries.

Table 1. Areas of Kuchler (1966) types encompassed by the two possible boundaries (Figure 1) of the potential Cheyenne River RNA. Numerators are areas within boundary #1; denominators are areas within boundary #2. "M" denotes a major type in a complex, and "m" a minor type.

| Cover Type | Acres | Hectares |
|---|---|---|
| Wheatgrass-needlegrass shrubsteppe (50) (M) (*Agropyron-Stipa-Artemisia*) and Grama-needlegrass-wheatgrass (57) (M) (*Bouteloua-Stipa-Agropyron*) | 716/1029 | 290/417 |
| Northern floodplain forest (89) (*Populus-Salix-Ulmus*) | 305/437 | 123/177 |

Table 2. Areas of complexes of plant community encompassed by the two possible boundaries (Figure 1) of the potential Cheyenne River RNA. Numerators are areas within boundary #1; denominators are areas within boundary #2. "M" denotes a major community type in a complex, and "m" a minor type. See synonyms in Appendix 4.

| Complex | Acres | Hectares |
|---|---|---|
| Plains cottonwood/western wheatgrass | 305/437 | 123/177 |
| Prairie sandreed - needle-and-thread (M) and Western wheatgrass (M) with Sandbar willow/mesic graminoid (m), leafy bulrush (m), and alkali cordgrass (m) | 716/1029 | 290/417 |

## PHYSICAL AND CLIMATIC CONDITIONS

### Physical Setting

The potential Cheyenne River RNA lies within the Cheyenne River Basin in east-central Wyoming, and is centered on the valley of the Cheyenne River, a perennial stream flowing primarily eastward through rolling hills of claystone and sandstone. The stream valley is ca. 0.3 mile (0.5 km) wide and ca. 150 feet (46 m) deep.

### Geology

Bedrock in the region of the potential Cheyenne River RNA is claystone and concretionary sandstone of the Paleocene-aged Lebo Member of the Fort Union Formation (Love and Christiansen 1985). Within the potential RNA, the substrate is Quaternary alluvium derived from the surrounding uplands. Textures of the alluvium range from clay to sand, and a large proportion of it contains a high volume of sand and gravel.

## 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.

### Flora

#### Threatened, Endangered, and Sensitive Plant Species

No federally listed Threatened or Endangered plant species, or species on the USDA Forest Service Region Two Sensitive Species List (Estill 1993) are known from the potential Cheyenne River RNA. The following species of conservation interest, which has no federal status, may occur in the area.

#### Plant Species List

The following species were identified during field work in the potential Cheyenne River RNA.

Table 3. Vascular Plants of the potential Cheyenne River RNA. Nomenclature for scientific names is based on Dorn (1992). Family acronyms are based on Weber (1982). Family acronyms are based on Weber (1982). Non-native species are indicated by "!" before the species name.

| Scientific Name | Common Name | Family |
|---|---|---|
| TREES | | |
| Elaeagnus angustifolia | Russian olive | ELE |
| Populus deltoides var. occidentalis | Plains cottonwood | SAL |
| SHRUBS & DWARF SHRUBS | | |
| Chrysothamnus nauseosus | Rubber rabbitbrush | AST |
| Chrysothamnus viscidiflorus | Green rabbitbrush | AST |
| Salix exigua | Sandbar willow | SAL |
| Sarcobatus vermiculatus | Black greasewood | CHN |
| Tamarix chinensis | Salt cedar, tamarisk | TAM |
| GRAMINOIDS | | |
| Aristida purpurea var. longiseta | Fendler threeawn | POA |
| Bouteloua gracilis | Blue grama | POA |
| !Bromus commutatus | Meadow brome | POA |
| !Bromus inermis var. inermis | Smooth brome | POA |
| !Bromus tectorum | Cheatgrass | POA |
| Calamovilfa longifolia | Prairie sandreed | POA |
| Carex filifolia | Threadleaf sedge | CYP |
| Distichlis stricta | Inland saltgrass | POA |
| Eleocharis palustris | Common spikerush | CYP |
| Elymus smithii | Western wheatgrass | POA |
| Elymus trachycaulus var. trachycaulus | Slender wheatgrass | POA |
| Festuca octoflora | Sixweeks fescue | POA |
| Hordeum jubatum | Foxtail barley | POA |
| Juncus balticus | Baltic rush | JUN |
| Koeleria macrantha | Prairie junegrass | POA |
| Oryzopsis hymenoides | Indian ricegrass | POA |
| Poa juncifolia var. ampla | Alkali bluegrass | POA |
| !Poa pratensis | Kentucky bluegrass | POA |
| Poa secunda | Sandberg bluegrass | POA |
| Scirpus pungens | Leafy bulrush | CYP |
| Spartina gracilis | Alkali cordgrass | CYP |
| Sporbolus cryptandrus | Sand dropseed | POA |
| Stipa comata | Needle-and-thread | POA |
| Stipa viridula | Green needlegrass | POA |
| FORBS | | |
| Abronia fragrans | Snowball sand verbena | NYC |
| Achillea millefolium | Common yarrow | AST |
| Ambrosia psilostachya | Cuman ragweed | AST |
| Arenaria hookeri | Hooker's sandwort | CRY |
| Artemisia frigida | Fringed sagewort | AST |
| Artemisia ludoviciana | Lousianna sagewort | AST |
| Asclepias speciosus | Showy Milkweed | ASC |
| Aster sp. | Aster | AST |

| | | |
|---|---|---|
| Astragalus miser | Weedy milkvetch | FAB |
| Astragalus miser var. decumbens | Milkvetch | FAB |
| ! Camelina microcarpa | Littlepod falseflax | BRA |
| Chenopodium sp | Chenopod | CHN |
| !Cirsium arvense | Canada thistle | AST |
| Cryptantha cinerea | Cryptantha | BOR |
| Descurainia pinnata | Western tansymustard | BRA |
| !Descurainia sophia | Herb sophia (flixweed) | BRA |
| Equisetum laevigatum | Smooth horsetail | EQU |
| Erigeron sp. | Fleabane | AST |
| Euphorbia missurica var. petaloides | Prairie sandmat | EUP |
| !Filago arvensis | Field cottonrose | AST |
| Grindelia squarrosa | Curleycup gumweed | AST |
| !Lactuca sp. | Prickly lettuce | AST |
| Lappula redowskii | Desert stickseed | BOR |
| Lepidium densiflorum | Common pepperweed | BRA |
| Lithospermum sp. | Gromwell (stoneseed) | BOR |
| Lupinus pusillus | Rusty lupine | FAB |
| Lygodesmia sp. | Skeletonplant | AST |
| !Melilotus officinalis | Yellow sweetclover | FAB |
| Opuntia polyacantha | Plains pricklypear | CAC |
| Ratibida columnifera | Prairie coneflower | AST |
| Rumex sp. | Dock | PLG |
| Sisymbrium altissimum | Tall tumblemustard | BRA |
| !Taraxacum officinale | Common dandelion | AST |
| !Taraxacum sp. | Dandelion | AST |
| Thermopsis rhombifolia | Prairie thermopsis | FAB |
| !Tragopogon dubius | Yellow salsify | AST |
| Vicia americana | American vetch | FAB |
| Xanthium strumarium | Common cocklebur | AST |

Fauna

Threatened, Endangered, and Sensitive Vertebrates

No federally listed Threatened, Endangered, or Candidate vertebrate species are known to occur in the potential Cheyenne River RNA. The mountain plover (*Charadarius montanus*), a candidate for listing as threatened under the Endangered Species Act and a USDA Forest Service Region Two Sensitive Species (Estill 1993), occurs in the black-tailed prairie dog towns on the uplands north and west of the Cheyenne River, and it may at times occur within the western boundary (particularly the second possible boundary) of the potential RNA.

Animal Species List

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

Lands

The potential Cheyenne River RNA includes only national grassland. Adjoining lands are national grassland, private land, and state land.

## SUITABILITY FOR RESEARCH NATURAL AREA SELECTION

An area is suitable for designation as a research natural area according to how well it meets four criteria: quality, condition, viability, and defensibility (USDA Forest Service 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 major terrestrial ecosystem type in the potential RNA is the riparian ecosystem associated with the Cheyenne River, a perennial stream. The plains cottonwood (*Populus deltoides*) woodland contains a rich mix of even-aged stands of seedlings, saplings, poles, and trees of different sizes. Understories in the tree stands vary with substrate, with western wheatgrass (*Pascopyrum smithii*) and Kentucky bluegrass (*Poa pratensis*) on fine-textured alluvium and prairie sandreed (*Calamovilfa longifolia*), needle-and-thread (*Stipa comata*), and cheatgrass (*Bromus tectorum*) on sandier alluvium. Cottonwood groves are interspersed with meadows of needle-and-thread grass and prairie sandreed on sandy alluvium, and of western wheatgrass on finer-textured alluvium. Parches of leafy bulrush (*Scirpus pungens*) and spikerush (*Eleocharis palustris*) are common near the river channel throughout the potential RNA, and sparsely-vegetated sediment bars are common in and along the channel.

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

-- Exotic Species

Exotic grasses abound in the herbaceous vegetation component of the potential RNA, with *Bromus tectorum* on sandier soils, and *Poa pratensis* and *Bromus japonicus* (or a similar biennial brome grass) on finer-textured soils. Large areas of the upper alluvial terraces are co-dominated or dominated by cheatgrass. Sweetclover (*Melilotus spp.*, mainly *M. officinalis*) is common throughout, and co-dominates areas covering up to an acre (0.4 ha) each on upper alluvial terraces. Canada thistle (*Cirsium*

*arvense*) also is common throughout the potential RNA, as scattered patches containing up to several hundred stems and covering several hundred square meters.

Tamarisk (*Tamarix chinensis*) is represented in the potential RNA by individual shrubs or groups of several shrubs widely scattered throughout the area, and by at least one stand of ca. 100 shrubs covering several hundred square meters near the south, or upstream, end. Russian olive (*Elaeagnus angustifolia*) is represented by individual trees (many of them less than 3 feet tall) scattered throughout the area.

A fire in ca. 160 acres (ca. 65 ha) of higher alluvial terraces in central part of the potential RNA has converted stands of very sparse, old cottonwoods to herbaceous vegetation -- at the moment, with an abundance of *Bromus tectorum*. The fire was limited mainly to upper terraces and had little effect on woodlands nearer the stream.

-- Structures

Structures are limited to two underground petroleum pipelines (one crossing the northern end of the potential RNA from southeast to northwest, and the other crossing south to north through the center of the area and running northeast along the area's northern boundary), barbed-wire livestock fences, and a limited number of two-track roads.

-- Ecological processes

Flooding is an ecological process crucial to the riparian ecosystem that forms the core of the potential RNA. The Cheyenne River and its major tributary, Antelope Creek, are not impounded, although Porcupine Creek, a major tributary to Antelope Creek, has been dammed several miles (several km) upstream from the potential RNA. The presence of numerous stands of cottonwood seedlings and saplings indicates that the hydrologic regime is adequate to maintain cottonwood woodlands.

Beaver can exert a significant effect on cottonwood woodlands. Scattered throughout potential RNA are stumps of cottonwood trees cut long ago by beaver, and active beaver dams are present, several at the northern (downstream) end of area and several at the southern (upstream) end. Recently, beaver have been cutting mainly cottonwood saplings and poles.

Grazing also can have substantial effects on the riparian vegetation, by suppressing reproduction of the woody plants. Grazing by large mammals was undoubtedly a major ecological factor influencing the composition of the upland vegetation in the Cheyenne River Basin before settlement by whites, and grazing animals used the riparian zones at least sporadically. 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 still inhabit parts of the Cheyenne River Basin. Pronghorn were abundant in eastern Wyoming in pre-settlement times (Long 1965) and still are common.

Black-tailed prairie dogs (*Cynomys ludovicianus*) are present on the northern edge of the potential RNA, but not in riparian areas.

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

The viability of cottonwood woodlands depends on a flood regime that provides sites for tree establishment (Friedmann et al. 1997). The presence of numerous stands of cottonwood seedlings and saplings indicates that the flood regime is adequate to assure the viability of the riparian woodland.

The abundance of exotic grasses, particularly the biennial bromes (*Bromus tectorum* and *B. japonicus*) raises questions about the viability of deeper-rooted, native understory species.

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 obvious, serious threats to the ecosystems of the potential RNA are apparent. Livestock grazing that suppresses cottonwood regeneration and limited recreational use appear to be the only potential threats, but neither was observed during the 1997 survey to be a problem and both could be controlled by management.

Degree to Which the Potential RNA Meets the Criteria

The quality of the potential RNA is good, in that it contains a variety of vegetation types typical of a plains riparian area. The condition has been compromised by the abundance of exotic species in the herbaceous vegetation (primarily *Bromus spp.* and *Melilotus spp.*), which appear to contribute more cover in the potential Cheyenne River RNA than in other areas (such as the potential Antelope Creek RNA upstream). Woody species (especially *Elaeagnus angustifolia*) are present now, and without control efforts, may become major species in the area. The abundance of cottonwood seedlings and saplings indicates that the flood regime is adequate to maintain the viability of the cottonwood woodlands, although the viability of

the cottonwood woodlands depends on actions upstream from the potential RNA that affect the flood regime and water quality. The defensibility appears good, in that anthropogenic threats can be minimized.

## 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 conflicts with use of mineral resources were observed.

### Grazing

The potential RNA is part of livestock grazing allotment #231 and is grazed in the winter. 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.

No evidence was observed during the 1997 survey of heavy grazing.

### Timber

The potential RNA contains only plains cottonwood trees. While this species is being harvested from riparian zones in northwestern Wyoming (Kent Houston, USDA Forest Service, Shoshone National Forest, personal communication), no evidence was observed during field survey of timber harvest in the potential RNA or along other streams in the area.

### Watershed Values

The potential Cheyenne River RNA contains a reach of the Cheyenne River, a perennial stream. No evidence was observed during field survey to suggest that RNA designation would interfere with watershed values.

### Recreation Values

The potential RNA contains no developed recreation areas. The cottonwood woodlands in the area offer attractive camping sites on public land in a region where suitable campsites are limited. With the recent publicity about land exchanges between the USDA Forest Service and private landowners, camping and driving in the potential RNA may increase. Wood-gathering and fires associated with this recreational use may become a threat to the condition of the area.

Wildlife and Plant Values

No evidence was observed during the field survey to suggest that RNA designation would conflict with wildlife or plant values.

Transportation Values

The potential RNA includes no maintained roads. The area delimited by the second possible boundary includes ca. 2 miles (3.2 km) of two-track road northwest of the river in the central part of the area. Both sets of possible boundaries include a two-track road that fords the river in the northern part of the area. These two-track roads provide ready access to the potential RNA, but by themselves they appear to have no effect on the values for which an RNA would be designated.

## MANAGEMENT CONCERNS

Designation of a research natural area on the Cheyenne River apparently would cause no major conflicts with management of resources. Recreational use of the area may increase now that land trades have made it part of the Thunder Basin National Grassland, and wood-gathering, campfires, and vehicle travel may increase to a level that threatens the condition and viability of the ecosystems. Livestock grazing could, hypothetically, suppress recruitment of cottonwoods and increase the weediness of the herbaceous vegetation, but apparently it has not done so in the past and there is no reason to expect that it will in the future. All of these potential threats could be averted with judicious management of the area that allows use of the natural resources and protects the values of a research natural area.

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Appendix 1. Maps of the potential Cheyenne River Research Natural Area.

Figure 1. Contour map showing complexes of plant associations in the potential Cheyenne River RNA. Major associations in each complex are indicated by (M) after the name, and minor associations by (m).

| Associations in Complex | Map Symbol |
|---|---|
| Plains cottonwood/western wheatgrass | |
| Western wheatgrass (M) and Prairie sandreed-needle-and-thread (M) with sandbar willow/ mesic graminoid (m), leafy bulrush (m), and alkali cordgrass (m) | |
| Sample plot | |
| Reclaimed oil well site | |
| First boundary | |
| Second boundary | |
| Barbed-wire fence | |
| Approximate limit of burned area | |

Appendix 2. Photographs from the potential Cheyenne River RNA.

Appendix 3. Canopy cover of plants in plots in the potential Cheyenne River Research Natural Area.

In all of the tables in this appendix, the cover values for species are midpoints of the following cover classes:

| Cover Value | Range of Canopy Cover |
|---|---|
| 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% |

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

| | Plot/Association* | | | |
|---|---|---|---|---|
| | 10.04 | 10.05 | 12.01 | 13.02 |
| | Popdel/ | Popdel/ | Popdel/ | Popdel/ |
| Species | Elysmi | Elysmi | Elysmi | Elysmi |
| TREES | | | | |
| Populus deltoides | 60/12 | 40/12 | 50/7 | 20/20 |
| DWARF SHRUBS | | | | |
| Chrysothamnus nauseosus | | | 1 | |
| GRAMINOIDS | | | | |
| Aristida purpurea var. longiseta | 1 | | | |
| ! Bromus commutatus | 1 | 1 | 10 | 30 |
| ! Bromus tectorum | 10 | 90 | 10 | 20 |
| Calamovilfa longifolia | 1 | 3 | 3 | 30 |
| Elymus smithii | 10 | 3 | 10 | 30 |
| Elymus trachycaulus var. trachycaulus | 1 | | | |
| Koeleria macrantha | | 1 | | 1 |
| Oryzopsis hymenoides | 1 | | 1 | |
| ! Poa pratensis | | 3 | 20 | 20 |
| Sporbolus cryptandrus | | 1 | 1 | 1 |
| Stipa comata | 1 | 3 | | 10 |
| Stipa viridula | | | 1 | 10 |
| FORBS | | | | |
| Ambrosia psilostachya | | | 1 | |
| Artemisia frigida | 1 | 1 | | |
| Artemisia ludoviciana | | | 1 | |
| Asclepias speciosus | | 1 | 1 | |
| Aster sp. | 1 | 1 | | |
| !Camelina microcarpa | 1 | | | 1 |
| Cryptantha cinerea | 1 | | | |
| Descurainia pinnata | | | 1 | |
| !Descurainia sophia | | 1 | | |
| Lappula redowskii | | 1 | | |
| Lepidium densiflorum | | 1 | 1 | |
| Lithospermum sp. | 1 | 1 | | |
| Lupinus pusillus | 1 | | | |
| !Melilotus officinalis | | | | 1 |
| Opuntia polyacantha | | 1 | | |
| Psoralidium lanceolatum | 1 | | | |
| Sisymbrium altisissimum | 1 | | | |
| !Taraxacum officinale | 1 | 1 | | |

| | | | | |
|---|---|---|---|---|
| !Tragopogon dubius | 1 | 1 | 1 | 1 |
| GROUND COVER | | | | |
| Bare ground | 30 | 2 | 30 | 5 |
| Gravel | 1 | | 1 | |
| Rock | 1 | | | |
| Litter | 60 | 93 | 68 | 89 |
| Wood | 6 | 1 | | 2 |
| Basal vegetation | 2 | 5 | 2 | 4 |

**Association acronyms:**

- Popdel/Elysmi: Populus deltoides/Elymus smithii (Plains cottonwood/western wheatgrass)

**Notes:**

- Plot 10.04: 5 m x 25 m, representing one band of cottonwoods (mostly saplings and poles) on an intermediate terrace Surface soil is loamy sand. Adjacent herbaceous vegetation was sampled with plot 10.03.
- Plot 10.05: 15m x 35 m, representing one grove of older cottonwoods on a higher terrace, in a matrix of meadow sampled by plot 10.06. Surface soil is sandy loam.
- Plot 12.01: 5 m x 20 m, in band of cottonwood saplings on old point bar. Surface soil is loamy sand. Adjacent cutoff channel is western wheatgrass grassland, sampled with plot 12.02.
- Plot 13.02: 15 m x 20 m, in area with relatively little exotic species cover. Surface soil is clay. Photo 97GJ1.35.

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Table 3-2. Size-class structure of trees in the plains cottonwood sample plots from the potential Cheyenne River RNA.

| Plot 10.04; 5 m x 25 m | | | DBH, | INCHES | | |
|---|---|---|---|---|---|---|
| SPECIES | <Breast Height | <5" | <9" | <14" | <21" | <36" |
| Populus deltoides, live | 2 | 8 | 11 | 5 | | |
| Populus deltoides, dead | 2 | 11 | 1 | | | |

| Plot 10.05; 15 m x 35 m | | | DBH, | INCHES | | |
|---|---|---|---|---|---|---|
| SPECIES | <Breast Height | <5" | <9" | <14" | <21" | <36" |
| Populus deltoides, live | | | | 1 | 6 | 2 |
| Populus deltoides, dead | | | | 1 | | |

| Plot 12.01; 5 m x 20 m | | | DBH, | INCHES | | |
|---|---|---|---|---|---|---|
| SPECIES | <Breast Height | <5" | <9" | <14" | <21" | <36" |
| Populus deltoides, live | 4 | 32 | 1 | | | |
| Populus deltoides, dead | 2 | 10 | | | | |

| Plot 13.02; 15 m x 20 m | | | DBH, | INCHES | | |
|---|---|---|---|---|---|---|
| SPECIES | <Breast Height | <5" | <9" | <14" | <21" | <36" |
| Populus deltoides, live | | 1 | | 3 | 2 | 1 |

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Table 3-3. Canopy cover of plants in the herbaceous sample plots from the potential Cheyenne River RNA.

| | Plot/Association* | | | | |
|---|---|---|---|---|---|
| | 11.01 | 12.02 | 10.06 | 13.01 | 10.03 |
| Species | | | | | |
| | | | | | |
| DWARF SHRUBS | | | | | |
| Guterriezia sarothrae | 1 | | | | |
| GRAMINOIDS | | | | | |
| Aristida purpurea var. longiseta | | | | | 1 |
| !Bromus commutatus | 80 | 10 | 1 | | |
| !Bromus tectorum | | 20 | 3 | 1 | 1 |
| Calamovilfa longifolia | | | 40 | 50 | 1 |
| Distichlis stricta | | 1 | | | |
| Elymus smithii | 40 | 60 | 3 | | |
| Festuca octoflora | | | 3 | | |
| Oryzopsis hymenoides | | 1 | 1 | 1 | 1 |
| !Poa pratensis | | 1 | | | |
| Sporobolus cryptandrus | | 1 | | | |
| Stipa comata | | 3 | 3 | 1 | |
| FORBS | | | | | |
| Ambrosia psilostachya | 1 | 1 | | | |
| Artemisia frigida | | 1 | | | |
| Astragalus miser var. decumbens | | | | | 1 |
| !Camelina microcarpa | 1 | 1 | | 1 | |
| Cryptantha cinerea | | | 1 | 1 | 1 |
| Descurainia pinnata | 1 | | 1 | | |
| Chenopodium sp. | | | 1 | | |
| Equisetum laevigatum | 1 | | | | |
| Euphorbia missurica var. petaloides | | | | | 1 |
| Grindelia squarrosa var. serrulata | 1 | | | | |
| !Lactuca sp. | 1 | | | | |
| Lepidium densiflorum | 1 | 1 | 1 | 1 | |
| Lithospermum sp. | | | 1 | | |
| Lupinus pusillus | | | 1 | 1 | 3 |
| Lygodesmia sp. | | | 1 | | 1 |
| !Melilotus officinalis | 1 | | 1 | 1 | 1 |
| Psoralidium lanceolatum | | | 1 | 50 | 60 |
| Ratibida columnifera | 1 | | | | |
| Sisymbrium altissimum | | | | 1 | 1 |
| !Taraxacum sp. | 1 | | | | |
| Thermopsis rhombifolia | | | | | 1 |
| !Tragopogon dubius | 1 | | 1 | | 1 |
| Vicia americana | 1 | | | | |
| Xanthium strumarium | | | | 1 | |

| GROUND COVER | | | | | |
|---|---|---|---|---|---|
| Bare ground | 60 | 20 | 40 | 60 | 40 |
| Gravel | | | 1 | | 19 |
| Rock | | | | | 5 |
| Litter | 40 | 78 | 57 | 37 | 30 |
| Wood | | | | | |
| Moss | | | | | |
| Basal vegetation | | 2 | 2 | 3 | 1 |

**Association acronyms:**

**Notes:**

Plot 11.01: 10 m x 20 m, representing fine soil types in old channels. Surface soils is clay or silty clay. Location was chosen because of a relatively small amount of Bromus commutatus. Most of the stand, however, is basically Bromus commutatus with traces of Elymus smithii and (in some places) traces of Bouteloua gracilis.

Plot 12.02: 5 m x 20 m, in cut-off channel. Surface soil is sandy clay loam.

Plot 10.06: 10 m x 25 m, representing a major vegetation type of the higher terraces. Surface soil is sandy loam.

Plot 13.01: 10 m x 20 m, representing major type of higher, sandy terraces. Surface soil is loamy sand. Photo 97GJ1.34.

Plot 10.03: 10 m x 25 m, representing part of one opening in the cottonwood woodland and including cobble bar with cutoff channel. Surface soil is loamy sand. Adjacent cottonwood stand was sampled with plot 10.04; combination of these two types is common along the river.

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Table 3-4. Canopy cover of plants in the sandbar willow sample plots from the potential Cheyenne River RNA.

| | Plot/ Association* | |
|---|---|---|
| | 10.01 | 10.02 |
| Species | Salexi/ MG | Salexi/ MG |
| SHRUBS | | |
| Populus deltoides seedlings | 1 | |
| Salix exigua | 20 | 40 |
| GRAMINOIDS | | |
| !Bromus commutatus | | 3 |
| !Bromus tectorum | | 1 |
| Eleocharis palustris | 20 | 3 |
| Elymus canadensis | | 1 |
| Elymus smithii | | 10 |
| Elymus trachycaulus var. trachycaulus | | 3 |
| Hordeum jubatum | 10 | 20 |
| Juncus balticus | 1 | |
| Puccinellia nuttalliana | 1 | |
| !Poa pratensis | | 3 |
| Poa juncifolia var. ampla | 3 | 10 |
| Scirpus pungens | 10 | 3 |
| Spartina gracilis | 3 | 10 |
| FORBS | | |
| Ambrosia psilostachya | | 1 |
| Artemisia ludoviciana | | 1 |
| Equisetum laevigatum | | 1 |
| !Cirsium arvense | | 1 |
| Grindelia squarrosa var. serrulata | | 1 |
| !Melilotus officinalis | 1 | 20 |
| Rumex sp. | 1 | |
| !Taraxacum officinale | | 1 |
| Xanthium strumarium | 10 | |
| GROUND COVER | | |
| Bare ground | 88 | 48 |
| Gravel | 1 | |
| Rock | 1 | |
| Litter | 7 | 49 |
| Wood | 1 | |
| Moss | | |
| Basal vegetation | 2 | 3 |

**Association acronym:**

Salexi/MG = Sandbar willow/Mesic graminoid (Salix exigua/Mesic graminoid)

**Notes:**

Plot 10.01: 10 m x 20 m, representing the vegetation on one point bar. Surface soil is loamy sand, with clay aggregates in

the top several inches. Vegetation is patchy, with Scirpus nearer the channel and Salix farther from the channel.

Plot 10.02: 10 m x 20 m, representing one willow patch. Surface soil is sandy clay.

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Appendix 4. Plant community types in the potential Cheyenne River 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;
-- The Nature Conservancy (1997): equivalent plant association from the classification of the network of state Natural Heritage Programs and The Nature Conservancy;
-- Thilenius et al. (1995): equivalent vegetation type from this study of the Cheyenne River Basin;
-- 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.

Plains cottonwood/western wheatgrass
-- Johnston (1987): Unknown
-- The Nature Conservancy (1997): Populus deltoides/Pascopyrum smithii woodland
-- Thilenius et al. (1995): Populus sargentii/Symphoricarpos occidentalis deciduous forest
-- Federal Geographic Data Committee (1997): II.B.2.N.b.; temporarily-flooded, cold-deciduous, open tree canopy, natural/semi-natural woodland
-- Kuchler (1966): Northern floodplain forest (Populus-Salix-Ulmus)

Leafy bulrush
-- Johnston (1987): Unknown
-- The Nature Conservancy (1997): Scirpus pungens herbaceous vegetation
-- Thilenius et al. (1995): Unknown
-- Federal Geographic Data Committee (1997): V.A.5.N.m.; saturated, temperate or subpolar, natural/semi-natural grassland
-- Kuchler (1966): Wheatgrass-needlegrass shrubsteppe (Agropyron-Stipa-Artemisia)?

Alkali cordgrass
-- Johnston (1987): None?
-- The Nature Conservancy (1997): Spartina gracilis herbaceous vegetation
-- Thilenius et al. (1995): Unknown
-- Federal Geographic Data Committee (1997): V.A.5.N.k.; seasonally flooded, temperate or subpolar, natural/semi-natural grassland
-- Kuchler (1966): Wheatgrass-needlegrass shrubsteppe (Agropyron-Stipa-Artemisia)?

Prairie sandreed - needle-and-thread
-- Johnston (1987): Calamovilfa longifolia/Stipa comata plant association
-- The Nature Conservancy (1997): Calamovilfa longifolia-Stipa comata herbaceous vegetation
-- Thilenius et al. (1995): Calamovilfa longifolia-Stipa comata preliminary type
-- Federal Geographic Data Committee (1997): V.A.5.N.a.; tall, sod, temperate or subpolar, natural/semi-natural grassland
-- Kuchler (1966): Grama-needlegrass-wheatgrass (Bouteloua-Stipa-Agropyron)?

Western wheatgrass
-- Johnston (1987): Elytrigia smithii-Stipa viridula plant association?
-- The Nature Conservancy (1997): Pascopyrum smithii-Nassella viridula herbaceous vegetation?
-- Thilenius et al. (1995): Unknown
-- Federal Geographic Data Committee (1997): V.A.5.N.c.; medium-tall, sod, temperate or subpolar, natural/semi-natural grassland.
-- Kuchler (1966): Wheatgrass-needlegrass shrubsteppe (Agropyron-Stipa-Artemisia)