A Natural Heritage Assessment of Wetlands and Riparian Areas in the Uncompahgre River Basin

Eastern Montrose and Ouray Counties

Volume II

Colorado Natural Heritage Program
Colorado State University
College of Natural Resources
254 General Services Building
Ft. Collins, Colorado 80523

May 1999

The Nature Conservancy

Natural Heritage Program COLORADO

Colorado State University

Knowledge to Go Places

A Natural Heritage Assessment of Wetlands and Riparian Areas in the Uncompahgre River Basin

Eastern Montrose and Ouray Counties
Volume II

Prepared for:

Colorado Department of Natural Resources
1313 Sherman Street Room 718
Denver, Colorado 80203

Prepared by:

Thomas Stephens, Denise Culver, Jennifer Zoerner, and Peggy Lyon

May 1999

Colorado Natural Heritage Program
College of Natural Resources
254 General Services Building
Colorado State University
Fort Collins, Colorado 80523

USER'S GUIDE

The Uncompahgre River Basin Natural Heritage Assessment conducted by the Colorado Natural Heritage Program consists of two essentially distinct projects that are highly integrated with respect to methodology and fieldwork. This report reflects the separate nature of the projects by being organized in a two-volume set. Both projects utilized the same Natural Heritage methodology that is used throughout North America, and both searched for and assessed the plants, animals, and plant communities on the Colorado Natural Heritage Program's List of rare and imperiled elements of biodiversity. Each volume prioritizes potential conservation sites based on the relative significance of the biodiversity they support and the urgency for protection of the site. All information explaining Natural Heritage methodology and ranks is repeated in each volume, so that each volume can stand alone and be used independently of the other.

Volume I presents *all* potential conservation sites identified in the Uncompahgre River Basin that support rare and imperiled plants, animals, and significant plant communities, including wetland and riparian areas. Volume II focuses exclusively on wetland and riparian areas. Volume II also presents "locally significant areas." These are sites that are among the most important wetlands in the Uncompahgre River Basin, but they did not support animals, plants or plant communities that are unique from a national or statewide perspective, therefore these sites did not receive a Biodiversity Rank. Additionally, Volume II presents an assessment of the wetland functions performed by each site that was surveyed. These functional assessments are intended to provide the user with a more complete picture of the value wetlands and riparian areas provide to Uncompahgre River Basin residents.

ACKNOWLEDGEMENTS

Financial support for this study was provided by a grant from the Environmental Protection Agency (EPA), Region VIII, through the Colorado Department of Natural Resources (CDNR), with in-kind services provided by the Colorado Natural Heritage Program. We greatly appreciate the support and assistance of Doug Robotham and Deborah Mellblom of the CDNR and Sarah Fowler, Jim Louie, and Ed Sterns of the EPA.

This project would not have been possible without the help of numerous dedicated individuals. We appreciate the support of the eastern Montrose and Ouray County Commissioners and the assistance that both County Assessors Offices gave us in determining land ownership.

We received much help from the Bureau of Land Management, especially Jim Ferguson and Amanda Clements; Colorado Division of Wildlife, especially Rick Sherman, Ken Miller and Jim Garner; the U. S. Forest Service, especially Craig Grother; the Natural Resource Conservation Service, especially Steve Woodis; and the National Park Service, especially Nancy Zaenger and Myron Chase.

We appreciate the many landowners that gave us permission to survey their property. In many cases, they imparted to us knowledge that they had gained from many years' experience in caring for the land. Our staff in Fort Collins, including Mary Klein, Jill Handwerk, Susan Spackman, Kim Fayette, Renee Rondeau, Barry Baker, Amy Lavender, and Mike Wunder all worked with us patiently.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

EXECUTIVE SUMMARY

The Uncompahgre River Basin is experiencing a period of rapid growth. Citizens of eastern Montrose and Ouray counties have expressed concerns over the loss of open space, wildlife habitat, and their unique natural surroundings. They have recognized the need to plan for the conservation of plants and animals that are native to the Uncompahgre River Basin, especially those that depend on this area for their survival.

The Uncompahgre River Basin contains a diverse array of wetlands that support a wide variety of plants, animals, and plant communities. At least 32 major wetland/riparian plant communities, 10 birds, 1 plant, 1 fish, and 1 amphibian from the Colorado Natural Heritage Program's (CNHP) list of rare and imperiled plants, animals, and plant communities are known to occur in, or are associated with, wetlands in the Uncompahgre River Basin. In addition to their biological significance, these wetlands perform many functions that provide value to the residents of the county and the communities down river. Uncompahgre River Basin wetlands maintain water quality, provide wildlife habitat, provide recreational opportunities, and add to the aesthetic quality of eastern Montrose and Ouray counties.

In 1998, CNHP received funding to inventory wetland areas within the Uncompahgre River Basin. Wetlands occurring on private lands were given the highest priority for inventory. The U.S. Environmental Protection Agency (EPA) provided the funding for this project to the Colorado Department of Natural Resources (CDNR), which selects projects and administers funding. The purpose of the funding is to provide local planners, resource managers, and citizens with information on the status and value of their riparian and wetland areas, as well as restoration potential. This report presents the results of a comprehensive wetland survey designed to better understand the types of wetlands that occur in the Uncompahgre River Basin, along with their distribution and their natural heritage value.

In 1998, CNHP scientists began their research by updating the Biological and Conservation Data System with existing information. These data were drawn from previous studies by various individuals and organizations, the Colorado Division of Wildlife (CDOW) database, regional and local herbaria, local experts, federal agencies, and others. Areas supporting wetland vegetation types in the study area were analyzed and mapped on 7.5 min. quadrangles using aerial photography. CNHP selected a representative number of Targeted Inventory Areas (TIAs), within a range of elevations and locations to survey during the 1998 field season. TIAs were characterized in terms of plant associations, hydrology, and wetland class, then prioritized for on-site inventory based on these criteria. Wetlands heavily impacted by roads, buildings, weeds, agriculture, or grazing were eliminated from the inventory. CNHP initially identified 77 wetlands and riparian areas that merited inventory. More than 40 areas of interest were added to this list during the field season.

A function and value assessment was conducted to provide finer details for each TIA that merited on-site inventory. Fourteen functions and values were evaluated using the

Montana Wetland Field Evaluation Form (Berglund 1996) and the hydrogeomorphic approach (HGM) (Brinson 1993). Function and value data will be incorporated into Microsoft Access and GIS databases created for the Statewide Wetlands Characterization and Classification project scheduled to begin the summer of 1999.

Twenty-five wetland and riparian sites of biodiversity significance are profiled in this report. These sites represent the best examples of 32 types of wetland and riparian communities observed on public and private lands. CNHP believes these sites include those wetlands that most merit conservation efforts, while emphasizing that protecting only these sites will, in no way, adequately protect all the values associated with wetlands in the Uncompahgre River Basin. Additionally, four areas of local significance have been identified based on the local importance of their functions and values within Ouray and eastern Montrose counties. The delineation of Potential Conservation Area boundaries in this report does not confer any regulatory protection on recommended areas. They are intended to be used to support wise planning and decision making for the conservation of these significant areas.

Recommendations for a comprehensive approach to wetland conservation in the Uncompahgre River Basin are presented. Rapid growth throughout much of the valley continues to pose a threat to wetlands through encroachment, fragmentation, altered hydrology, and weed introduction. Historically, some of the most profound impacts on Colorado's wetlands have resulted from changes in hydrology imposed by reservoirs, diversion, irrigation ditches, canals, and ground water pumping. As water becomes an increasingly valuable commodity in western Colorado, more changes of this type are anticipated.

In addition to providing important information for Ouray and eastern Montrose counties, this inventory will advance efforts to evaluate and manage wetlands on state and regional levels. Wetland plant community information gathered during this project is being assimilated into the Statewide Wetlands Characterization and Classification Project and the Terrestrial Vegetation of the United States (Anderson et al. 1998). Policy makers, land use planners, and resource managers can use information in the classification to make informed decisions governing the use and conservation of natural heritage resources.

Information from this effort will also be used to enhance the development of a program for hydrogeomorphic (HGM) wetland function assessment. This report can be used to help identify wetland subclasses in the area, and to better characterize the range of variation within a subclass. Additionally, several of the sites profiled in this report have the potential for use as reference sites, or to be part of the reference standard.

RECOMMENDATIONS

Specific protection and management needs are addressed under the descriptions of individual sites. However, some general recommendations for conservation of biological diversity in the Uncompahgre River Basin are given here.

1) **Develop and implement a plan for protecting the Potential Conservation Areas profiled in this report**. Strong consideration should be given to protecting sites with global and statewide significance as indicated by Biodiversity Rank (B1=highest priority, B5=lowest priority). Protection priority should then be given to "locally significant areas". These sites provide the Uncompahgre River Basin with the basic framework to implement a wetland conservation program.
2) **Treat all the sites included in this report as "red flags" when considering proposals for commercial and residential land use changes**. Wetlands with significant natural heritage elements generally require a buffer from development of at least 300 ft.
3) **Consider the effects on wetlands, especially the significant wetlands identified in this report, when evaluating proposals for water diversions, extensive development within a watershed, ground water development, and other activities potentially affecting wetlands**. Hydrology defines wetlands, and wetlands can often be affected by changes in hydrology far from their boundaries. Changes in water quality and quantity must be considered in planning for protection of significant wetlands of the Uncompahgre River Basin.
4) **Develop and implement a basin-wide wetland conservation program**. Use the U.S. Fish and Wildlife Service definition of wetlands and this report to guide this program. Develop a system of buffers, while recognizing that some wetlands, such as those with natural heritage significance, require larger buffers.
5) **Make the riparian zone of the Uncompahgre River a top priority for conservation and restoration efforts**. The Valley Land Conservancy has taken the lead in working to protect private lands along the Uncompahgre River corridor (Hoag 1997). A long-term comprehensive watershed level management plan should include the following components:
    a) **A preliminary study of the Uncompahgre River to determine the current physical dynamics of the system, and what natural and cultural values the riparian corridor is capable of supporting now, and for the future.**
    b) **Within the context of the findings of the physical study mentioned above, identify site specific goals for the entire length of the Uncompahgre River.** Goals for enhancing or improving the riparian zone may include the following: wildlife habitat and biodiversity values, sediment/nutrient/toxicant removal, bank stabilization and flood control, aesthetics, open space and recreation.
    c) **Develop incentives or mechanisms to encourage good stewardship of the Uncompahgre River.** Such incentives may include: conservation easements, tax incentives, voluntary participation in wetland protection programs such as CDOW Wetlands Program, and enhancement programs such as the NRCS Wetland Reserve Program and the U.S. Fish and Wildlife Service Partners for Wildlife

Program, and purchase of critical riparian and wetland habitat by public agencies, local government, or private conservation organizations.

6) **Prohibit the introduction, sale, and planting of plants that are known to negatively and profoundly affect wetland and riparian areas**. These include, but are not limited to purple loosestrife, tamarisk and Russian olive. Encourage land managers and others to remove these plants from their properties.
7) **Encourage and support statewide wetland protection efforts**. County government is encouraged to support research efforts on wetlands. Countywide education of the importance of wetlands could be implemented through the county extension service or other local agencies. Cultivate communication and cooperation with landowners regarding protection of wetlands in the Uncompahgre River Basin.

PROJECT BACKGROUND AND PURPOSE

Wetlands are places where soils are inundated or saturated with water long enough and frequently enough to significantly affect the plants and animals that live and grow there. Until recently, most people viewed wetlands as a hindrance to productive land use. Consequently, many wetlands across North America were purposefully drained. Kelly et al. (1993) states that wetlands in the United States are being lost at a rate of 260,000 acres/year (105,218 ha/year). In Colorado an estimated 1 million acres of wetlands (50% of the total for the state) were lost prior to 1980 (Dahl 1990).

Although the rate of wetland loss in the Uncompahgre River Basin is difficult to quantify, it is clear that many of eastern Montrose and Ouray counties' wetlands, especially along the Uncompahgre River, have been destroyed or profoundly altered from their pre-settlement state. Agriculture, grazing, development, reservoirs, water diversions, and mining of minerals and gravel have had tremendous impacts on wetlands throughout the Uncompahgre River Basin. Fertile soils and available water for irrigation attract agriculture to floodplains. Since the nineteenth century hydrological diversions developed for irrigation, recreation, and drinking water supplies, have removed water from some wetlands, and created other wetlands very different from those in existence prior to European settlement. For example, the vast wetland complexes that historically occurred in the Lower Uncompahgre River bottomlands have been reduced to a fraction of their former extent; while the development of an extensive network of canals has created irrigation-induced wetlands where none previously existed. It is clear that with the current rate of land use conversion and the lack of comprehensive wetland protection programs, wetlands will continue to be lost or dramatically altered.

Because of the profound physical change water resources have undergone in the Uncompahgre River Basin, the goal of restoring degraded wetlands and riparian areas to pre-settlement conditions is probably not realistic. However, by enacting a watershed level wetland protection and enhancement program, many of the beneficial functions and values performed by wetlands could be enhanced, re-created or restored.

Increasingly, local Colorado governments and federal agencies, particularly in rapidly growing parts of the state, are expressing a desire to better understand their natural heritage resources, including wetlands. The Colorado Natural Heritage Program approached this project with the intent of addressing this desire.

The primary goal of this project was to identify significant wetlands within the Uncompahgre River Basin, with an emphasis on private lands in accordance with the EPA's mission to protect human health and safeguard the natural environment — air, water, and land — upon which life depends. In order to do this, CNHP determined which wetlands in eastern Montrose and Ouray counties support rare and imperiled plants, animals, and significant natural communities. To supplement the biological information, CNHP also assessed all the other functions and values attributed to each wetland. The overall goal of this project was to facilitate better understanding of the wetlands that occur in The Uncompahgre River Basin, and thus, extend overall knowledge of Colorado

wetlands. A secondary goal was to identify wetlands in good condition to serve as reference sites to guide restoration efforts, and to identify wetlands that are good candidates for potential restoration efforts.

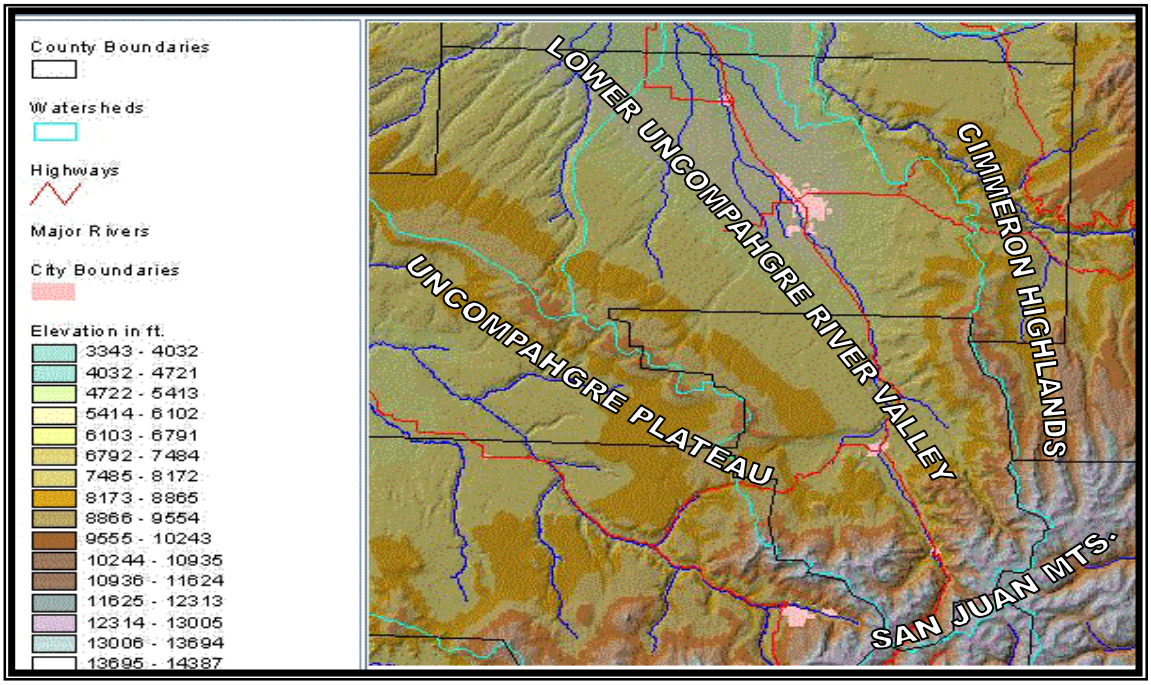
STUDY AREA

The purpose of this section is to briefly describe the physical environment and natural processes that control the potential distribution, abundance, and characteristics of wetlands and riparian areas across the landscape. With a basic understanding of the natural context, the magnitude of anthropogenic change imposed upon the hydrology of the Uncompahgre River Basin can be appreciated. The effect of post settlement land-use activities on wetland and riparian ecology cannot be overemphasized. U.S. Bureau of Reclamation Engineer Glen Stone states, "Every drop of water in the Lower Uncompahgre River Valley has been used and reused. I don't think you can really find such a thing as a natural wetland."

General Description

The study area is located in an intermountain valley lying along the western flank of the Rocky Mountains, and includes those parts of eastern Montrose and Ouray counties drained by the Uncompahgre and Gunnison rivers and their tributaries. The Uncompahgre River Basin falls at the dividing line between the Southern Rocky Mountain and Colorado Plateau provinces of Bailey's Ecoregions (Bailey 1994). The Uncompahgre River flows in a northwesterly direction to its confluence with the Gunnison River at the town of Delta. Cimarron Ridge confines the drainage area to the east, the Uncompahgre Plateau to the west, and the high peaks of the San Juan Mountains to the south. Elevations range from 5,190 ft. (1,582 m) where the Uncompahgre River flows out of Montrose County to 14,300 ft. (4,359 m) on Uncompahgre Peak (Figure 1).

Figure 1. Uncompahgre River Basin Study Area (NDIS 1999).



For discussion purposes, and in the presentation of Potential Conservation Sites (page 42) the physiography, geology, regional hydrology, and land use history of the area can be divided into several major sub-regions: the **Lower Uncompahgre River Valley,** the **Uncompahgre Plateau**, the **Cimarron Ridge Uplands**, and the **San Juan Mountains**.

Land ownership in the Uncompahgre valley follows this general pattern: private lands are concentrated in the valleys, mid elevation rangelands are managed by the Bureau of Land Management (BLM) or held by large private ranches, and higher elevation forests and alpine are managed by the Uncompahgre National Forest or designated as Wilderness (Figure 2).

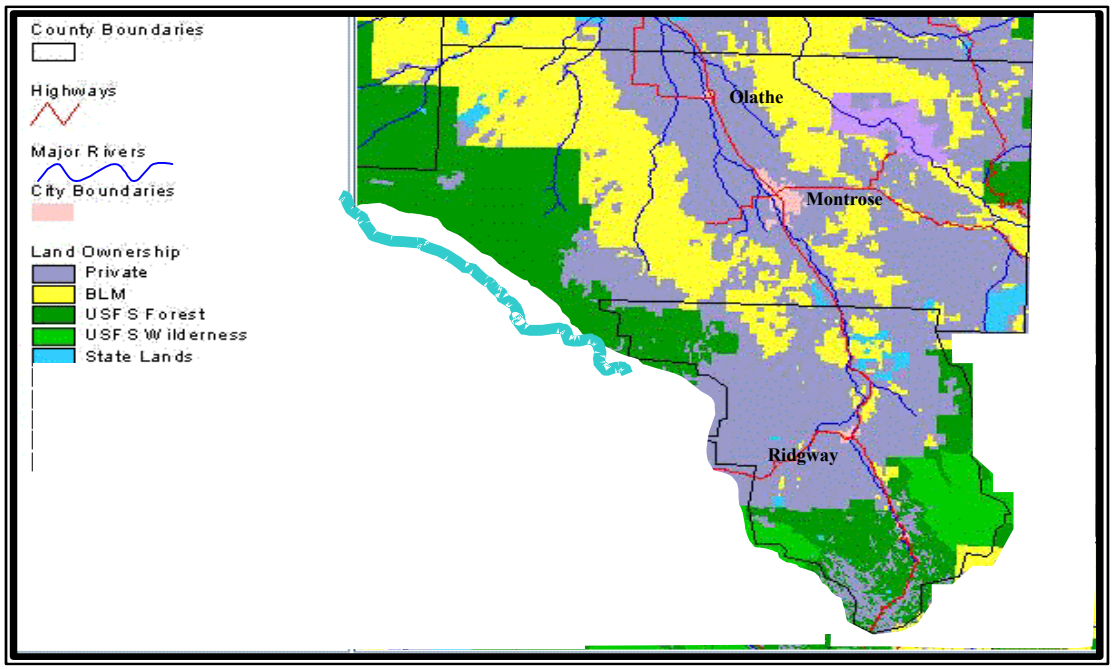


Figure 2. Land ownership in the Uncompahgre River Basin (NDIS 1999).

Physiography and Geology

Major geologic formations of the Uncompahgre River Basin include: sandstone and shale deposited by a great inland sea that covered western Colorado in the Triassic, Jurassic and Cretaceous periods 135 to 65 million years ago (mya), Tertiary volcanic rocks (35 mya), and unconsolidated glacial and fluvial sediments of Quaternary age (1.5 mya to 10,000 years ago) (Chronic 1980).

Lower Uncompahgre River Valley. Mancos Shale, a marine formation with a high salt content, underlies most of the valley of the Uncompahgre River. In the upper Uncompahgre River Valley surficial Pleistocene glacial moraine and outwash gravels mantle the Mancos Shale, while parts of the lower river valley are mantled by alluvial (river deposited) material. Soils of the Lower Uncompahgre River Valley ar mostly derived from the Mancos Shale and have a high clay content, are high in soluble salts, have a very low permeability, and are susceptible to sheet and gully erosion (USDA 1967).

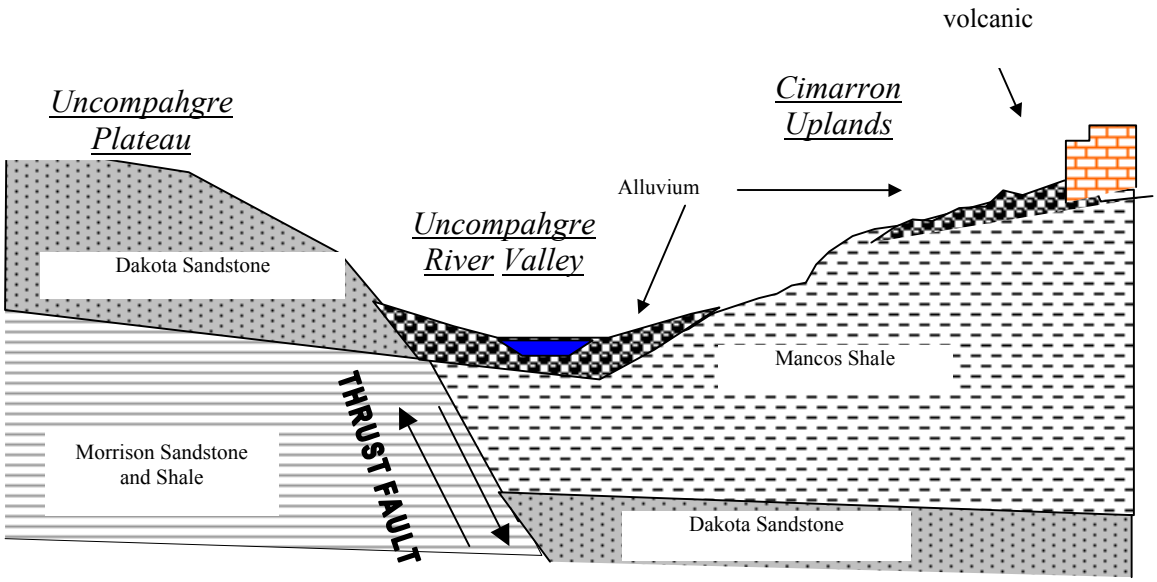


Figure 3. Generalized geologic cross-section of the Lower Uncompahgre River Valley between Ridgway and Montrose (from Tweto 1979)

Uncompahgre Plateau. The major geologic structural feature in the area is the Uncompahgre uplift, which borders the Lower Uncompahgre River Basin to the west. The ninety-mile long northwest trending Uncompahgre Plateau is a great fault uplifted during the late Cretaceous period of tectonic activity that built the Rocky Mountains (Chronic 1980). The surface of the plateau is a resistant cap of northeast dipping Dakota sandstone rising up to 9,685 ft. (2,958 m), from which the overlying Mancos Shale has been eroded away. As the block was pushed upward, jointing occurred perpendicular to the axis of uplift, resulting in many closely spaced parallel cracks trending northeast. Tributaries arising on the plateau have carved canyons through the sandstone bedrock. Soils developing on the sandstone plateau tend to be shallow and well drained (USDA 1967).

Cimarron Ridge Uplands. Uplands to the west of the Uncompahgre River Valley are mostly of younger volcanic origin with loosely consolidated landslide and glacial alluvial deposits, resting precariously upon the Mancos Shale. The gently southward dipping Mancos Shale is made up of layer upon layer of flat plate-like strata, which are relatively impermeable to the vertical movement of water. These layers form a slippery surface on which the overlying volcanic and alluvial deposits frequently slide and slump, especially when the contact layer is saturated with water (Chronic 1980).

San Juan Mountains. The southern portion of the Uncompahgre River Valley begins high in the San Juan Mountains. These rugged and scenic mountains have several peaks above 14,000 ft. (330 m). The San Juans were formed by volcanic activity in the Tertiary period (35 mya). During their explosive formation gold, silver, lead, and other metals were concentrated in veins of intrusive igneous rock. Oxidized iron-bearing deposits exposed at the surface give the mountains their striking red, yellow-orange and brown hues. During the Quaternary period, glaciers covered the San Juans, carving knife edge ridges and typical U-shaped valleys. The valley from Ouray to Ridgway was buried beneath 1,000 ft. of glacial ice some 18,000 years ago. As the ice retreated, it left behind lakes in the valley floors that gradually filled in with fine sediments and coarser gravels (Blair 1996).

Climate and Vegetation

With an elevation change of 8,950 ft. (2,728 m) from the Lower Uncompahgre River Valley to the high peaks of the San Juan Mountains, there is a great variety of vegetation in the Uncompahgre River Basin (Figure 4). Vegetation zones range from desert shrub communities at the lowest elevations, to alpine tundra. Traveling from Olathe to Red Mountain Pass can be compared to traveling from Colorado to northern Canada.

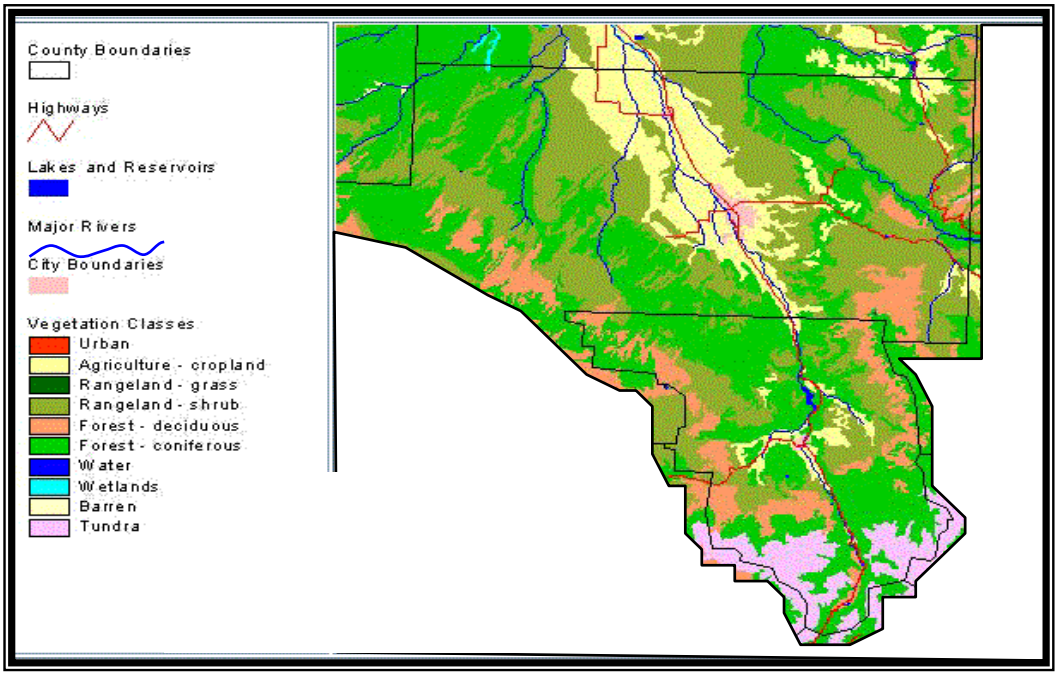


Figure 4. General vegetation patterns in the Uncompahgre River Basin Study Area (NDIS 1999).

Vegetation in eastern Montrose County and Ouray County can be classified into seven broad types, each containing several plant associations. These types more or less correspond to elevation. From lowest to highest, they are:

1. Riparian zone of the Uncompahgre River
2. Shrub-steppe of salt desert shrubs or sagebrush
3. Pinyon and juniper woodlands
4. Gambel's oak-Mountain shrublands
5. Mixed conifer and aspen forests
6. Engelmann spruce-subalpine fir forests
7. Alpine

Lower Uncompahgre River Valley. In many ways, the climate of the Lower Uncompahgre Valley is typical of intermountain valleys on the western slope. At elevations below 7,000 ft. (2,134 m) the climate can be characterized as semi-arid, with low precipitation, low humidity, abundant sunshine, and a wide range in daily and annual temperatures. The mean annual temperature recorded at the regional weather station in Delta is 51°F (11°C) ranging from a mean maximum temperature for July of 94°F

(34°C), to a minimum mean temperature for January of 14°F (-10°C) (Western Regional Climate Center 1999). At an elevation of 5,830 ft. (1,777 m) the mean annual precipitation for Montrose is 9 in. (23 cm), about half of that is in the form of winter snow.

The two major vegetation zones are:

1. Shrub-steppe of salt desert shrubs or sagebrush
2. Riparian zone of the Uncompahgre River

The Shrub-step is dominated by shadscale (*Atriplex confertifolia*), greasewood (*Sarcobatus vermiculatus*), four-winged saltbush (*Atriplex canescens*), big sagebrush (*Artemisia tridentata*), snakeweed (*Gutierrezia* spp.), and rabbitbrush (*Chrysothamnus* spp.). These shrubs are associated with grasses or other hardy herbaceous species such as saltgrass (*Distichlis spicata*), alkali sacaton (*Sporobolis aeroides*), blue gramma (*Bouteloua gracilis*), foxtail barley (*Hordeum jubateum*). Vegetation growing on the Mancos Shale tends to be sparse because of the clay soil's high salinity content, low moisture availability, and tendency to shrink and swell.

Riparian zones and wetlands allong the Uncompahgre River comprise several distinct plant communities. At low elevations in eastern Montrose County, native vegetation of the riparian zone is dominated by narrowleaf cottonwood with an understory of coyote willow or skunkbrush. Riparian plant communities that occur along the Uncompahgre River at lower elevations and are tracked by the Colorado Natural Heritage Program include: *Populus angustifolia/Rhus trilobata*, *Populus angustifolia/Salix exigua*, and *Salix exigua/mesic graminoid*. Wetlands with standing water or a high water table are characterized by cattails, giant reed, reed canary grass, and a variety of sedges and rushes. Tracked wetland communities are *Typha latifolia*, and *Phragmites australis*.

Farther upstream, between Colona and Ridgway, narrowleaf cottonwood still dominates, but silver buffaloberry, Rocky Mountain juniper, river birch, and red-osier dogwood are increasingly common understory species. Tracked communities here include *Populus angustifolia/Salix ligulifolia-Shepherdia argentea*, *Populus angustifolia/Juniperus scopulorum*, *Populus angustifolia/Alnus incana*, and *Populus angustifolia/Cornus sericea*.

As elevation increases toward Ouray, conifers, including blue spruce, Douglas fir and white fir are added. Deciduous trees and shrubs such as thinleaf alder, aspen, and Rocky Mountain and Drummond willows are common riparian species here. Tracked communities include *Populus angustifolia-Picea pungens/Alnus incana*, *Salix monticola*/mesic forb, *Picea pungens/Cornus sericea*, *and Pseudotsuga menziesii/Cornus sericea*. Higher yet, subalpine fir and Engelmann spruce take over as the dominant species. Tracked communities include *Abies lasiocarpa-Picea engelmannii/Alnus incana*, *Abies lasiocarpa-Picea engelmannii/Mertensia ciliata*, *Abies lasiocarpa-Picea engelmannii/Salix drummondiana*, *Picea engelmannii/Heracleum lanatum*, *Alnus incana/*mesic forb, and *Salix drummondiana/Carex utriculata*.

Uncompahgre Plateau and Cimarron Ridge Uplands. At approximately 7,000 ft. (2,134 m) precipitation begins to increase, along with effective moisture and length of

time snowfall remains on the ground before melting. Annual average precipitation probably ranges from 14 in. (35.5 cm) at lower elevations to 25 in. (63.5 cm) at higher elevations (Western Regional Climate Center 1999).

Vegetation patterns follow the moisture and elevation gradient. As one climbs through the elevation zones, the habitat types encountered are:

1. Pinyon and juniper woodlands
2. Gambel's oak-Mountain shrublands
3. Mixed conifer and aspen forests
4. Engelmann spruce-subalpine fir forests

San Juan Mountains. Precipitation can be considerable, with most moisture falling as snow. The most snowfall measured in one winter was 581 in. (1,476 cm) in the winter of 1975 and spring 1976, with 184 in. (467 cm) still on the ground April 13 that same year (Keen 1996). As one climbs through the elevation zones, the habitat types encountered are:

1. Mixed conifer and aspen forests
2. Engelmann spruce-subalpine fir forests
3. Alpine

At the headwaters of the Uncompahgre River, trees become less frequent, and finally disappear altogether, replaced by low growing willows or bog birch, and then alpine meadows and wetlands. Typical plant communities here include *Salix planifolia -Salix brachycarpa/ Caltha leptosepala.* At Ironton Park, along Red Mountain Creek, a major tributary of the Uncompahgre River, there is a large colony of bog birch, *Betula glandulosa/*mesic forb-esic graminoid.

Regional Hydrology

The physiographic, climatic, and geologic variables discussed above combine to control the natural distribution and characteristics of wetlands and riparian areas.

Lower Uncompahgre River Valley. Most of the semi-arid Lower Uncompahgre River Valley is underlain with Mancos Shale. Because of the dry climate and impermeable nature of the geology and soils, naturally occurring wetland habitat is mainly limited to the river bottoms.

Historically the broad river bottoms of the Uncompahgre valley supported extensive and diverse riparian woodlands with large willow carrs and cattail marshes (Rector et al. 1979). Open water could be found in abandoned oxbows and sloughs. Released from their incised stream channels, tributaries descending from the Uncompahgre plateau were free to meander across the alluvial plains covering the valley floor west of the Uncompahgre River. Five wetlands most often mentioned in early descriptions of the area are: the Uncompahgre River bottoms, Gunnison River bottom, Happy Canyon, Spring Creek, and Dry Creek (Adamus 1993). Wetlands in the outcropping Mancos Shale badlands east of the Uncompahgre River would have been extremely rare, and limited to a few small saline seeps in arroyo bottoms.

Uncompahgre Plateau. At higher elevations, precipitation and effective moisture are sufficient to support wetlands fed by springs emerging from the porous sandstone bedrock. Numerous creeks arise on the plateau, flowing down closely spaced parallel joints in the underlying Dakota sandstone to join with the Uncompahgre or Gunnison rivers.

At lower elevations, the larger creeks have carved deep canyons through the semi-arid landscape, sometimes supporting hanging gardens and seep wetlands where springs emerge from the sandstone cliffs. Major tributaries draining the Uncompahgre Plateau include: Escalante Creek, Cottonwood Creek, Monitor Creek, Roubideau Creek, Dry Creek, Spring Creek, Happy Canyon, and Horsefly Creek.

Cimarron Ridge Uplands. The uplands to the east of the Uncompahgre River have the potential to support natural wetlands. Most of the area is above 7,000 ft. (2,134 m), and receives significantly more rain and snow than the adjacent lowlands. Precipitation easily infiltrates the porous volcanic and alluvial soils; however, the underlying Mancos Shale prevents deep percolation. Groundwater is trapped in the upper layers, where it eventually comes to the surface in seeps or springs. Hillside slumping and sliding over the shale creates an undulating topography with depressions and ridges where water can collect. In locations with shallow depth to bedrock, water levels fluctuate with climate cycles. During longer periods of below average precipitation, smaller ponds may shrink or dry up (Sherman 1999).

The San Juan Mountains. Glaciers sculpted the landscape of the San Juan Mountains into U-shaped valleys and high basins, surrounded by spectacular jagged peaks, headwalls, horns and aretes. The high topographic relief funnels snowmelt and runoff to collect in the basins and broad flat-bottomed valleys.

In high alpine basins, shallow depth to bedrock or permafrost maintains a high water table. Snowmelt percolates through the shallow soils to emerge as springs that feed tarn lakes, slope wetlands, wet alpine meadows, willow carrs, and small creeks. Pocket-like depressions form as heavy snow and ice press down on saturated soils, often filling with snowmelt and spring water to form shallow ponds.

In some of the larger valleys, end terminal moraines left by retreating glaciers dammed melt-water. These lakes gradually filled in with alluvial gravels which serve as deep aquifers, and often support extensive willow carrs (Blair 1996). Springs also come to the surface in places of topographic convergence such as at the foot of a concave slope, or basin where two valleys meet. Beavers can play an important role creating and maintaining montane wetlands by building dams that store water and spread it out across the valley floor.

Steep mountain streams and rivers deliver huge peak flows in high snowmelt years, rolling large rocks and gravel down their river beds and carrying large volumes of suspended sediment. Flooding rivers are constantly destroying their banks, then rebuilding them with material deposited as their turbulent waters subside. Where a

river's gradient moderates and the valley widens coarse bedload is dropped, and the river jumps its channel, meandering across the floodplain.

Human Impacts on the Ecology of Wetlands and Riparian Areas

In the semi-arid west, water is life. This is true for all species, including humans. An estimated 80% of vertebrate fauna depend on wetlands for year round habitat or for migratory stopovers (Somers and Floyd-Hanna 1996). Likewise, all farming in the Uncompahgre River Basin is dependent on supplemental irrigation, and large-scale livestock production would not be possible without development of water (USDA 1967).

Beginning at the turn of the century the people of western Colorado, aided by the state and federal government, embarked upon a systematic program to harness all water resources in the valley and put them to use in agricultural production. Because of this remarkable engineering effort, the distribution and ecology of wetland and riparian areas have been greatly altered. Implications of these changes for wetlands and riparian areas are complex; sometimes resulting in surprising hydrological consequences and a few management paradoxes for agencies entrusted to protect wetland habitat.

Lower Uncompahgre River Valley

Uncompahgre River. The natural hydrology of the Lower Uncompahgre River valley has been altered the most of the four major sub-regions. Riparian areas were the first lands to be homesteaded because of their fertile soils, level ground, and easy access to water. Over the past 100 years, river bottoms have been drained and cleared for farmland, and livestock grazing has degraded the understory in remaining cottonwood stands (USDA 1981). Gravel mining in or near the river channel has also disturbed several miles of riparian area. Plant community alterations include a gradual shift from diverse multi-aged riparian woodlands to a mature single aged forest canopy with a shrubby and weedy understory.

Research has demonstrated that the construction of dams and water diversions has had the greatest effect on riparian systems of all human activities in the American West (Somers and Floyd-Hanna 1996). Dams regulate stream flows at a constant level that drastically reduces peak snowmelt flows during the spring, resulting in channelization of the river and loss of natural geomorphic processes that are necessary to maintain riparian communities. In 1990, the Ridgway Dam was completed on the Uncompahgre River. Peak seasonal flows have been reduced from a ten-year peak flow of about 3,500 cubic ft./second (cfs) in the decade before completion of the Ridgway Dam, to a ten-year peak flow of about 1,700 cfs (USGS 1999).

The cumulative effects of dams, reservoirs, irrigation diversions, channelization, overgrazing, lowering of the water table, and conversion to croplands or pasture has been to reduce the total area of river bottom wetlands to a fraction of their historical extent, and to suspend the fluvial processes on which they depend.

Irrigation-induced Wetlands. As riparian wetlands in the Uncompahgre River Basin were lost, the growth of irrigated agriculture inadvertently created new wetlands in areas where

wetlands never existed before. The Uncompahgre Project was begun by the U.S. Bureau of Reclamation to supply water to potential farmland in the Uncompahgre River Basin from the Gunnison River via the 7-mile long Gunnison Tunnel. Completed in 1908, the project now brings water to approximately 91,000 acres of irrigated cropland through 485 miles of off-farm canals and lateral ditches (USDA 1981). According to U.S. Bureau of Reclamation engineer Glen Stone, there are an additional 128 miles of canals, 438 miles of laterals, and 216 miles of drains supplemental to the project area, adding up to over 1,000 miles of off-farm irrigation delivery structures (Stone 1999).

Water seeps from hundreds of miles of unlined canals and earthen ditches. Much of the water applied in irrigation leaves the fields as groundwater and surface runoff. As a result of these over-applications and leaky delivery systems, areas have developed the hydric soils and support the hydrophytic plants that technically meet the definition of a wetland. There are an estimated 14,800 acres of irrigation-induced wetlands that did not exist before irrigation was introduced into the Uncompahgre River Basin (USDA 1981).

As the quality and extent of historically present natural wetlands diminished, some of the habitat loss was offset by the creation of irrigation-induced wetlands. It is debatable whether the biodiversity significance of an integrated network of river bottom wetland can be equated to the dispersed pattern of irrigation-induced wetlands across an agricultural landscape, but local wildlife has become dependent upon the new habitat. An estimated 72% of all reptiles, 77% of all amphibians, 80% of all mammals, and 90% of all bird species generally occurring in the Valley commonly use irrigated wetlands and riparian areas (Adamus 1993). In addition to providing valuable wildlife habitat, irrigation-induced wetlands may be acting to remove nitrate, pesticides, and sediments from agricultural tail waters before entering the Colorado River system.

There are some serious ecological and political problems with irrigation-induced wetlands in the Lower Uncompahgre River Valley. Because of the semi-arid climate, salts have not naturally leached out of the Mancos Shale soils underlying productive farmland (Figure 4). Percolation of excess irrigation water down through the salt-rich soil, and horizontal movement between underlying layers of Mancos Shale, dissolve the salts and severely increase the water's salt content. One usually beneficial wetland function is the recharge of groundwater; however, in the Lower Uncompahgre River Valley subsurface flow is the major cause of poor quality water entering the Colorado River system. About 840,000 tons of salt enter the Colorado River annually as a result of irrigated agriculture in the Lower Gunnison River Valley, which includes the Uncompahgre River (USDA 1981).

The economic cost of such poor quality water delivered to California, Arizona, and Mexico is enormous, and in violation of the Clean Water Act and various treaties with Mexico. Furthermore, third or fourth generation irrigation water carries high concentrations of selenium, which can bio-accumulate to levels that prevent successful reproduction in species of bottom feeding waterfowl. In a semi-arid climate, surface waters in open tail-water fed ponds evaporate quickly, concentrating selenium and causing it to precipitate out in bottom sediments. Benthic invertebrates are eaten by bottom feeding ducks, which in turn suffer reproductive failure. Selenium does not seem to be a problem for non-bottom feeding waterfowl, amphibians, and songbirds using the area, which mostly feed on terrestrial insects (Kruger 1999).

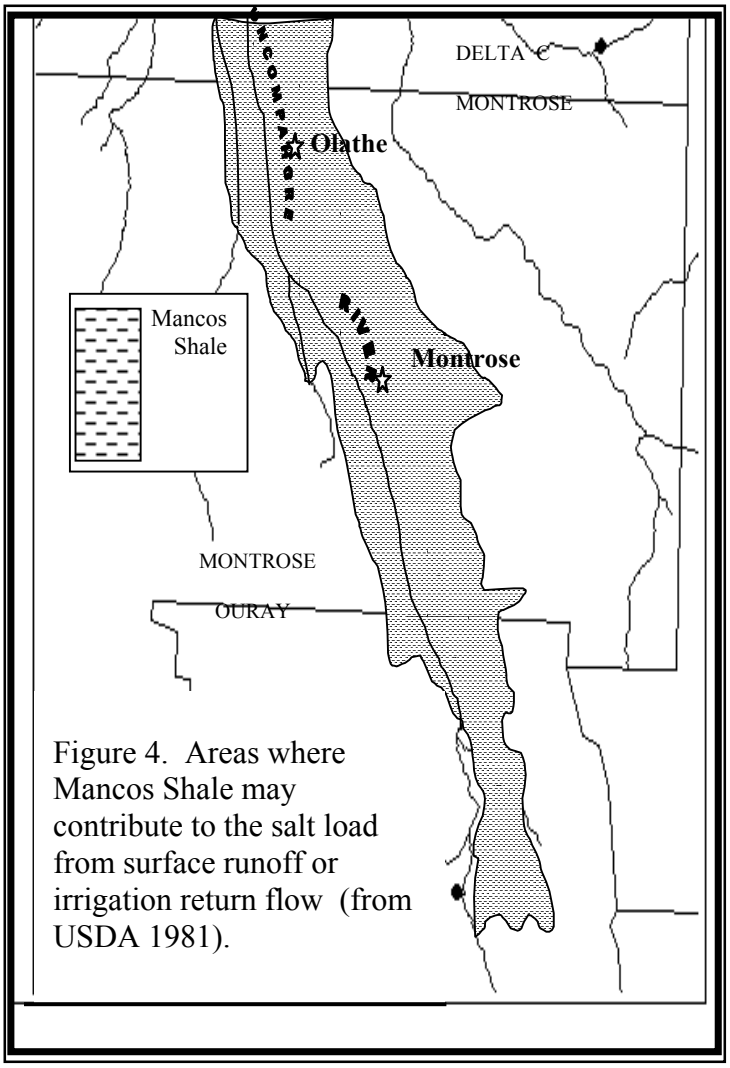


Figure 4. Areas where Mancos Shale may contribute to the salt load from surface runoff or irrigation return flow (from USDA 1981).

In response to the salinity problem, the Colorado River Basin Salinity Control Act of 1974 directed the Department of the Interior (Bureau of Land Management - BLM, U.S. Bureau of Reclamation, U.S. Geologic Service - USGS, U.S. Fish and Wildlife Service -USFWS), the Environmental Protection Agency - EPA, and the Department of Agriculture (U.S. Forest Service - USFS, Natural Resource Conservation Service - NRCS), to effectively coordinate their efforts to reduce salt loading (USDA 1981). Initiatives to manage the problem include lining canals and stock ponds with concrete, using pipes to distribute water instead of open ditches, and discouraging the practice of over-irrigation. Primarily it is the responsibility of the NRCS and the U.S. Bureau of Reclamation to provide financial and technical assistance to farmers who wish to participate in salinity reducing programs.

Salinity control improvements in the area are estimated to reduce the amount of water sustaining up to 13,200 acres of irrigation-induced wetlands (Adamus 1993). There is something of a paradox in this situation. Government agencies are being directed to take action to reduce salt inputs, which will have adverse consequences for the wetland resources they are directed to protect. In order to escape from this regulatory straitjacket, the NRCS's Colorado River Salinity Control Program is monitoring the

program's effects on wetland habitat, and preferentially funds salinity control contracts with private landowners who agree to develop wetland, riparian, and upland wildlife habitat (Warren et al. 1993). In Montrose County, over 80% of the salinity contracts include wildlife habitat improvement projects (Woodis 1998).

Uncompahgre Plateau and Cimarron Ridge Uplands.

Ranchers shared the philosophy of maximum utilization of water resources that inspired agricultural interests to build such ambitious water engineering projects in the Lower Uncompahgre River Valley. Natural water sources that supported diverse types of wetlands were impounded, diverted, or otherwise altered for watering livestock. Because of their steep banks, stock ponds generally do not develop hydric soils or support wetland plants to the extent that natural wetlands do. Stock ponds are often dredged and cleared of aquatic vegetation.

The San Juan Mountains.

The major land use impacts on wetlands and riparian areas in the San Juan Mountains result from mining of minerals in the upper watershed and gravel from the river. Around the turn of the century, the upper basin was home to some of the richest mining fields in the American West. The Mountains above the town of Ouray are literally honeycombed with tunnels and shafts. Ironton Park once supported a population of several thousand people. The Idarado mine just above Ironton Park is connected to the Pandora mine six miles to the west in Telluride Valley by 80 miles of tunnels (Blair 1996). Acid drainage from tailings piles and extensive mine tunnels severely effects the water quality of Red Mountain Creek and the upper Uncompahgre River (Hoag 1997).

The lush forests and meadows of the San Juan Mountains have also served as summer pasture for sheep and cattle. In such rugged terrain, livestock tend to concentrate in the valley bottoms and meadows where the terrain is gentler and vegetation is abundant. These areas often support wetlands and riparian areas. Livestock concentrating in wetlands and riparian areas through the growing season, year after year, can trample stream banks, lower the water table, alter channel morphology, cause streams to downcut, impair plant regeneration, establish weedy and exotic species, shift community structure and composition, degrade water quality, and diminish general riparian and wetland functions (Windell *et al*. 1986).

THE NATURAL HERITAGE NETWORK AND BIODIVERSITY

Colorado is well known for its rich diversity of geography, wildlife, plants, and plant communities. However, like many other states, it is experiencing a loss of much of its flora and fauna. This decline in biodiversity is a global trend resulting from human population growth, land development, and subsequent habitat loss. Globally, the loss in species diversity has become so rapid and severe that Wilson (1988) has compared the phenomenon to the great natural catastrophes at the end of the Paleozoic and Mesozoic eras.

The need to address this loss in biodiversity has been recognized for decades in the scientific community. However, many conservation efforts made in this country were not based upon preserving biodiversity; instead, they primarily focused on preserving game animals, striking scenery, and locally favorite open spaces. To address the absence of a methodical, scientifically-based approach to preserving biodiversity, Robert Jenkins, in association with The Nature Conservancy, developed the Natural Heritage Methodology in 1978.

Recognizing that rare and imperiled species are more likely to become extinct than common ones, the Natural Heritage Methodology ranks species according to their rarity or degree of imperilment. The ranking system is scientifically based upon the number of known locations of the species as well as its biology and known threats. By ranking the relative rareness or imperilment of a species, the quality of its populations, and the importance of associated proposed Conservation Areas, the methodology can facilitate in prioritizing conservation efforts so the most rare and imperiled species may be preserved first. As the scientific community began to realize that plant communities are equally important as individual species, this methodology has also been applied to ranking and preserving rare plant communities as well as the best examples of common communities.

The Natural Heritage Methodology is used by Natural Heritage Programs throughout North, Central, and South America, forming an international database network. Natural Heritage Network data centers are located in each of the 50 U.S. states, five provinces of Canada, and 13 countries in South and Central America and the Caribbean. This network enables scientists to monitor the status of species from a state, national, and global perspective. It also enables conservationists and natural resource managers to make informed objective decisions in prioritizing and focusing conservation efforts.

What is Biological Diversity?

Protecting biological diversity has become an important management issue for many natural resource professionals. Biological diversity at its most basic level includes the full range of species on Earth, from species such as bacteria and protists, through multicellular kingdoms of plants, animals, and fungi. At finer levels of organization, biological diversity includes the genetic variation within species, both among geographically separated populations and among individuals within a single population. On a wider scale, diversity includes variations in the biological communities in which species live, the ecosystems in which communities exist, and the interactions among these levels. All levels are necessary for the continued survival of species and plant communities, and all are important for the well-being of humans. It stands to reason that biological diversity should be of concern to all people.

The biological diversity of an area can be described at four levels:

1. **Genetic Diversity** -- the genetic variation within a population and among populations of a plant or animal species. The genetic makeup of a species is variable between populations within its geographic range. Loss of a population results in a loss of genetic diversity for that species and a reduction of total biological diversity for the region. This unique genetic information cannot be reclaimed.
2. **Species Diversity** -- the total number and abundance of plant and animal species and subspecies in an area.
3. **Community Diversity** -- the variety of natural communities within an area that represent the range of species relationships and inter-dependence. These communities may be diagnostic or even endemic to an area. It is within communities that all life dwells.
4. **Landscape Diversity** -- the type, condition, pattern, and connectedness of natural communities. A landscape consisting of a mosaic of natural communities may contain one multifaceted ecosystem, such as a wetland ecosystem. A landscape also may contain several distinct ecosystems, such as a riparian corridor meandering through shortgrass prairie. Fragmentation of landscapes, loss of connections and migratory corridors, and loss of natural communities all result in a loss of biological diversity for a region. Humans and the results of their activities are integral parts of most landscapes.

The conservation of biological diversity must include all levels of diversity: genetic, species, community, and landscape. Each level is dependent on the other levels and inextricably linked. In addition, and all too often omitted, humans are also linked to all levels of this hierarchy. We at the Colorado Natural Heritage Program believe that a healthy natural environment and human environment go hand in hand, and that recognition of the most imperiled elements is an important step in comprehensive conservation planning.

Colorado Natural Heritage Program

To place this document in context, it is useful to understand the history and functions of the Colorado Natural Heritage Program (CNHP). CNHP is the state's primary comprehensive biological diversity data center, gathering information and field observations to help develop statewide conservation priorities. After operating in Colorado for 14 years, the Program was relocated from the State Division of Parks and Outdoor Recreation to the University of Colorado Museum in 1992, and more recently to the College of Natural Resources at Colorado State University.

The multi-disciplinary team of scientists and information managers gathers comprehensive information on rare, threatened, and endangered species and significant plant communities of Colorado. Life history, status, and locational data are incorporated into a continually updated data system. Sources include published and unpublished literature, museum and herbaria labels, and field surveys conducted by knowledgeable naturalists, experts, agency personnel, and our own staff of botanists, ecologists, and zoologists. Information management staff carefully plot the data on 1:24,000 scale USGS maps and enter it into the Biological and Conservation Data System. The Element Occurrence database can be accessed from a variety of angles, including taxonomic group, global and state rarity rank, federal and state legal status, source, observation date, county, quadrangle map, watershed, management area, township, range, and section, precision, and conservation unit.

CNHP is part of an international network of conservation data centers that use the Biological and Conservation Data System developed by The Nature Conservancy. CNHP has effective relationships with several state and federal agencies, including the Colorado Natural Areas Program, Colorado Department of Natural Resources and the Colorado Division of Wildlife, the U.S. Environmental Protection Agency, and the U.S. Forest Service. Numerous local governments and private entities also work closely with CNHP. Use of the data by many different individuals and organizations, including Great Outdoors! Colorado, encourages a proactive approach to development and conservation thereby reducing the potential for conflict. Information collected by the Natural Heritage Programs around the globe provides a means to protect species before the need for legal endangerment status arises.

Concentrating on site-specific data for each element of natural diversity allows us to evaluate the significance of each location to the conservation of Colorado's, and indeed the nation's, natural biological diversity. By using species imperilment ranks and quality ratings for each location, priorities can be established for the protection of the most sensitive or imperiled sites. A continually updated locational database and priority-setting system such as that maintained by CNHP provides an effective, proactive land-planning tool.

The Natural Heritage Ranking System

Information is gathered by CNHP on Colorado's plants, animals, and plant communities. Each of these species and plant communities is considered an **element of natural diversity**, or simply an **element**. Each element is assigned a rank that indicates its relative degree of imperilment on a five-point scale (e.g., 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences, i.e., the number of known distinct localities or populations. This factor is weighted more heavily because an element found in one place is more imperiled than something found in twenty-one places. Also of importance are the size of the geographic range, the number of individuals, trends in both population and distribution, identifiable threats, and the number of already protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State or S-rank) and the element's imperilment over its entire range (its Global or G-rank). Taken together, these two ranks give an instant picture of the degree of imperilment of an element. CNHP actively collects, maps, and electronically processes specific occurrence information for elements considered extremely imperiled to vulnerable (S1 - S3). Those with a ranking of S3S4 are "watchlisted," meaning that specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted. A complete description of each of the Natural Heritage ranks is provided in Table 1.

This single rank system works readily for all species except those that are migratory. Those animals that migrate may spend only a portion of their life cycles within the state. In these cases, it is necessary to distinguish between breeding, non-breeding, and resident species. As noted in Table 1, ranks followed by a "B", e.g., S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N", e.g., S4N, refer to nonbreeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

Table 1. Definition of Colorado Natural Heritage Imperilment Ranks.

Global imperilment ranks are based on the range-wide status of a species. State imperilment ranks are based on the status of a species in an individual state. State and Global ranks are denoted, respectively, with an "S" or a "G" followed by a character. **These ranks should not be interpreted as legal designations.**

G/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction.
G/S2	Imperiled globally/state because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range.
G/S3	Vulnerable through its range or found locally in a restricted range (21 to 100 occurrences).
G/S4	Apparently secure globally/state, though it might be quite rare in parts of its range, especially at the periphery.
G/S5	Demonstrably secure globally/state, though it may be quite rare in parts of its range, especially at the periphery.
GX	Presumed extinct.
G#?	Indicates uncertainty about an assigned global rank.
G/SU	Unable to assign rank due to lack of available information.
GQ	Indicates uncertainty about taxonomic status.
G/SH	Historically known, but not verified for an extended period, usually.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.
S#B	Refers to the breeding season imperilment of elements that are not permanent residents.
S#N	Refers to the non-breeding season imperilment of elements that are not permanent residents. Where no consistent location can be discerned for migrants or non-breeding populations, a rank of SZN is used
SZ	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected.
SA	Accidental in the state.
SR	Reported to occur in the state, but unverified.
S?	Unranked. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

Notes: Where two numbers appear in a state or global rank (e.g., S2S3), the actual rank of the element falls between the two numbers.

Protection Urgency Ranks

Protection urgency ranks (P-ranks) refer to the time frame in which conservation protection must occur. In most cases, this rank refers to the need for a major change of protective status (e.g., agency special area designations or ownership). The urgency for protection rating reflects the need to take legal, political, or other administrative measures to alleviate threats that are related to land ownership or designation. The following codes are used to indicate the rating which best describes the urgency to **protect** the area:

P1 Immediately threatened by severely destructive forces, within 1 year of rank date; protect now or never!
P2 Threat expected within 5 years.
P3 Definable threat but not in the next 5 years.
P4 No threat known for foreseeable future.
P5 Land protection complete or adequate reasons exists not to protect the site; do not act on this site.

A protection action involves increasing the current level of legal protection accorded one or more tracts at a potential conservation area. It may also include activities such as educational or public relations campaigns or collaborative planning efforts with public or private entities to minimize adverse impacts to element occurrences at a site. It does not include management actions, i.e., any action requiring stewardship intervention. Threats that may require a protection action are as follows:

1) Anthropogenic forces that threaten the existence of one or more element occurrences at a site; e.g., development that would destroy, degrade or seriously compromise the long-term viability of an element occurrence and timber, range, recreational, or hydrologic management that is incompatible with an element occurrence's existence;
2) The inability to undertake a management action in the absence of a protection action; e.g., obtaining a management agreement;
3) In extraordinary circumstances a prospective change in ownership management that will make future protection actions more difficult.

Management Urgency Ranks

Management urgency ranks (M-ranks) indicate the time frame in which a change in management of the element or site must occur. Using best scientific estimates, this rank refers to the need for management in contrast to protection (e.g., increased fire frequency, decreased herbivory, weed control, etc.). The urgency for management rating focuses on land use management or land stewardship action required to maintain element occurrences at the potential conservation area.

A management action may include biological management (prescribed burning, removal of exotics, mowing, etc.) or people and site management (building barriers, rerouting trails, patrolling for collectors, hunters, or trespassers, etc.). Management action does not

include legal, political, or administrative measures taken to protect a potential conservation area. The following codes are used to indicate the action needed to be taken at the area:

M1 Management action required immediately or element occurrences could be lost or irretrievably degraded within one year.
M2 New management action will be needed within 5 years to prevent the loss of element occurrences.
M3 New management action will be needed within 5 years to maintain current quality of element occurrences.
M4 Although not currently threatened, management may be needed in the future to maintain the current quality of element occurrences.
M5 No serious management needs known or anticipated at the site.

Element Occurrence Ranking

Actual locations of elements, whether they be single organisms, populations, or plant communities, are referred to as element occurrences. The element occurrence is considered the most fundamental unit of conservation interest and is at the heart of the Natural Heritage Methodology. In order to prioritize element occurrences for a given species, an element occurrence rank (EO-Rank) is assigned according to the estimated viability or probability of persistence (whenever sufficient information is available). This ranking system is designed to indicate which occurrences are the healthiest and ecologically the most viable, thus focusing conservation efforts where they will be most successful. The EO-Rank is based on three factors:

1. **Size** – a quantitative measure of the area and/or abundance of an occurrence such as area of occupancy, population abundance, population density, or population fluctuation.

2. **Condition** – an integrated measure of the quality of biotic and abiotic factors, structures, and processes within the occurrence, and the degree to which they affect the continued existence of the occurrence. Components may include reproduction and health, development/maturity for communities, ecological processes, species composition and structure, and abiotic physical or chemical factors.

3. **Landscape Context** – an integrated measure of the quality of biotic and abiotic factors, and processes surrounding the occurrence, and the degree to which they affect the continued existence of the occurrence. Components may include landscape structure and extent, genetic connectivity, and condition of the surrounding landscape.

Each of these factors is rated on a scale of A through D, with A representing an excellent grade and D representing a poor grade. These grades are then averaged to determine an appropriate EO-Rank for the occurrence. If there is insufficient information available to rank an element occurrence, an EO-Rank is not assigned. Possible EO-Ranks and their appropriate definitions are as follows:

A Excellent estimated viability.
B Good estimated viability.
C Fair estimated viability.
D Poor estimated viability.
E Verified extant, but viability has not been assessed.
H Historically known, but not verified for an extended period.

Potential Conservation Areas

In order to successfully protect populations or occurrences, it is necessary to recognize Proposed Conservation Areas. These Proposed Conservation Areas focus on capturing the ecological processes that are necessary to support the continued existence of a particular element occurrence of natural heritage significance. Proposed Conservation Areas may include a single occurrence of a rare element or a suite of rare element occurrences or significant features.

The goal of the process is to identify a land area that can provide the habitat and ecological processes upon which a particular element occurrence or suite of element occurrences depends for their continued existence. The best available knowledge of each species' life history is used in conjunction with information about topographic, geomorphic, and hydrologic features, vegetative cover, as well as current and potential land uses. The proposed boundary does not automatically exclude all activity. It is a hypothesis that some activities will prove degrading to the element or the process on which they depend, while others will not. Consideration of specific activities or land use changes proposed within or adjacent to the proposed conservation planning boundary should be carefully considered and evaluated for their consequences to the element on which the conservation unit is based.

Potential Conservation Planning Boundaries

Once the presence of rare or imperiled species or significant natural communities has been confirmed, the first step towards their protection is the delineation of a proposed conservation planning boundary. In general, the proposed conservation planning boundary is an estimate of the landscape that supports the rare elements as well as the ecological processes that allow them to persist. In developing such boundaries, CNHP staff consider a number of factors that include, but are not limited to:

- extent of current and potential habitat for the elements present, considering the ecological processes necessary to maintain or improve existing conditions;
- species movement and migration corridors;

- maintenance of surface water quality within the site and the surrounding watershed;
- maintenance of the hydrologic integrity of the groundwater, e.g., by protecting recharge zones;
- land intended to buffer the site against future changes in the use of surrounding lands;
- exclusion or control of invasive exotic species;
- land necessary for management or monitoring activities.

As the label "conservation planning" indicates, the boundaries presented here are for planning purposes. They delineate ecologically sensitive areas where land-use practices should be carefully planned and managed to ensure that they are compatible with protection goals for natural heritage resources and sensitive species. All land within the conservation planning boundary should be considered an integral part of a complex economic, social, and ecological landscape that requires wise land-use planning at all levels.

Off-Site Considerations

Furthermore, it is often the case that all relevant ecological processes cannot be contained within a site of reasonable size. Taken to the extreme, the threat of ozone depletion could expand every site to include the whole globe. The boundaries illustrated in this report signify the immediate, and therefore most important, area in need of protection. Continued landscape level conservation efforts are needed. This will involve county-wide efforts as well as coordination and cooperation with private landowners, neighboring land planners, and state and federal agencies.

Ranking of Potential Conservation Areas

One of the strongest ways that CNHP uses element and element occurrence ranks is to assess the overall biodiversity significance of a site, which may include one or many element occurrences. Based on these ranks, each site is assigned a **biodiversity** (or B-) **rank**:

B1 Outstanding Significance: only site known for an element or an excellent occurrence of a G1 species.

B2 Very High Significance: one of the best examples of a community type, good occurrence of a G1 species, or excellent occurrence of a G2 or G3 species.

B3 High Significance: excellent example of any community type, good occurrence of a G3 species, or a large concentration of good occurrences of state rare species.

B4 Moderate or Regional Significance: good example of a community type, excellent or good occurrence of state-rare species.

B5 General or Local Biodiversity Significance: good or marginal occurrence of a community type, S1, or S2 species.

Legal Designations

Natural Heritage imperilment ranks should not be interpreted as legal designations. Although most species protected under state or federal endangered species laws are extremely rare, not all rare species receive legal protection. Legal status is designated by either the U.S. Fish and Wildlife Service under the Endangered Species Act or by the Colorado Division of Wildlife under Colorado Statute 33-2-105 Article 2. In addition, the U.S. Forest Service recognizes some species as "Sensitive," as does the Bureau of Land Management. Table 2 defines the special status assigned by these agencies and provides a key to the abbreviations used by CNHP.

Please note that the U.S. Fish and Wildlife Service has issued a Notice of Review in the February 28, 1996 Federal Register for plants and animal species that are "candidates" for listing as endangered or threatened under the Endangered Species Act. The revised candidate list replaces an old system that listed many more species under three categories: Category 1 (C1), Category 2 (C2), and Category 3 (including 3A, 3B, 3C). Beginning with the February 28, 1996 notice, the Service will recognize as candidates for listing only species that would have been included in the former Category 1. This includes those species for which the Service has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered

Species Act. Candidate species listed in the February 28, 1996 Federal Register are indicated with a "C". While obsolete legal status codes (Category 2 and 3) are no longer used, CNHP will continue to maintain them in its Biological and Conservation Data system for reference.

Table 2. Federal and State Agency Special Designations.

Federal Status:

1. U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993) and (61 Federal Register 7598, 1996)

LE Endangered; species formally listed as endangered.

E(S/A) Endangered due to similarity of appearance with listed species.

LT Threatened; taxa formally listed as threatened.

P Proposed endangered or threatened; species formally proposed for listing as endangered or threatened

C Candidate: species for which the Service has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened.

2. U.S. Forest Service (Forest Service Manual 2670.5) (noted by the Forest Service as "S")

FS Sensitive: those plant and animal species identified by the Regional Forester for which population viability is a concern as evidenced by:

a. Significant current or predicted downward trends in population numbers or density.

b. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.

3. Bureau of Land Management (BLM Manual 6840.06D) (noted by BLM as "S")

BLM Sensitive: those species found on public lands, designated by a State Director, that could easily become endangered or extinct in a state. The protection provided for sensitive species is the same as that provided for C (candidate) species.

State Status:

1. Colorado Division of Wildlife

E Endangered

T Threatened

SC Special Concern

WETLAND DEFINITIONS, REGULATIONS, FUNCTIONAL ASSESSMENTS

Wetland Definitions

A U.S. government regulatory definition of jurisdictional wetlands is found in the regulations used by the U.S. Army Corps of Engineers (the Corps) for the implementation of a dredge and fill permit system required by Section 404 of the Clean Water Act Amendments (Mitsh and Gosselink 1993). According to the Corps, wetlands are "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstance do support, a prevalence of vegetation typically adapted for life in saturated soil condition." For Corps' programs, the wetlands' boundary must be determined according to the mandatory technical criteria described in the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory 1987). In order for an area to be classified as jurisdictional wetlands (i.e., a wetland subject to federal regulations), it must have **all** three of the following: 1) wetland plants; 2) wetland hydrology; and 3) hydric soils.

The U.S. Fish and Wildlife Service defines wetlands from an ecological point of view. In *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979) the definition states that "wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water". Wetlands must have *one or more* of the following three attributes: 1) at least periodically, the land supports predominantly hydrophytes (wetland plants); 2) the substrate is predominantly undrained hydric soil; and/or 3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year. This definition only requires that an area meet one of the three criteria (vegetation, soils, and hydrology) in order to be classified as a wetland.

CNHP prefers the wetland definition used by the U.S. Fish and Wildlife Service, because it recognizes that some areas display many of the attributes of wetlands without exhibiting all three characteristics required to fulfill the Corps' criteria. Additionally, riparian areas, while often technically not wetlands, should be included in a wetland conservation program. Riparian areas perform many of the same functions as do wetlands, including maintenance of water quality, storage of floodwaters, and enhancement of biodiversity, especially in the western United States (National Research Council 1995).

Wetland Regulation in Colorado

Wetlands in Colorado are currently regulated under the authority of the federal Clean Water Act. A permit issued by the Corps is required before placing fill in a wetland (e.g., building up a site before constructing a home), and before dredging, ditching, or channelizing a wetland. The Clean Water Act exempts certain filling activities, such as normal agricultural activities.

The 404(b)(1) guidelines, prepared by the Environmental Protection Agency in consultation with the Corps, are the federal environmental regulations for evaluating projects that will impact wetlands. Under these guidelines, the Corps is required to determine if alternatives exist for minimizing or eliminating impacts to wetlands. When unavoidable impacts occur, the Corps requires mitigation of the impacts. Mitigation may involve creation or restoration of similar wetlands in order to achieve an overall goal of no net loss of wetland area.

The U.S. Fish and Wildlife Service has conducted inventories of the extent and types of our nation's wetlands. The Cowardin et al. (1979) classification system provides the basic mapping units for the U.S. National Wetlands Inventory (NWI). The NWI drew maps for The Uncompahgre River Basin, west of the 106th meridian, based on 1:58,000 scale color infrared aerial photography taken in September 1983. The NWI maps east of the 106th meridian were completed in the 1970s using black and white photos. Photo-interpretation and field reconnaissance was used to refine wetland boundaries according to the wetland classification system. The information is summarized on 1:24,000 and 1:100,000 maps.

The NWI maps provide important and accurate information regarding the location of wetlands. They can be used to gain an understanding of the general types of wetlands in the county and their distribution. The NWI maps cannot be used for federal regulatory programs that govern wetlands for two reasons. First, the U.S. Fish and Wildlife Service uses a definition of wetland that differs slightly from Corps, the agency responsible for executing federal wetland regulations. Secondly, there is a limit to the resolution of the 1:24,000 scale maps. For example, at this scale, the width of a fine line on a map represents about 5 m (17 ft) on the ground (Mitsch and Gosselink 1993). For this reason, precise wetland boundaries must be determined on a project by project basis. Colorado's state government has developed no guidelines or regulations concerning the management, conservation, and protection of wetlands, but a few county and municipal governments have, including the City of Boulder, Boulder County, and San Miguel County.

Wetland Function and Values

Wetlands perform many functions beyond simply providing habitat for plants and animals. It is commonly known that wetlands act as natural filters, helping to protect water quality, but it is less well known that wetlands perform other important functions. Adamus et al. (1991) list the following functions performed by wetlands:

- Ground water recharge--the replenishing of below ground aquifers.
- Ground water discharge--the movement of ground water to the surface e.g., springs.
- Floodflow alteration--the temporary storage of potential flood waters.
- Sediment stabilization--the protection of stream banks and lake shores from erosion.
- Sediment/toxicant retention--the removal of suspended soil particles from the water, along with toxic substances that may be attached to these particles.

- Nutrient removal/transformation--the removal of excess nutrients from the water, in particular nitrogen and phosphorous.
- Production export--supply organic material (dead leaves, etc.) to the base of the food chain.
- Aquatic diversity/abundance--wetlands support fisheries.
- Wildlife diversity/abundance--wetlands provide habitat for wildlife.

Adamus and Stockwell (1983) include two items they call "values" which also provide benefits to society:

- Recreation--wetlands provide areas for fishing, birdwatching, etc.
- Uniqueness/heritage value--wetlands support rare and unique plants, animals, and plant communities.

"Values" are subject to societal perceptions, whereas "functions" are all biological or physical processes and manifestations of processes which occur in wetlands, regardless of the value placed on them by society (National Research Council 1995). The actual value attached to any given function or value listed above depends on the needs and perceptions of society.

CNHP utilized a function and value assessment based on the Montana Wetland Field Evaluation Form prepared by Morrison-Maierle Environmental Corporation (Berglund 1996). This technique is designed to provide rapid, economical, and repeatable wetland evaluation results. This form minimizes subjectivity and variability between evaluators, provides a means of assigning wetlands overall ratings, and incorporates some of the principles of the hydrogeomorphic (HGM) assessment method. It also classifies each wetland using the Cowardin et al. (1979) classification system. It is important to note that this method is intended to evaluate wetland functions and values, and is not to be used to delineate jurisdictional wetland boundaries (Berglund 1996).

The following functions and values are evaluated using the Montana Wetland Field Evaluation Form:

- Habitat for federally listed, proposed, or candidate threatened or endangered plants or animals
- Habitat for plants, animals, and natural plant communities rated S1, S2, or S3 by CNHP
- General wildlife habitat
- General fish habitat
- Flood attenuation and storage
- Sediment/nutrient/toxicant retention and removal
- Sediment/shoreline stabilization
- Production export/food chain support
- Groundwater discharge/recharge
- Uniqueness

- Recreation/education potential
- Dynamic surface water storage

The methodology assigns each of the functions and values ratings of "low", "moderate", or "high", and scores each on a scale of .1 (lowest) to 1 (highest) "functional points." The scoring scale for each function and value is similar to that of HGM (see description below), although HGM does not generally consider values and not all of the variables considered by HGM with respect to a given function were included in this method.

Functional points are summed on the form and expressed as a percentage of the possible total. This percentage is then used in conjunction with other criteria to provide an overall wetland ranking into one of four categories. Category I is the highest overall ranking a wetland can receive, Category IV the lowest. Functional points are also multiplied by the total acreage in the assessment area to determine the total "functional units" for a given site.

Habitat for Federally Listed, Proposed, Candidate Threatened or Endangered Plants or Animals and CNHP's Significant Plants, Animals, and Natural Plant Communities

This function assesses the wetland's ability to support habitat for federally threatened or endangered and/or state rare plants, animals, and natural plant. This field assesses the habitat based on known or suspected occurrence.

General Wildlife and Fish Habitat

Habitat includes those physical and chemical factors which affect the metabolism, attachment, and predator avoidance of the adult or larval forms of fish, and the food and cover needs of wildlife in the place where they reside. Wetland characteristics indicating good fish habitat include: deep, open, non-acidic water, no barriers to migration, well-mixed (high oxygen content) water, and highly vegetated. Wetland characteristics indicating good wildlife habitat are: good edge ratio, islands, high plant diversity, and a sinuous and irregular basin. This field assesses general wildlife and fish habitat potential of the wetland based on known or suspected use by wildlife and fish and habitat diversity.

Flood Attenuation and Storage

Wetlands are excellent in their ability to store or delay flood waters that occur from peak flow, gradually recharging the adjacent groundwater table. Indictors of flood storage include: debris along streambank and in vegetation, low gradient, formation of sand and gravel bars, high density of small and large depressions, and dense vegetation. This field assesses the capability of the wetland to detain moving water from in-channel flow or overbank flow for a short duration when the flow is outside of its channel.

Sediment/Nutrient/Toxicant Retention and Removal

Sediment and toxicant trapping is the process by which suspended solids and chemical contaminants are retained and deposited within the wetland. Deposition of sediments can ultimately lead to removal of toxicants through burial, chemical break down, or temporary assimilation into plant tissues (Boto and Patrick 1979). Most vegetated

wetlands are excellent sediment traps, at least in the short term. Wetland characteristics indicating this function include: dense vegetation, deposits of mud or organic matter, gentle sloping gradient, and location next to beaver dams or human-made detention ponds/lakes.

Nutrient retention is the storing of nutrients within the sediment or vegetation. Inorganic nutrients are transformed into the organic form, resulting in the transformation and subsequent removal of one nutrient (e.g., nitrogen) as a gas. Nutrient removal/ transformation involves trapping of nutrients before they reach deep water, are carried downstream, or are transported to underlying aquifers. Particular attention is focused on processes involving nitrogen and phosphorus, as these nutrients are usually of greatest importance to wetland systems (Kadlec and Kadlec 1979). Nutrient storage in wetlands may be for long-term (greater than 5 years) for example peatlands or short-term (30 days to 5 years) as in riverine wetlands. A densely vegetated cattail or bulrush community would be an example of a wetland that performs this function for the short-term. A wetland that would not perform this function would be sparsely vegetated and located on a steep slope.

Some indicators of nutrient retention include: high sediment trapping, organic matter accumulation, presence of free-floating, emergent, and submerged vegetation, and permanently or semi-permanently flooded areas. This functions assesses the ability of the wetland to retain sediments and retain and remove nutrients and toxicants.

Sediment/Shoreline Stabilization
Shoreline anchoring is the stabilization of soil at the water's edge by roots and other plant parts. The vegetation dissipates the energy caused by fluctuations of water and prevents streambank erosion. The presence of woody vegetation and sedges in the understory are the best indicator of good shoreline anchoring. This field assesses the wetland's ability to dissipate flow or wave energy, reducing erosion.

Production Export/Food Chain Support
Production export refers to the flushing of relatively large amounts of organic material (carbon) from the wetland downstream. Production export emphasizes the production of organic foods within the wetland and the utilization of the exported production by fish and aquatic invertebrates. Food chain support is the direct or indirect use of nutrients, in any form, of animals inhabiting aquatic environments. Indicators of wetlands that perform downstream food chain support are: an outlet, seasonally flooded, overhanging vegetation, and dense and diverse vegetation. Wetlands that perform within food chain support do not have stagnant water and contain productive vegetation.

Groundwater Discharge/Recharge
Ground water recharge occurs when the water level in a wetland is higher than the water table of its surroundings resulting in the movement (usually downward) of surface water (e.g., flood water retention). Ground water discharge results when the groundwater level of a wetland is lower than the water table of its surroundings, resulting in the movement (usually laterally or upward) of surface water (e.g., springs, seeps). Neither of these

functions is exclusionary for a wetland can perform both functions simultaneously. Ground water movement can greatly influence some wetlands, whereas in others it may have minimal effect (Carter and Novitzki 1988).

Both groundwater discharge and recharge are difficult to estimate without intensive data collection. Wetland characteristics that may indicate groundwater recharge are: porous underlying strata, irregularly shaped wetland, dense vegetation, and presence of a constricted outlet. Indicators of groundwater discharge are: a dam upstream and wet slopes with no obvious source.

Uniqueness
This value expresses the general uniqueness of the wetland in terms of relative abundance of similar sites occurring in the same watershed, size, condition, landscape context, and the replacement potential.

Recreation/Education Potential
Active recreation refers to recreational activities which are water-dependent. This includes the following activities: swimming, boating, canoeing, and kayaking. Passive recreation refers to the use of wetlands for aesthetic enjoyment e.g., nature study, picnicking, open space, or research.

Dynamic Surface Water Storage
Dynamic surface water storage refers to the potential of the wetland to capture water from precipitation, upland surface (sheetflow) or subsurface (groundwater) flow. Wetlands are subjected to surface inflows of several types. Sheetflow is nonchannelized sheet flow that usually occurs during and immediately following rainfall or a spring thaw. Wetlands can also receive surface inflow from seasonal or episodic pulses of flood flow from adjacent streams and rivers that may otherwise not be connected hydrologically with the wetlands (Mitsch and Gosselink 1993). This function refers to wetlands that are not subject to flooding or are flooded by in-channel or overbank flow (see Flood Storage and Attenuation).

Hydrogeomorphic (HGM) Approach to Wetland Function Assessment

Few people argue about the value of wetlands for water quality maintenance, flood regulation, and wildlife habitat, but when wetlands occur on private land their regulation for public good provokes controversy. In an effort to provide a more consistent and logical basis for regulatory decisions about wetlands, a new approach to assessing wetland functions--the *hydrogeomorphic* approach is being developed. In Colorado, the hydrogeomorphic, or HGM, approach to wetland function assessment is being developed by the Colorado Geological Survey, with help from the U.S. Army Corps of Engineers, other government agencies, academic institutions, the Colorado Natural Heritage Program, and representatives from private consulting firms (Colorado Geologic Society et al. 1998).

This approach is based on a classification of wetlands according to their hydrology (water source and direction of flow) and geomorphology (landscape position and shape of the wetland) called "hydrogeomorphic" classification (Brinson 1993). There are four hydrogeomorphic classes present in Colorado: riverine, slope, depression, and mineral soil flats (Table 3). Within a geographic region, HGM wetland classes are further subdivided into subclasses. A subclass includes all those wetlands that have essentially the same characteristics and perform the same functions.

Using the HGM method, wetland functions are evaluated only with respect to other wetlands in the same subclass, because different subclasses often perform very different functions. For example, a montane kettle pond may provide habitat for rare plant communities never found on a large river, but it has little flood control value. While on the other hand, the wetlands along a major river perform important flood control functions.

One of the fundamental goals of the HGM approach is to create a system whereby every wetland is evaluated according to the same standard. In the past, wetland function assessments typically were on a site by site basis, with little ability to compare functions or assessments between sites. The HGM approach allows for consistency, first through the use of a widely applicable classification, then through the use of *reference wetlands*. Reference wetlands are chosen to encompass the known variation of a subclass of wetlands. A subset of the reference wetlands is a *reference standard*, wetlands that correspond to the highest level of functioning of the ecosystem across a suite of functions (Brinson and Rheinhardt 1996).

The hydrogeomorphic approach to wetland function assessment assumes that highest, sustainable functional capacity is achieved in wetland ecosystems and landscapes that have not been subject to long-term anthropogenic disturbance. Under these conditions, the structural components and physical, chemical, and biological processes in the wetland and surrounding landscape reach the dynamic equilibrium necessary to achieve the highest, sustainable functional capacity (Smith et al. 1995). In general reference standards, against which all other wetlands in a subclass will be compared, meet this condition.

Table 3. Hydrogeomorphic wetland classes in Colorado
(Cooper 1998 as cited in Colorado Geological Survey et al. 1998).

Class	Geomorphic setting	Water Source	Water Movement	Subclass	Examples
Riverine	In riparian areas along rivers and streams	Overbank flow from channel	One-directional and horizontal (downstream)	R1-steep gradient, low order streams	Herbaceous plants community in subalpine
				R2-moderate gradient, low to middle order	Willow shrublands along a montane creek
				R3-middle elevation, moderate gradient along small/mid-order stream	Yampa River
				R4-low elevation canyons or plateaus	Yampa River in Dinosaur N.M.
				R5-low elev. floodplains	Arikaree River in eastern CO
Slope	At the base of slopes, e.g., along the base of the foothills; also, places where porous bedrock overlying a non-porous bedrock intercepts the ground surface.	Groundwater	One-directional, horizontal (to the surface from groundwater)	S1-alpine and subalpine fens on non-calcareous substrates.	Big Meadows in R.M. N.P.
				S2-subalpine and montane fens on calcareous substrates	High Creek fen
				S3-wet meadows at middle elev.	Irrigated/ natural meadows
				S4-low elevation meadows	Sedge meadow in eastern CO
Depressional	In depressions cause by glacial action (in the mountains) and oxbow ponds within floodplains. Lake, reservoir, and pond margins are also included.	Shallow ground water	Generally two-directional, vertical: flowing into and out of the wetland in the bottom and sides of the depression	D1-mid to high elevation basins with peat soils or lake fringe without peat	Kettle ponds
				D2-low elevation basins that are permanently or semi-permanently flooded	Reservoir or lake margins
				D3-low elevation basin with seasonal flooding	Mishak Lakes in SLV
				D4-low elevation basins that are temporarily flooded	Abandoned beaver ponds
				D-5-low elevation basins that are intermittently flooded	Playa lakes
Mineral Soil Flat	Topographically flat wetland	Precipitation	Two directional	F1-low elevation with seasonal high water table	Southern side of Antero Reservoir

METHODS

Survey Site Selection

CNHP classifies wetland and riparian plant associations or communities, not wetlands. Plant communities reflect the broader nature of the wetlands in the study area (i.e., willow carr, sedge meadow, etc.), while also mirroring the local nature of the wetlands. Most other classifications applied to wetlands in Colorado and across the nation classify wetlands based mainly on the physiognomy (structure) of the vegetation. Unfortunately, these structural classes can be applied across virtually all wetlands, and they generally do not reflect the importance or singularity of the Uncompahgre River Basin's wetlands.

Potential wetlands or target inventory areas (TIAs) were initially identified using color infrared aerial photographs, 7.5 minute topographic quadrangles, in conjunction with a review of CNHP's Biological and Conservation Data (BCD) system for known occurrences. The TIAs were prioritized for surveying in such a manner that each type of wetland in the Uncompahgre River Basin would be visited, with an emphasis on private lands. Within the full spectrum of wetland types, the highest quality occurrence of each type was targeted during the field season.

The majority of these sites are on private lands, so field personnel requested permission to access the TIAs. Each landowner was contacted either by telephone or in person. For various reasons, permission to access some TIAs was not obtained.

Site Assessment

Site assessments included assessments of the natural heritage elements at the site and a wetland function evaluation. Site visits and assessments were conducted on the following three levels:

1) **Roadside or adjacent land assessments.** Many of the sites could be viewed at a distance from a public road or from adjacent public land. While on the ground the field scientist can see, even from a distance, many features not apparent on maps and aerial photos. The majority of the sites selected during the TIA analysis were rejected during this phase from consideration as potential conservation sites. The road assessments determined the extent of human and livestock impacts on the TIA, which included ditching, adventive plant species, indicator plant species of intensive livestock use, stream bank destabilization, establishment of saplings on point bars, major hydrologic alterations, excessive weed cover (especially noxious weeds), or new construction. Sites with these characteristics were immediately and no extensive data were gathered at these areas.

2) **On-site assessments**. On-site assessment was the preferred method, as it was the only assessment technique that can yield high-confidence statements concerning the

known or potential presence of rare and imperiled elements or excellent examples of common communities. On-site assessments are also the most resource intensive because of the required landowner contact and comprehensive field efforts. In several cases where on-site assessments were desired, they could not be conducted because either the field crews were denied access to the property by the landowner, or CNHP was unable to contact the landowner in the available time.

3) **Off-site assessments**. Off-site assessment was the least preferred method because of the low confidence in the results. In cases where access to a property was not possible, off-site assessments are made when there are indications that the site contains a good example of a natural community or a rare or imperiled species. Off-site assessments generally included intensive analysis of aerial photos, surveys of the property from the nearest publicly accessible point, surveys of similar sites on nearby public land, and assessment of existing data in BCD.

For the sites that were visited, the following information was noted (Example of field forms are located at the end of the report):

General Field Information

- sketch of the site layout, with distribution of community types indicated (this was generally done on the 7.5' USGS topographic map, but occasionally for clarity a separate map was drawn on the site survey form)
- elevation (from 7.5 min. USGS topographic maps)
- current and historic land use (e.g., grazing, logging, recreational use) when apparent
- notes on geology and geomorphology
- reference photos of the site
- signs of disturbance such as logging, grazing, flooding, etc.

Natural Heritage Information

- list of elements present or expected at the site
- element occurrence (EO) ranks, or information that will lead to EO Rank
- proposed site boundaries

General Wetland Information

- wetland class according to HGM
- water source
- hydroperiod
- flooding and inundation frequency
- general soils description, i.e., texture, color, cobble size, percent mottling

Qualitative Function and Value Assessment

- hydrological functions, i.e., groundwater recharge/discharge, flood storage, shoreline anchoring

- biogeochemical functions, i.e., sediment trapping, long and short term nutrient retention
- biological functions, i.e., downstream foodchain support, within food chain support, fish and wildlife habitat, passive recreation

Plant Communities

Plant communities are very useful indicators of site conditions, therefore, our TIA analysis attempted to identify potential sites for the full range of plant communities present in the study area. The following information about plant communities was gathered when visiting a site. For every site where an element occurrence was located, the following information was entered into BCD:

- List of all plant associations in the wetland complex, including the amount of wetland area covered by that community. In almost all cases, plant associations were immediately placed in existing classifications. However, on rare occasions a plant association was encountered which could not be easily classified based on stands sampled previously.
- Vegetation data for each major plant association in the wetland were collected using visual ocular estimates of species cover in a representative portion of the plant association.
- Hydrologic information, including water source and hydroperiod (i.e., perennially flooded, seasonally saturated, etc.).
- Soil descriptions based on a shallow pit or an augured sample within each plot. Thickness, texture (via hand-texturing), color, mottling/gleying, structure, matrix color, coarse fragments, and parent material when possible were noted for each soil horizon.
- Notes on unusual features, alkali deposits, unusual microtopography, beaver activity, etc.

RESULTS

CNHP scientists identified over 100 wetland/riparian Targeted Inventory Areas (TIAs) that merited on-site investigation. Out of these TIAs, 25 sites are presented here as Proposed Conservation Areas and four sites are presented as Sites of Local Significance. Sixty-four of the TIAs were non-riparian wetlands (e.g., slope or depressional wetlands), and 33 TIAs were riparian wetlands (wetlands whose hydrology is dependent upon a stream or river).

Priority in site selection was given to wetlands occurring on private land. Of 64 non-riparian wetland TIAs, 48 (75%) were located on private land, and 16 (25%) were located on public land. Obtaining permission from private landowners to conduct a biological survey of wetlands on their property was often difficult. Fear that an inventory would lead to wetland regulations restricting landowners property rights, or even resulting in loss of the property if a threatened or endangered species were found, was often sited as justification for denying access.

An effort was made to select sites that potentially had natural hydrology and plant associations intact. However, on-site inspection revealed that many of our wetland TIAs were heavily impacted by roads, buildings, weeds, agriculture, or grazing and were eliminated from the inventory (Figure 5 and Figure 6). The following figures present an overall summary of TIA findings in graph form.

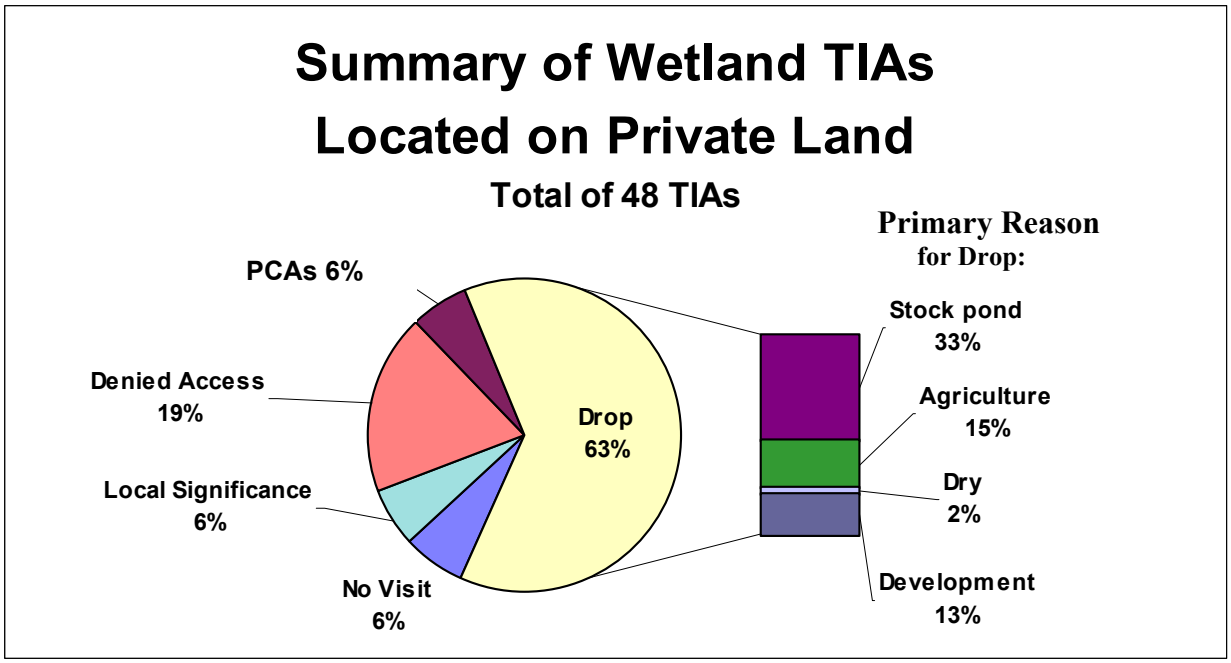


Figure 5. Summary of non-riparian wetland TIAs located on private land.

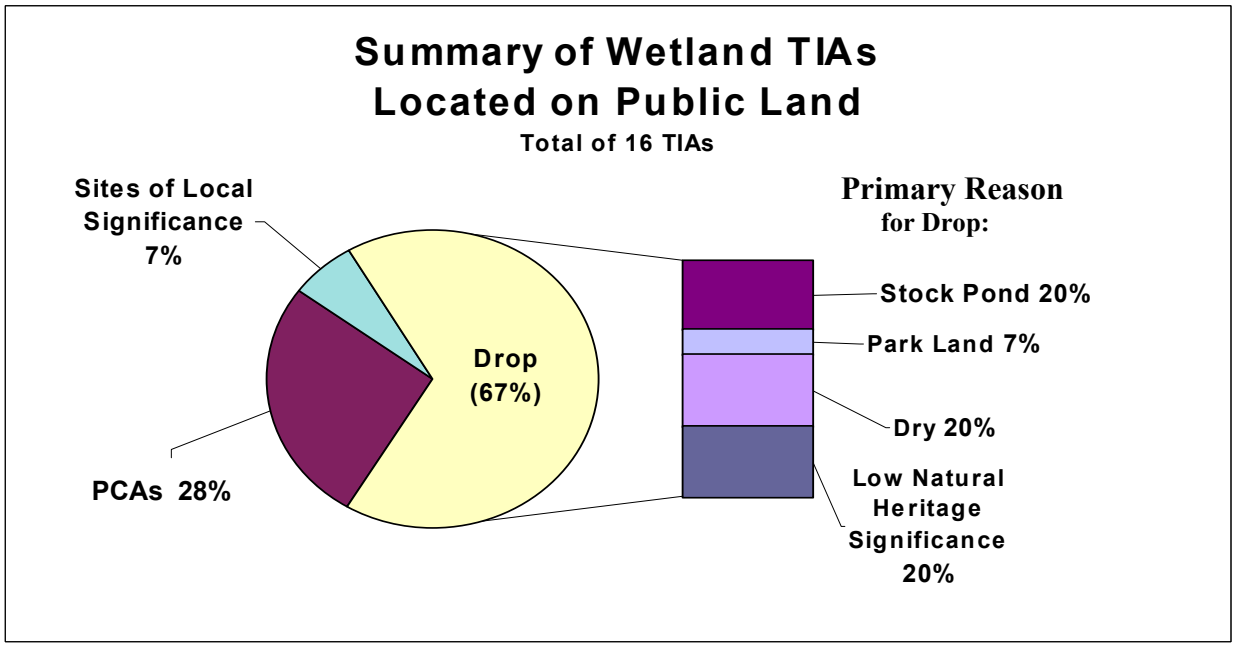


Figure 6. Summary of non-riparian wetland TIAs located on public land.

Thirty-three riparian TIAs were identified. Twenty-one TIAs (64%) were located on public land and 12 (36%) were on private land. Twenty-two TIAs are described in this report as Potential Conservation Areas (PCAs) or Macro-Sites. Generally, the tributaries of the Uncompahgre River were found to be in fair to good condition (Figure 7). However, the Uncompahgre River riparian zone has been severely degraded for most of its length.

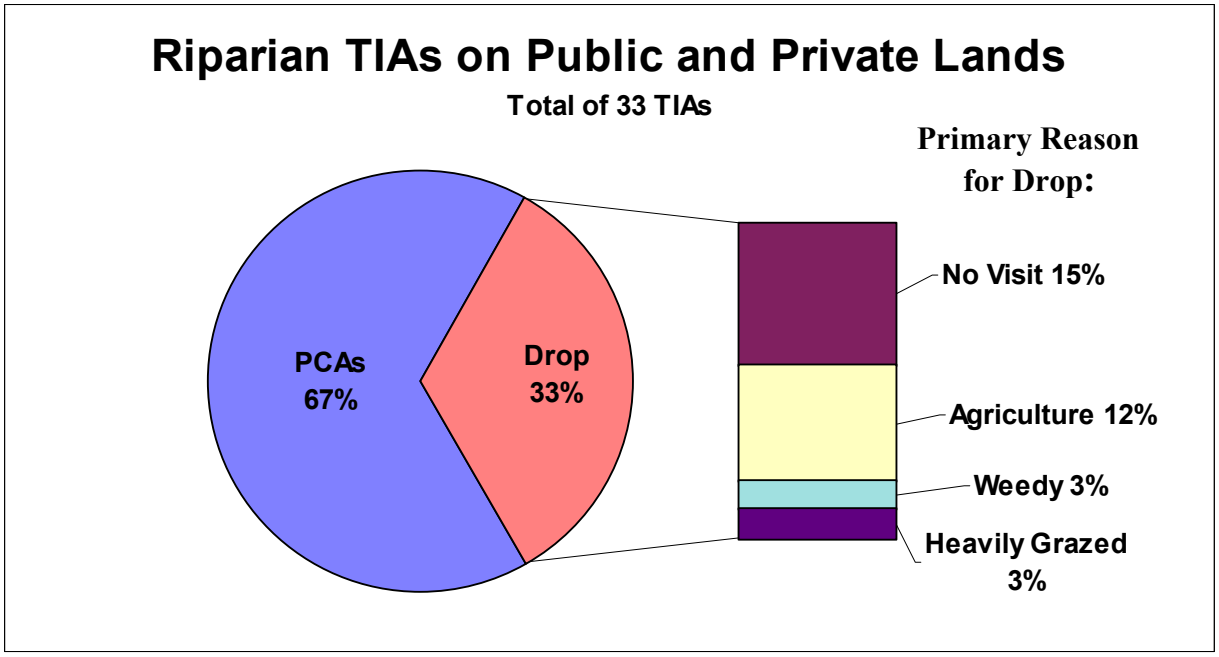


Figure 7. Summary of riparian TIAs.

Restoration Sites

As discussed on page 14, the ecology and natural hydrology of wetlands and riparian areas in the Uncompahgre River Basin have been profoundly affected by human land use. In many cases, true restoration of wetlands to presettlement conditions may not be politically, economically, or ecologically possible. However, almost every impacted wetland has the potential to have some of its compromised functions and values enhanced or recreated. Table 4 lists Potential Conservation Areas (PCAs) with a high potential for successful restoration efforts. Restoration potential is more fully discussed on a site-specific basis in the Management Rank Justification section for each PCA.

Table 4. PCAs with high potential for successful restoration efforts.

Site Name	Biodiversity Rank	Protection Urgency Rank	Management Urgency Rank	Functional Assessment
Uncompahgre River at Eldredge	B2	P2	M2	X
Uncompahgre River at Ridgway	B2	P3	M3	
Uncompahgre River Macrosite	B3	P1	M1	
Escalante Wetland	B4	P4	M2	X
Dry Creek	B3	P4	M3	
Cimarron State Wildlife Area Wetland	Local significance	N/A	N/A	X
Ironton Park	B3	P2	M4	X
West Dallas Creek	B3	P3	M2	X

Sites of Biodiversity Significance

The 25 most important wetland sites in the Uncompahgre River Basin are profiled in this section as Potential Conservation Areas (PCAs) with biodiversity ranks (Table 5). These PCAs include the wetlands with the highest biodiversity significance, as well as the best examples of wetland types present in the study area. Also profiled are four Sites of Local Significance, based on the local importance of their functions and values within eastern Montrose and Ouray counties. Sites of Local Significance did not receive B-ranks.

The presentation of PCAs and Sites of Local Significance are organized by the following major sub-regions: the **Lower Uncompahgre River Valley,** the **Uncompahgre Plateau**, the **Cimarron Ridge Uplands**, and the **San Juan Mountains**. Wetlands occuring within each of these major sub-regions share a similar physiography, geology, climate, regional hydrology, and land use history, which is discussed in further detail on page 6.

Figure 8 displays all 25 PCAs and four Sites of Local Significance in the Uncompahgre River Basin study area. All of these sites merit protection, but available resources should be directed first toward the B2 sites, then the B3, and finally B4 and B5 sites. These sites alone do not represent a complete wetland conservation program; they only represent the rare and imperiled elements.

Table 5. Sites of Biodiversity Significance in the Uncompahgre River Basin, arranged by sub-region and biodiversity rank (B-rank).

Site Name	Biodiversity Rank	Protection Urgency Rank	Management Urgency Rank	Functional Assessment
Lower Uncompahgre River Valley				
Uncompahgre River at Eldredge	B2	P2	M2	X
Uncompahgre River at Ridgway	B2	P3	M3	
Cottonwood Creek	B3	P3	M4	X
Uncompahgre River Macrosite	B3	P1	M1	
Escalante Wetland	B3	P2	M2	X
McKenzie Creek	B4	P4	M3	
Jade Road Wetland	Local significance	N/A	N/A	X
Sazama Wetland	Local significance	N/A	N/A	X
Uncompahgre Plateau				
Roubideau Creek	B2	P4	M2	
Beaver Dams Creek	B3	P4	M3	
Dry Creek	B3	P4	M3	
East Fork Spring Creek	B4	P4	M5	
Natural Pond	B4	P3	M4	X
Pleasant Valley Creek	B4	P3	M4	X
Middle Fork Spring Creek	B5	P5	M3	
Cimarron Ridge Uplands				
Buckhorn Lakes	B3	P5	M3	X
Cimarron River	B3	P3	M4	
Crystal Creek	B3	P4	M2	
Cimarron State Wildlife Area Wetland	Local significance	N/A	N/A	X

Site Name	Biodiversity Rank	Protection Urgency Rank	Management Urgency Rank	Functional Assessment
San Juan Mountains				
Cow Creek-Oben Creek	B2	P2	M3	X
Dexter Creek	B3	P5	M3	
East Fork Dallas Creek	B3	P3	M2	X
Ironton Park	B3	P1	M3	X
Nate Creek	B3	P3	M3	
Red Creek	B3	P5	M5	
West Dallas Creek	B3	P4	M3	X
Wildhorse Basin	B3	P4	M5	X
Green Mountain	B5	P4	M3	
Miller Mesa	Local significance	N/A	N/A	

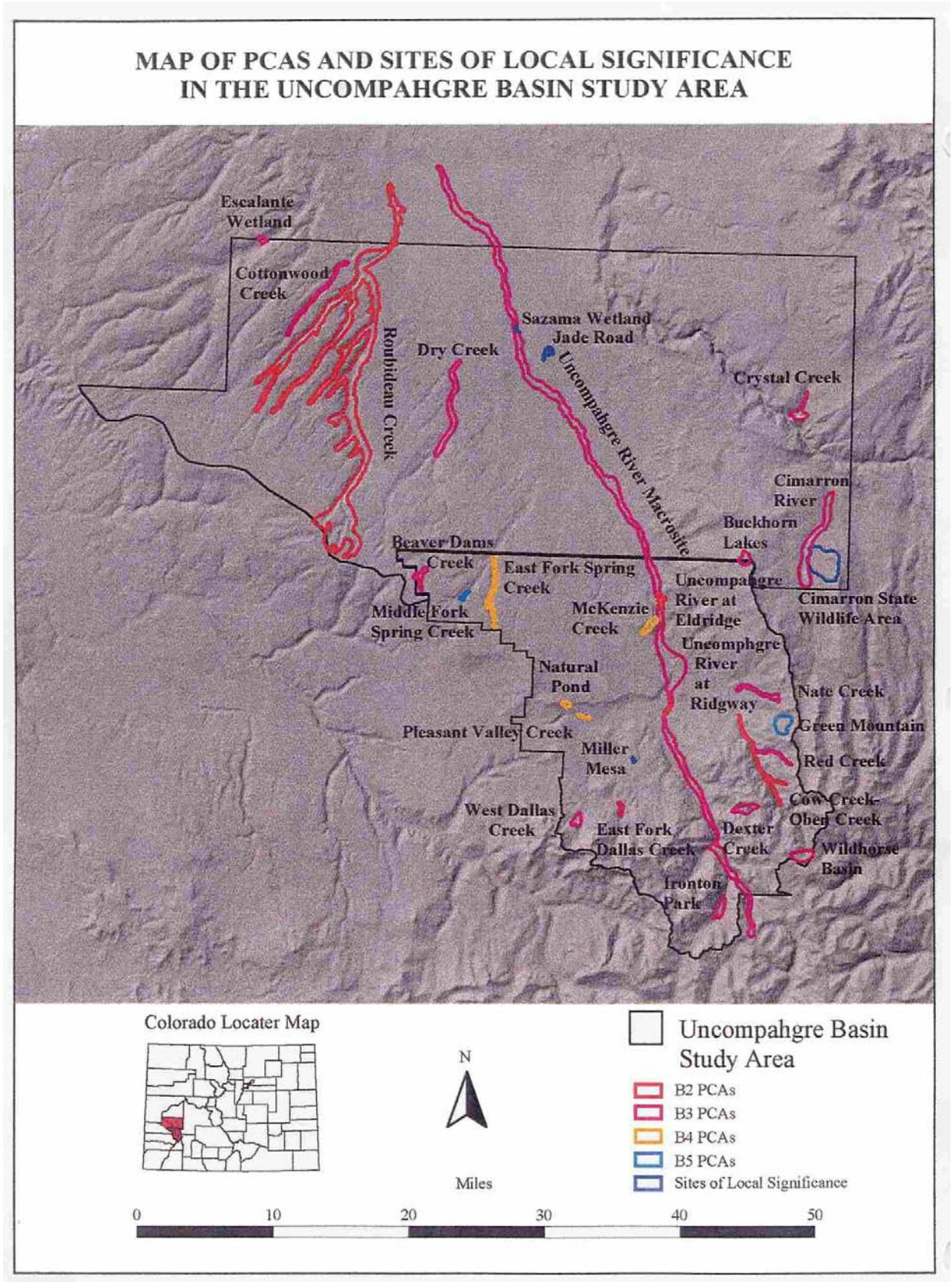


Figure 8. Map of PCAs and Sites of Local Significance in the Uncompahgre River Basin Study Area.

Each Potential Conservation Area (PCA) is described in a standard site report that reflects data fields in CNHP's Biological and Conservation Data (BCD) System, used to track rare and imperiled elements. The sections of this report and the contents are outlined and explained below.

BIODIVERSITY RANK: The overall significance of the PCA in terms of imperilment of the natural heritage resources and the quality (health, abundance, etc.) of their occurrences. These ranks range from B1 (Outstanding Significance) to B5 (General Biodiversity Significance). See page 20 for complete rank definition.

PROTECTION URGENCY RANK: The time frame in which conservation protection must occur. In most cases, this rank refers to the need for a major change of protective status (e.g., agency special area designations or ownership). The ranks range from P1 (immediate urgency; within a one year time frame) to P5 (no known urgency). See page 20 for complete rank definition.

MANAGEMENT URGENCY RANK: The time frame in which a change in management of the element or site must occur. Using best scientific estimates, this rank refers to the need for management in contrast to protection (e.g., increased fire frequency, decreased herbivory, weed control, etc.). The ranks range from M1 (immediate urgency, within one year) to M5 (no known urgency). See page 20 for complete rank definition.

LOCATION: General location, followed by the U.S.G.S. 7.5 min. quadrangle name(s) and the township, range, and section that include the Potential Conservation Area.

GENERAL DESCRIPTION: A brief narrative picture of the topography, general location, vegetation, and current use of the site. Common names are used along with the scientific names.

BIODIVERSITY RANK JUSTIFICATION: A synopsis of the rare species and significant natural communities that occur in the site, the driving element is bolded. The Natural Heritage elements associated with wetlands are listed alphabetically according to genera. See page 20 for explanations of ranks.

BOUNDARY JUSTIFICATION: The potential conservation planning boundary delineated in this report, which includes all known occurrences of natural heritage resources and, in some cases, adjacent lands required for their protection.

PROTECTION AND MANAGEMENT RANK JUSTIFICATION: A summary of the major issues and factors that are known or likely to affect the protection and management of the site.

WETLAND FUNCTIONAL EVALUATION. A summary of the functions, values, proposed HGM classification and Cowardin system for the wetlands occurring on each Potential Conservation Area and Site of Local Significance. Each function is ranked (i.e., none, low, moderate, high, or very high rank) according to how well the wetland is performing that function. Also included is a general soils description.

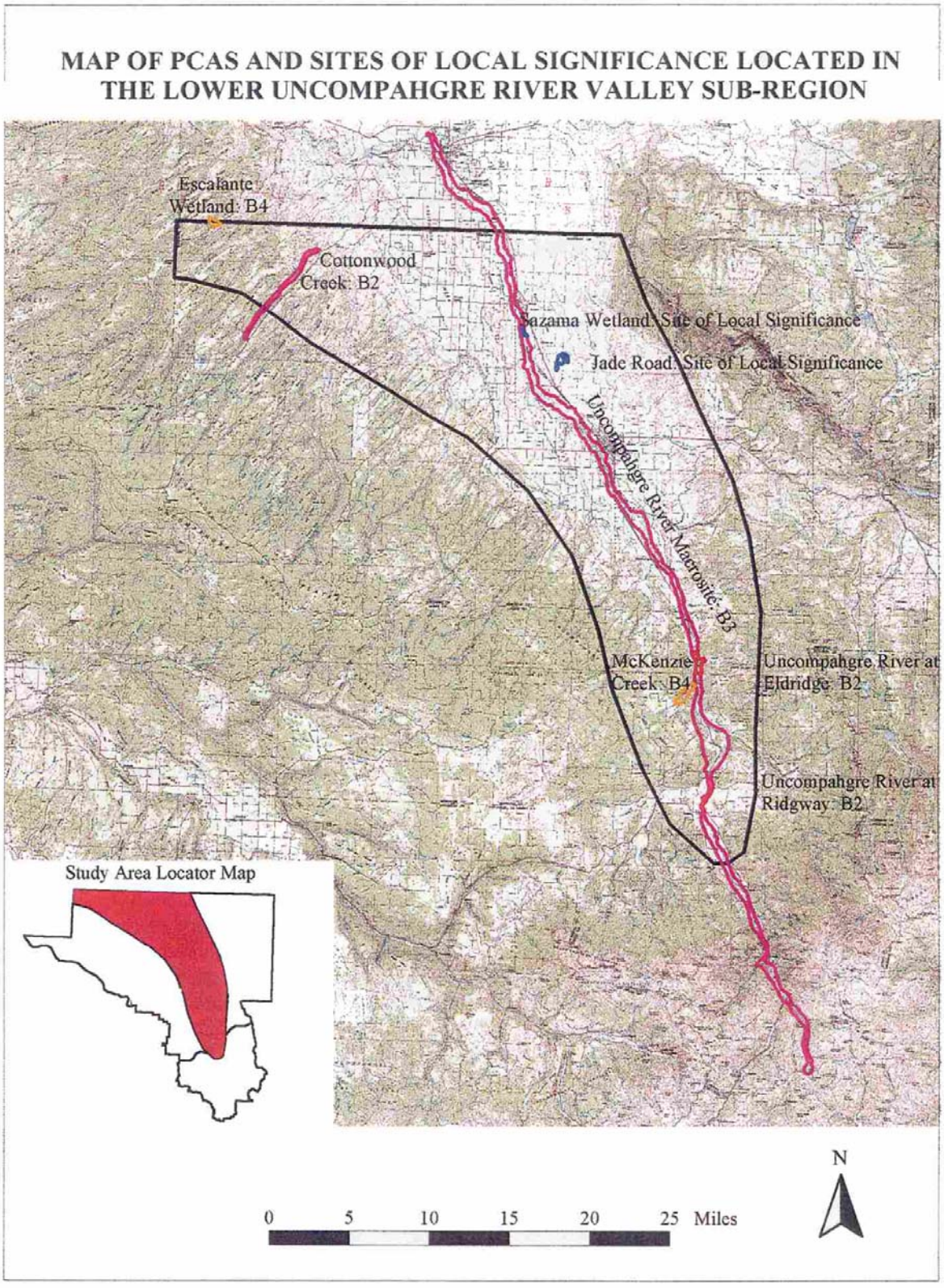


Figure 9. Map of PCAs and Sites of Local Significance Located in the Lower Uncompahgre River Valley Sub-region

Uncompahgre River at Eldredge Potential Conservation Area

Biodiversity Rank: B2 (Very high significance)
The Uncompahgre River at Eldredge PCA contains a fair example of a narrowleaf cottonwood riparian forest critically imperiled on a global scale, and a canyon bog-orchid that is rare in the state of Colorado.

Protection Urgency Rank: P2
Both the riparian plant community and the canyon bog-orchid are dependent on the continuation of the present hydrologic regime, and are threatened by road alterations. Approximately the middle 1/3 of the PCA is within the Billy Creek State Wildlife Refuge, with upper and lower portions located on private land.

Management Urgency Rank: M2
Road and irrigation ditch maintenance pose threats to the canyon bog-orchid population. The site has potential for successful restoration or rehabilitation efforts.

Location: Ouray County
U.S.G.S. 7.5 min. quadrangle: Colona
Legal Description: T47N R8W S 29, 30

General Description: This 290 acre PCA is located on the Uncompahgre River between Ridgway and Colona, partly in the Billy Creek State Wildlife Area. Elevations range from 6,500 to 7,000 ft. (1,950 to 2,150 m). It contains relict examples of the riparian vegetation that is typical of the Lower Uncompahgre River Valley, but has been lost along much of the river. Even here, the condition of the community is only moderately good.

Narrowleaf cottonwood (*Populus angustifolia*) and occasional box elders (*Acer negundo*) provide a canopy layer. There are dense thickets of western river birch (*Betula occidentalis*) and thinleaf alder (*Alnus incana*). Silver buffaloberry (*Shepherdia argentea*), a species that is typical of the Uncompahgre River, but has been much reduced, grows in the understory along with red-osier dogwood (*Cornus sericea*) and skunkbrush (*Rhus trilobata*). Wet areas along Highway 550 are dominated by reed canary grass (*Phragmites australis*), with some beaked sedge (*Carex utriculata*), cattails (*Typha latifolia*), horsetails (*Equisetum arvense*) and Baltic rush (*Juncus balticus*). A band of coyote willow (*Salix exigua*) grows along the river. The area has many exotic species in the understory, including Canada thistle (*Cirsium arvense*), burdock (*Arctium minus*), white top (*Cardaria draba*), and orchard grass (*Dactylis glomerata*). The highway, the Ridgway Dam, and gravel mining have altered the natural hydrology of the Uncompahgre River.

The canyon bog-orchid (*Platanthera sparsiflora*) was found in a backwater of the human-made fishing pond, formerly a gravel pit, in boggy areas in the willows adjacent to the river, and along an irrigation ditch on the west side of Highway 550. It prefers to be next to open water, with its roots reaching below the water table, but not inundated.

Biodiversity Rank Justification: The Uncompahgre River at Eldredge PCA contains a fair example of a narrowleaf cottonwood riparian forest critically imperiled on a global scale, and a canyon bog-orchid that is rare in the state of Colorado.

Natural Heritage elements associated with wetlands at the Uncompahgre River at Eldredge PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia*/*Salix ligulifolia-Shepherdia argentea	**Narrowleaf cottonwood riparian forests**	**G1**	**S1**			**C**
Platanthera sparsiflora	Canyon bog-orchid	G4G5T3	S2			C

*EO = Element Occurrence

Boundary Justification: The PCA includes the known element occurrences and a buffer to protect the PCA from direct disturbance. The boundary was extended to the west in 1998 to include an additional sub-population of the canyon bog orchid.

Protection Rank Justification: Both the riparian plant community and the canyon bog orchid are dependent on the continuation of the present hydrologic regime, and are threatened by road alterations. Approximately the middle 1/3 of the PCA is within the Billy Creek State Wildlife Refuge, with upper and lower portions located on private land.

Management Rank Justification: Road and irrigation ditch maintenance pose threats to the canyon bog-orchid population. The PCA is located below the Ridgway Dam, and the ecology of the area has likely been affected by altered flows. Some degree of restoration may be achieved by simulating spring flood regimes by occasional controlled discharges, aggressive control of exotic species, and the cessation of grazing in the riparian area. For further thoughts on restoration of the Uncompahgre River, please see the section on the Uncompahgre River Macrosite, page 60 of this report.

Wetland Function and Value Assessment for the Uncompahgre River at Eldredge PCA:

Proposed HGM Class: Depressional. Subclass: D2, wetland with permanent flooding; Class: Riverine. Subclass R3 Middle Elevation Perennial with seasonal flooding.

Cowardin System: Palustrine. Susbsystem: Emergent, Scrub-Shrub and Forested Wetland.

Category II provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the Uncompahgre River at Eldredge PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	Low	The small wetland area subject to flooding (< 2 acres) yields a low rating.
Sediment/Shoreline Stabilization	High	The high percentage of rooted vegetation cover combined with intermittent water yields a high rating.
Groundwater Discharge/ Recharge	Low	No D/R indicators present.
Dynamic Surface Water Storage	Low	Small size of flooded area and infrequent flood regime.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	High	Receives discharge of managed water, evidence of flooding and ponding, and over 50% rooted vegetation cover.
Biological Functions		
Habitat Diversity	High	The wetland site consists of emergent, forest and scrub-shrub wetland habitats.
Listed/Proposed/Candidate T&E Species Habitat	None	None known.
CO Natural Heritage Program Species Habitat	High	The wetland site supports a fair occurrence of narrowleaf cottonwood riparian forest (*Populus angustifolia*/*Salix ligulifolia-Shepherdia argentea*) G1/S1 and canyon bog-orchid (*Platanthera sparsiflora*) G4G5T3/S2.
General Wildlife Habitat	High	Deer, raptors and songbirds, raccoon, and chorus frogs are suspected to use the Assessment Area.
General Fish/Aquatic Habitat	Low	No fish were observed.
Production Export/Food Chain Support	High	A large wetland size (20 acres), high habitat diversity rating, and intermittent surface water yields a high potential to produce and export food/nutrients.
Values		
Uniqueness	Medium	This wetland type is considered common within the boundaries of the study area and there is direct disturbance to the wetland site, but it encompasses a mature forested wetland which heavily weights the rating toward medium.
Recreation/Education Potential	High	State wildlife area fishing access

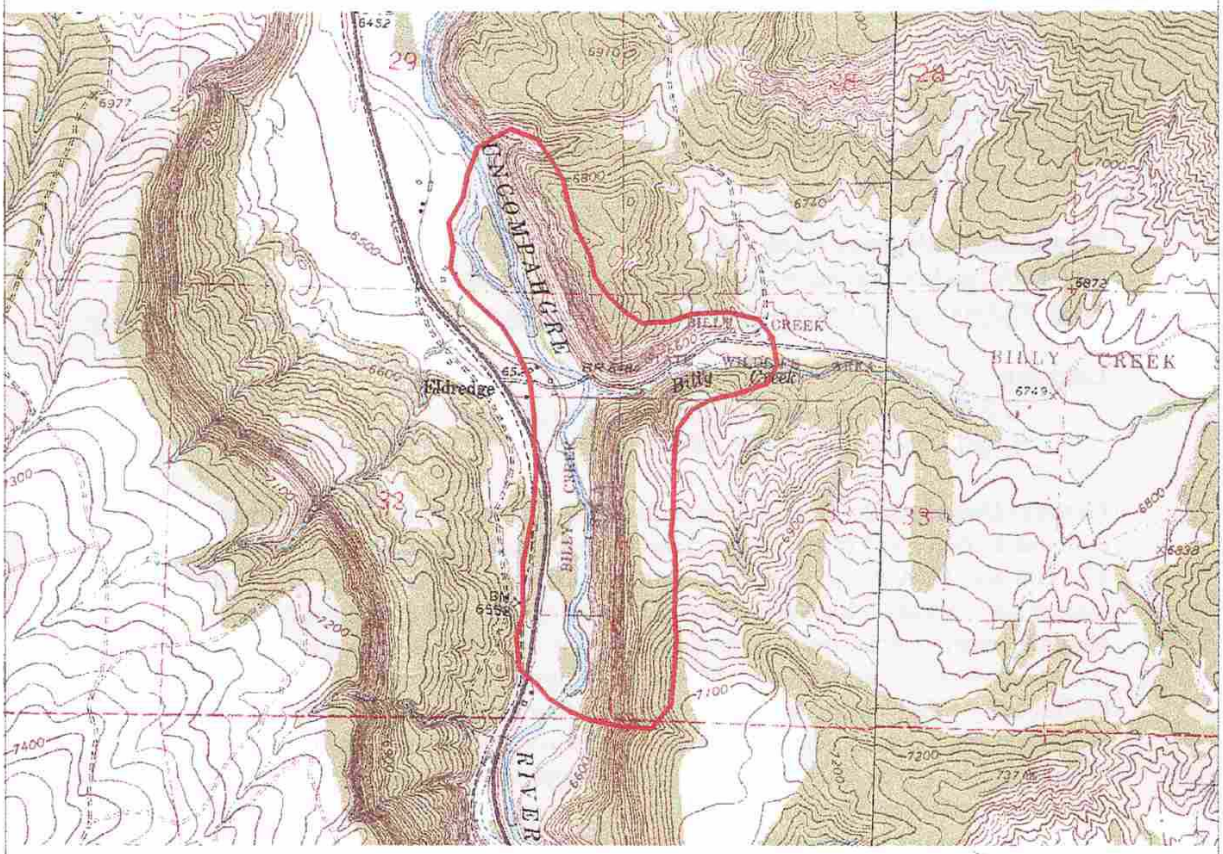
General Soil Description

Texture	Soil is mucky, clayey, with a sulfur smell
Color	7.5 YR 3/1
Cobble Size	N/A
Percent Mottling	5% 7.5 YR ¾

Uncompahgre River at Eldredge

Potential Conservation Area

Biodiversity Rank: B2



Colona U.S.G.S. 7.5 min. Quadrangle

ELEMENT OCCURRENCES:

Populus angustifolia/Salix eriocephala var. ligulifolia-Shepherdia argentea

Platanthera sparsiflora var. ensifolia

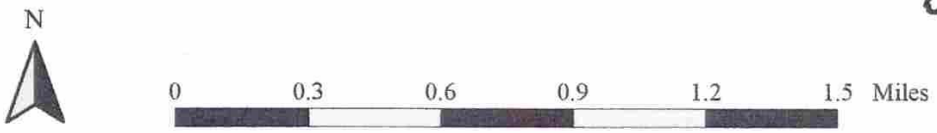


Figure 10. Map of Uncompahgre River at Eldredge PCA

Uncompahgre River at Ridgway Potential Conservation Area

Biodiversity Rank: B2 (Very high significance)
The Uncompahgre River at Ridgway PCA supports a good example of a narrowleaf cottonwood riparian forest critically imperiled on a global scale.

Protection Urgency Rank: P3
The town of Ridgway has expressed strong interest in purchasing and restoring this part of the riparian corridor.

Management Urgency Rank: M3
This PCA has been impacted by upstream gravel operations, but has potential for successful ecological restoration, rehabilitation, and enhancement for open space values.

Location: Ouray County
U.S.G.S. 7.5 min. quadrangles: Ridgway, Dallas
Legal Description: T45N R8W S 9

General Description: This small stretch of the Uncompahgre River north of Ridgway contains a good relict of the native riparian vegetation typical of the Uncompahgre River. The 108 acre PCA ranges in elevation from 6,960 to 7,000 ft. (2,120 to 2,150 m). Its mature narrowleaf cottonwoods (*Populus angustifolia*) and occasionally box elders (*Acer negundo*) provide roosting and hunting areas for wintering bald eagles. A lower tree layer consists of scattered Rocky Mountain junipers (*Juniperus scopulorum*). Silver buffaloberry (*Shepherdia argentea*), a species that has been much reduced throughout the area, grows in a continuous band here. Non-native species include Kentucky bluegrass (*Poa pratensis*), houndstongue (*Cynoglossum officinale*), Canada thistle (*Cirsium arvense*), and Russian thistle (*Salsola iberica*). Uplands in the area have pinyon (*Pinus edulis*) and juniper woodlands with mountain big sagebrush (*Artemisia trilobata*).

Biodiversity Rank Justification: The Uncompahgre River at Ridgway PCA supports a good example of a narrowleaf cottonwood riparian forest critically imperiled on a global scale.

Natural Heritage elements associated with wetlands at the Uncompahgre River at Ridgway PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia*/*Salix ligulifolia-Shepherdia argentea	**Narrowleaf cottonwood riparian forests**	**G1**	**S1**			**C**

*EO = Element Occurrence

Boundary Justification: The boundary includes the occurrence of the riparian community, and a small buffer to protect the occurrences from direct disturbance such as road construction and maintenance.

Protection Rank Justification: The town of Ridgway has expressed strong interest in purchasing and restoring this part of the riparian corridor.

Management Rank Justification: The town of Ridgway has expressed a strong interest in purchasing sections of the river adjacent to land owned by the town, and restoring the riparian corridor. This initiative is strongly encouraged. The riparian corridor has great potential to be improved for general open space and recreation values. Because the PCA is located above the Ridgway Dam, the natural flooding regime is relatively unaltered, and natural processes could be incorporated into a management plan to enhance the natural riparian communities. This site has been impacted by upstream gravel operations and the secession and remediation of the negative affects of mining should improve the river system. Work on the river channel and bank stabilization could benefit the riparian vegetation, and facilitate regeneration and maintenance of cottonwood trees and willows. Abandoned oxbows and meanders could be recreated, creating emergent and open water habitats, greatly contributing to the overall habitat diversity of the riparian site. This area also has a high potential to be used by the community and visitors as a natural park, with the construction of trails and interpretive signs to educate the public on the natural heritage value of riparian wetlands. For further thoughts on restoration of the Uncompahgre River, please see the section on the Uncompahgre River Macrosite, page 60 of this report.

Wetland Function and Value Assessment for the Uncompahgre River at Ridgway PCA.

Proposed HGM Class: Riverine. Subclass: R4 Lower Perennial, subject to seasonal flooding.

Cowardin System: Palustrine. Subsystem: Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment Was Performed at the Uncompahgre River at Ridgway PCA.

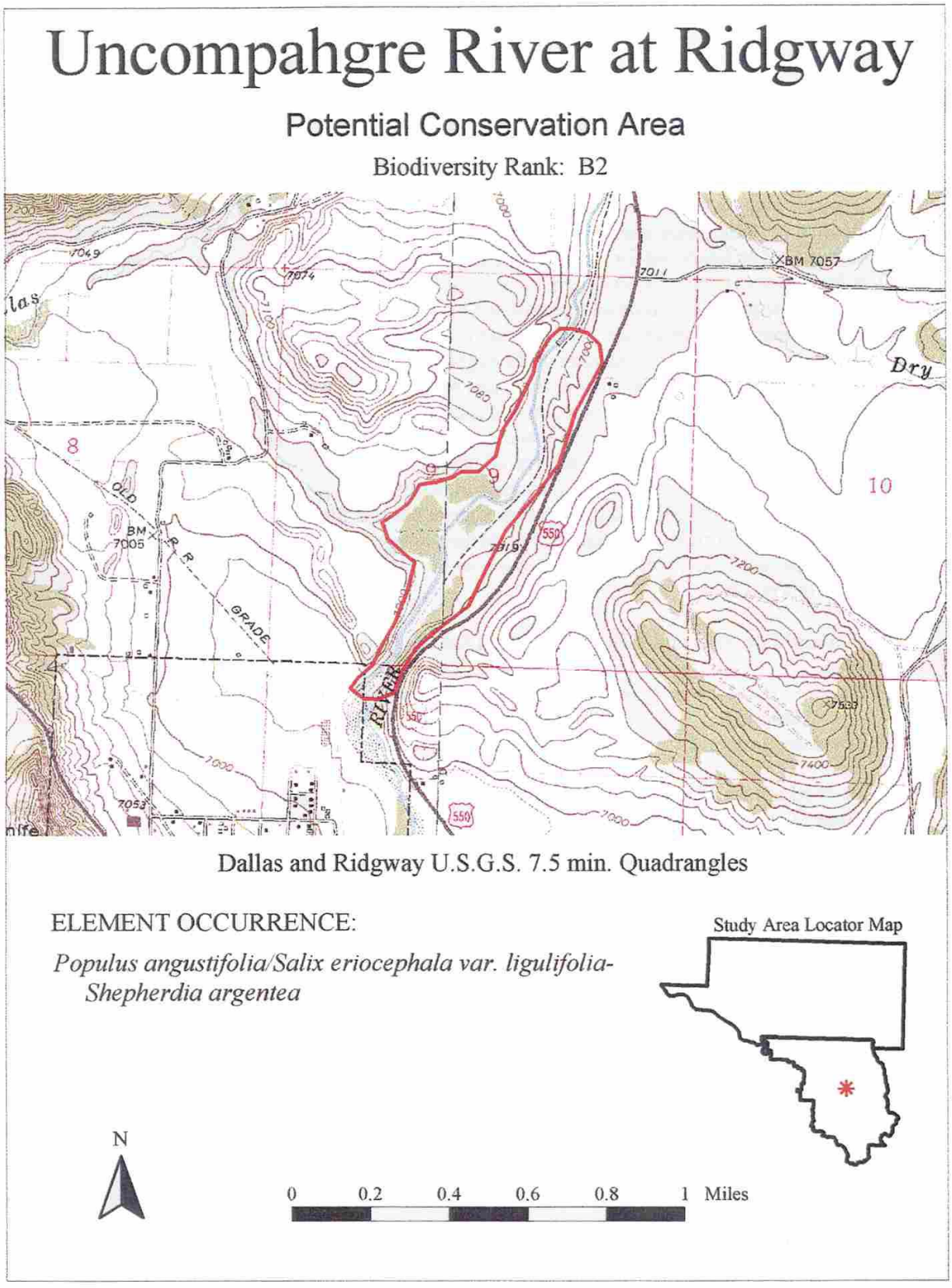


Figure 11. Map of Uncompahgre River at Ridgway PCA

Cottonwood Creek Potential Conservation Area

Biodiversity Rank: B3 (High significance)
The Cottonwood Creek PCA contains one of the best examples of a narrowleaf cottonwood/ skunkbrush riparian forest (*Populus angustifolia*/*Rhus trilobata*) observed during the 1998 field season. The community is considered vulnerable throughout its range.

Protection Urgency Rank: P3
The majority of the PCA is located on public lands managed by the BLM, with several private inholdings interspersed throughout. The area on BLM land would be a good candidate for protection as an ACEC (BLM Area of Critical Ecological Concern) or Research Natural Area.

Management Urgency Rank: M4
The current management practices do not adversely affect the riparian community. However, water diversion approximately 5 miles upstream may be influencing the hydrology of the riparian area.

Location: Montrose County. West of 25 Mesa Road.
U.S.G.S. 7.5 min. quadrangles: Cottonwood Basin, Camel Back, Roubideau
Legal Description: T50N R13W S 13, 23, 24, 26; T50NR12W S 5-7; T51N R12W S 32.

General Description: The 929 acre Cottonwood Creek PCA encompasses a narrow riparian area at the bottom of a deep canyon. Elevation ranges from 5,600 to 6,600 ft. (1,700 to 2,000 m). The riparian vegetation is in good condition. There are no roads or hydrological alterations within the PCA, and few weeds. Evidence of flooding was observed, and there is good regeneration of cottonwoods and willows. Schools of small fish were seen in the creek. Difficulty of access contributes to its excellent condition. Major vegetation in the riparian zone consists of narrowleaf cottonwood (*Populus angustifolia*), skunkbrush (*Rhus trilobata*), coyote willow (*Salix exigua*), and silver buffaloberry (*Shepherdia argentea*). Yellow sweet clover (*Melilotus officinal*) is one of the few weeds present. Soils are sandy with medium size cobbles. Banks are 60-75% vegetated. Uplands consist of mountain big sagebrush (*Artemisia tridentata*), Gambel oak (*Quercus gambelii*) and rubber rabbitbrush (*Chrysothamnus nauseosus*).

Biodiversity Rank Justification: The Cottonwood Creek Conservation PCA contains an excellent occurrence of a rare and imperiled narrowleaf cottonwood/skunkbrush riparian forest (*Populus angustifolia*/*Rhus trilobata*). It is an isolated area with its natural hydrology mostly intact, few weedy/introduced species in the understory, evidence of regeneration of riparian vegetation, and minimal negative impacts from grazing.

Natural Heritage elements associated with wetlands at the Cottonwood Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia/Rhus trilobata	**Narrowleaf cottonwood/ skunkbrush riparian forests**	**G3**	**S3**			**A**

*EO = Element Occurrence

Boundary Justification: The boundary contains the riparian zone of Cottonwood Creek from 5,600 to 6,600 ft. (1,700 to 2,000 m), and extends to include the canyon walls. Long-term management should consider the ecological processes within the upper watershed.

Protection Rank Justification: Because highly functioning riparian areas are so rare in the Uncompahgre River Basin, the Cottonwood Creek Conservation PCA merits special status, such as designation as an ACEC (Area of Critical Environmental Concern) or Research Natural Area.

Management Rank Justification: Water diversions like the one approximately five miles upstream (T49N R14W S18) have the potential to disrupt the hydrology of downstream riparian habitat. Further investigation of the effects of the upstream diversion and regular monitoring of the riparian community is recommended.

Wetland Function and Value Assessment for the Cottonwood Creek PCA:
Proposed HGM Class: Riverine. Subclass: R3 Middle Elevation Perennial wetland subject to periodic flooding.
Cowardin System: Palustrine. Subsystem: Forested and Scrub-Shrub Wetland.

Category II provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the Cottonwood Creek PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	High	This large riparian area is subject to in-channel and overbank flow with a high cover of forested or scrub-shrub vegetation.
Sediment/Shoreline Stabilization	High	The heavily vegetated riparian area is located on a perennial river's banks and floodplain
Groundwater Discharge/ Recharge	Unknown	The wetland is several miles long and probably passes through several geologic zones of discharge and recharge; however, at this level of analysis the exact status of the system cannot be specified.
Dynamic Surface Water Storage	N/A	This riparian area is flooded exclusively by in-channel or overbank flow.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	Moderate	The wetlands ability to retain sediment and retain or remove nutrients and toxicants is based on the evidence of flooding or ponding and the >50% cover of riparian vegetation.
Biological Functions		
Habitat Diversity	High	The wetland site consists of forested, scrub-shrub, and open water habitats.
Listed/Potential/Candidate T&E Species Habitat	None	None observed.
CO Natural Heritage Program Species Habitat	High	This site supports a good example of a community considered rare throughout its range and in the state of Colorado; narrowleaf cottonwood/skunkbrush (*Populus angustifolia*/*Rhus trilobata*) riparian forest, G3/S3.
General Wildlife Habitat	High	An estimated 80% of vertebrate fauna in the semi-arid West commonly use riparian areas and wetlands for year round habitat or for migratory stopovers (Somers and Floyd-Hanna 1996).
General Fish/Aquatic Habitat	High	Verified native fish were observed in the river.
Production Export/Food Chain Support	High	The wetlands high potential to produce and export food/nutrients for living organisms is driven by the presence of a year-round water source and an outlet for food/nutrient export. High habitat diversity that includes open water and its large size also contributes to the high ranking.
Values		
Uniqueness	High	The riparian area has a high diversity rating , with little unnatural disturbance. Although nearby streams may support the same community type, this riparian area is considered rare because few are in excellent condition.
Recreation/Education Potential	Low	Based on the location the potential for recreation/education is low, but there is some opportunity for scientific study.

General Soil Description

Texture	Sandy alluvium
Color	N/A
Cobble Size	Medium
Percent Mottling	N/A

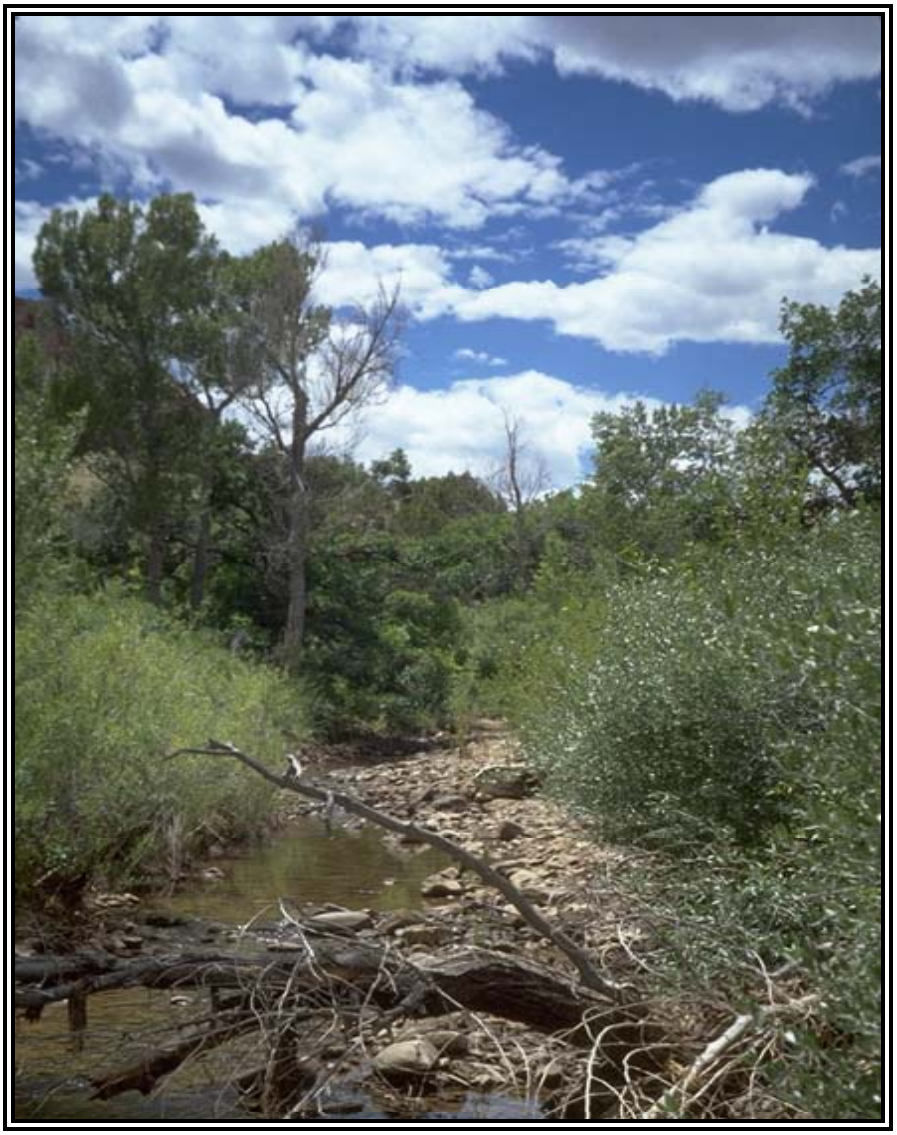


Figure 12. Narrowleaf cottonwood/skunkbrush riparian community at the Cottonwood Creek PCA

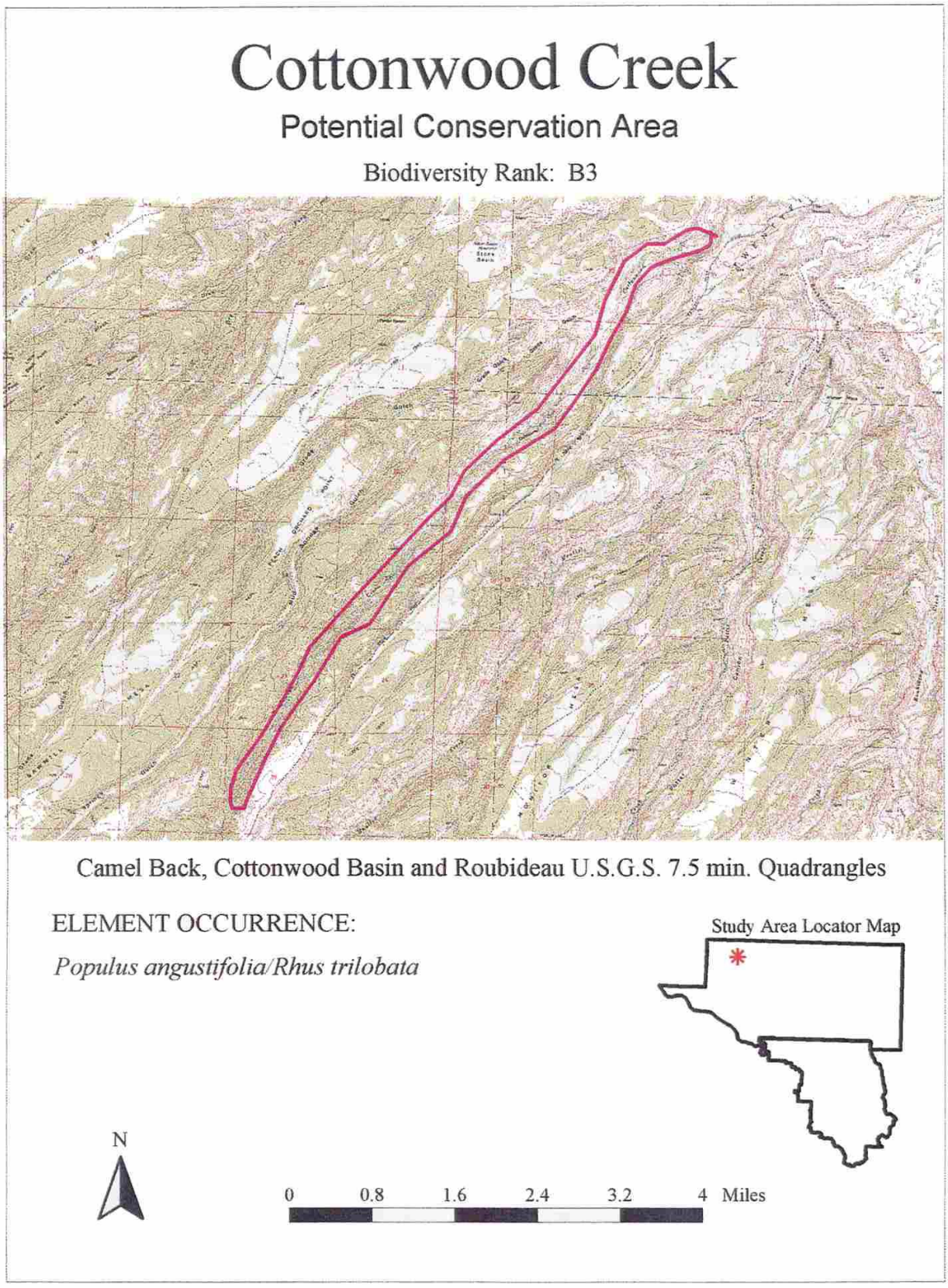


Figure 13. Map of Cottonwood Creek PCA

Uncompahgre River Macrosite

Biodiversity Rank: B3 (High significance)
The Uncompahgre River Macrosite contains relic stands of several rare and imperiled riparian forest types, plants, and animals tracked by CNHP. Although the general condition of the river is degraded, its importance in a regional context contributes to the high biodiversity rank.

Protection Urgency Rank: P1
Approximately 90% of the Lower Uncompahgre River corridor is privately owned and zoned for agriculture. Protection of as much of the riparian zone as possible, to prevent further damage to the system, is a prerequisite for improving the health of the river corridor.

Management Urgency Rank: M1
Changes in management should include cessation of gravel mining, discontinuing the cutting of cottonwoods to increase agricultural land, eliminating livestock grazing in the riparian understory during the growing season, and undertaking weed control measures to reduce exotic species such as Russian olive (*Eleagnus angustifolia*), tamarisk (*Tamarix ramosissima*), Russian knapweed (*Centaurea repens*). The entire river corridor presents an excellent opportunity to improve the river and adjacent riparian zone for biodiversity, aesthetic and open space values.

Location: San Juan, Ouray, Montrose, and Delta counties.

U.S.G.S. 7.5 min. quadrangles: Colona, Dallas, Delta, Handies Peak, Ironton Park, Montrose East, Montrose West, North Delta, Olathe, Olathe NW, Ouray, and Ridgway

Legal Description: T15S R96W S 11, 13, 14, 24, 25, 36; T15S R95W S31, 32; T51N R11W S 12, 13; T51N R10W S 7, 8, 17, 18, 20, 21, 29, 33; T50N R10W S 4, 9, 15, 16, 22, 26, 27, 34, 35; T49N R10W S 2, 3, 11-13; T49N R9W S 18-20, 28, 29, 33, 34; T48N R9W S 4, 5, 9, 10, 14, 15, 23, 25, 26, 36; T48N R8W S 31; T47N R8W S 6, 7, 17, 18, 20, 29, 32, 33; T46N R8W S 4, 5, 8, 9, 16, 17, 20, 21, 22, 27, 28, 33, 34; T45N R8W S 4, 9, 16, 21, 22, 27, 28, 34, 35; T44N R8W S 2, 3, 11, 13, 14, 24, 25, 30, 31, 36; T43N R7W S 5, 6, 8, 16, 17, 21, 22, 27, 34; T42N R7W S 3, 10.

General Description: The Uncompahgre River is the main artery of the Uncompahgre River Basin. It flows northwest from its source high in the San Juan Mountains at 14,300 ft. (4,359 m) to join the Gunnison River at 4,900 ft. (1,494 m) in Delta. It collects water from a multitude of tributaries as it drops nearly five thousand feet through Ouray and Montrose counties. The 18,626 acre Uncompahgre River Macrosite includes two standard wetland Potential Conservation Areas (PCAs) which are discussed separately in this report: the Uncompahgre River at Ridgway, and the Uncompahgre River at Eldredge. Elements occurring in the Macrosite that are not specifically tied to the wetland and riparian habitat are profiled in the companion to this report, Uncompahgre River Basin Natural Heritage Assessment Vol.I (Lyon et al. 1999).

Above Ouray, the river joins a major tributary, Red Mountain Creek, which has carved a steep canyon through crystalline Precambrian rocks. Red Mountain Creek has been the source of major pollution for the Uncompahgre River, contributing acids and heavy metals from mining activities high in the San Juan Mountains (Hoag 1997). The river meets Canyon Creek at Box Canyon, south of Ouray, where the spectacular waterfall is home to a colony of black swifts. Several rare ferns grow on the vertical cliffs of the canyon.

The City of Ouray Parks Department has undertaken a major river improvement project. The braided river channel is being reconfigured to a single channel with deep sinuous meanders to slow the flow of water, control flooding, reduce erosion, and improve the aesthetics of the river. Revegetation will be undertaken over the next few years.

The Uncompahgre River continues northward to Ridgway through a broad glacier-carved valley. Most of the land adjacent to the river has been converted to irrigated pasture. This section of the river has also been extensively mined for gravel. Effects of gravel mining can be seen in the altered channel morphology (e.g., braided channel, high steep banks formed by excavation machinery), and lowered water table of the river at Ridgway. Dallas Creek, which drains a large area of the San Juans and Uncompahgre Plateau to the west, adds its waters a few miles south of Ridgway. Here the river is impounded by the Ridgway Dam, and forms a large reservoir managed by the Colorado Department of Natural Resources.

Water leaving the reservoir through the bottom of the Ridgway Dam is cold and clear, and supports a well-known fishery. The river in this stretch has been enhanced for fish habitat by the installation of rock structures to slow the river and provide quiet pools. North of the reservoir, Cow Creek enters the river, and some of the best quality riparian vegetation on the river is found in the Billy Creek area (Uncompahgre River at Eldredge Potential Conservation Area).

From Billy Creek north the river shows the effects of a century of human agricultural use. For much of its length river bottom wetlands have been drained, and cultivated lands and pastures have replaced cottonwood communities on the banks of the river. Irrigation runoff from farming soils derived from the Mancos Shale are a major source of salts entering the Colorado River system (USDA 1981).

Water quality along the river varies from poor to good (Hoag 1997). It begins with a heavy load of metals and particulates from mining, improves as it is diluted by tributaries and as sediments settle in Ridgway Reservoir, declines again as it picks up runoff from irrigated fields, until it is again diluted by a major tributary.

The Uncompahgre River has been dramatically altered over the past hundred years (see Human Impacts on the Ecology of Wetlands and Riparian Areas, page 14 of this report). It has suffered the effects of hard rock mining, gravel extraction, damming, diversions for irrigation, draining of flood plains and channelization from agricultural use and road

construction, pollution from irrigation runoff, heavy grazing, and invasion of exotic weeds. However, there are signs that conditions may be improving.

Mine cleanup at the Idarado Mine has reduced sediments that contain acids and heavy metals. Some gravel operations are closing down. The Ridgway Reservoir, although it has altered the natural flows of the river substantially, does have some beneficial effects on water quality, as sediments collect in its bottom, and clean water is released. There is a new community interest in protecting the riparian vegetation that remains and restoring the river to a more naturally functioning state. The City of Ouray has begun a restoration and flood control project that will put meanders into the river where its channel was formerly straightened, slowing the flow and reducing erosion. The town of Ridgway is showing interest in acquiring land along the river and restoring riparian communities while providing for open space and recreation. Conservation easements have been obtained on parcels of riverfront land north of Ridgway and north of Billy Creek. Interpretive signs along the Uncompahgre Riverway bicycle path serve to educate its users on the importance of the riparian zone and its benefit to wildlife. The small portion of the river that falls in the Billy Creek State Wildlife Area is one of the better condition reaches, and will remain protected from development, although other uses such as a potential new powerline may pose a threat. Wetlands have been created along the river through habitat improvement projects by the Colorado Division of Wildlife and the Natural Resources Conservation Service. The Valley Land Conservancy, a local land trust, is working to protect land along the river through purchase of property, purchase of development rights, and conservation easements. Several conservation easements are already in place.

Biodiversity Rank Justification: The high biodiversity significance of the river is driven by the presence of small relic stands of a globally imperiled plant community, narrowleaf cottonwood/ willow-strapleaf, silverleaf buffaloberry riparian forest (*Populus angustifolia/Salix ligulifolia-Shepherdia argentea*). However, the importance of the river in the context of the entire landscape of the Uncompahgre River Basin is much higher. The importance of any natural waterway in a semi-arid region cannot be over emphasized. An estimated 80% of vertebrate fauna depend on wetlands and riparian areas for year round habitat or for migratory stopovers (Somers and Floyd-Hanna 1996).

Natural Heritage elements associated with wetlands at the Uncompahgre River Macrosite.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia/Salix ligulifolia-Shepherdia argentea	**Narrowleaf cottonwood riparian forests**	**G1**	**S1**			**C**
Populus angustifolia/Salix ligulifolia-Shepherdia argentea	**Narrowleaf cottonwood riparian forests**	**G1**	**S1**			**C**
Populus angustifolia/Salix ligulifolia-Shepherdia argentea	**Narrowleaf cottonwood riparian forests**	**G1**	**S1**			**C**
Populus tremuloides/Acer glabrum	**Montane riparian forests**	**G2**	**S1S2**			**B**
Aquila chrysaetos (*watch*)	Golden eagle	G5	S4BSZN			E
Cypseloides niger	Black swift	G4	S3B			E
Phragmites australis	Marshes	G4	S3			C
Platanthera sparsiflora	Canyon bog-orchid	G4G5T3	S2			C
Populus angustifolia/Rhus trilobata	Narrowleaf cottonwood/Skunkbrush riparian forests	G3	S3			C
Populus angustifolia/Salix exigua	Narrowleaf cottonwood riparian forests	G4	S4			C
Rana pipiens	Northern leopard frog	G5	S3	FS	SC	C
Rana pipiens	Northern leopard frog	G5	S3	FS	SC	C
Salix exigua/Bare ground	Coyote willow/barren soil	G5	S5			C
Typha latifolia	Narrow-leaf cattail marsh	G5	S3			C
Vireo vicinior	Gray vireo	G4	S2BSZN			E

*EO=Element Occurrence

Boundary Justification: The boundary is drawn to include the entire Uncompahgre River, from its source to its confluence with the Gunnison River at Delta. The width of the site approximates the natural flood plain of the river, allowing room for increasing its meanders when restoration of a more natural flow pattern is undertaken. The Macrosite includes the standard sites: Ouray Canyons, Uncompahgre River at Ridgway, and Uncompahgre River at Eldredge.

Protection Rank Justification: Approximately 90% of the Lower Uncompahgre River corridor is privately owned and zoned for agriculture (Hoag 1997). Protection of as much of the riparian zone as possible should be a top priority for all stakeholders. Protection is critical to prevent further damage to the system and to facilitate restoration efforts.

Management Rank Justification: Changes in management should include cessation of gravel mining, discontinuing the cutting of cottonwoods to increase agricultural land, eliminating livestock grazing in the riparian understory during the growing season, and undertaking weed control measures to reduce exotic species such as Russian olive (*Eleagnus angustifolia*), tamarisk (*Tamarix ramosissima*), Russian knapweed (*Centaurea repens*). The entire river corridor presents an excellent opportunity to improve the river and adjacent riparian zone for biodiversity, aesthetic and open space values.

Observations on Restoration Potential for the Uncompahgre River Macrosite: When the term "ecological restoration" is discussed in academic circles, it implicitly means the reconstruction of exactly what was there before the original ecosystem was degraded, which includes both structure (e.g., species and complexity) and function (usually measured in terms of processes such as productivity, nutrient cycling, or self perpetuation) (Bradshaw 1987). If restoration attempts are not completely successful, then what is achieved is termed "rehabilitation". Historically, the Lower Uncompahgre River Valley supported extensive river-bottom wetlands and riparian forests, which have been reduced to a fraction of their former extent since the turn of the century (USDA 1981). Because of the extensive alteration of the natural hydrological regime and introduction of non-native species, true restoration of the Uncompahgre River is probably not politically, economically, or ecologically possible. However, a less strictly defined vision of restoration, which includes efforts to improve and enhance the riparian corridor to the benefit of multiple natural and human values, is not only realistic, but also critical to the protection of biodiversity in the Lower Uncompahgre River Basin.

The first step in considering the restoration of the Uncompahgre River should be to conduct a preliminary study to determine the current physical and biological dynamics of the river system, and what natural and cultural values the riparian corridor is capable of supporting. The river could be subdivided into reaches according to major influences and environmental parameters for each section. For example, above Ridgway Dam, it may be possible to approximate the natural hydrological functions of the river, including seasonal flooding. Below the Ridgway Dam, the regulation of water discharge has reduced peak flows in the spring, while sediment inputs have remained constant (USGS 1999). This has resulted in a river that has a reduced capacity to flood, scour, erode its banks, and transport coarse material and flush sediments downstream. At the same time, summer releases from the Ridgway Dam combined with additional water delivered from the Gunnison Canal and other water projects have increased baseflows during the growing season. Given these new fluvial processes, the types of riparian plant communities that existed before settlement may not be sustainable, and the natural functioning of the river cannot be restored without drastic and unacceptable changes like removal of dams and irrigation diversions. However, it should be possible to improve the river's condition and prevent further damage within the existing parameters.

Within the context of the information learned in this invenrory, site specific goals for the entire length of the Uncompahgre River could be identified by a focus group made up of citizens, experts, agency personnel and other stakeholders. Goals for enhancing or improving the riparian zone may include the following: wildlife habitat and biodiversity

values, sediment/nutrient/ toxicant removal, bank stabilization and flood control, aesthetics, open space and recreation. All of these goals are linked to improving the condition of riparian vegetation. Riparian vegetation is resilient, and often recovers naturally when stresses are removed if the underlying hydrological processes are sufficient. We have seen examples of very rapid recovery of riparian vegetation with the cessation of gravel mining, and the reestablishment of wetland vegetation with the simple addition of water (e.g., Sazama Site of Local Significance, page 81). In order to offset the expected loss of thousands of acres of irrigation-induced wetlands due to proposed salinity control programs in the Lower Uncompahgre River Valley, it seems to make biological sense to recreate a network of river-bottom wetlands and riparian forests similar to those present in presettlement times (see page 14). Revegetation of the floodplain should be attempted only after the hydrology has been studied, and improved where possible, so that restoration efforts will be self-sustaining. It should then be accomplished using native plant species such as cottonwoods, willows, buffaloberry, skunkbush and native sedges and rushes appropriate to each particular site. Existing cottonwood and willow communities should be preserved and enhanced, while non-native species can gradually be eliminated. This will be a long-term commitment, but there is motivation among the people of eastern Montrose and Ouray counties to improve the condition of the river.

It is recommended that a high priority be given to the protection of the best examples of riparian vegetation that remain. Management practices that are damaging to the river should be strongly discouraged, including gravel mining, tree removal, over-grazing, and conversion of the riparian zone for agricultural crops and pasture. Virtually the entire river below Ouray is privately owned, therefore private landowners must be convinced that it is to their benefit to protect the health of the river. There are numerous incentives or mechanisms that could be developed to encourage good stewardship of the Uncompahgre River. Such incentives may include: education, conservation easements, tax incentives, voluntary participation in wetland protection and enhancement programs such as the NRCS Wetland Reserve Program, CDOW Wetlands Program, USFWS Partners for Wildlife Program, county land use planning, and purchase of critical riparian and wetland habitat by public agencies, local government, private conservation organizations.

Wetland Function and Value Assessment for the Uncompahgre River Macrosite:
Proposed HGM Class: Riverine. Subclass: R1, R2, R3, R4, R5 Upper and Lower Perennial, subject to periodic flooding.
Cowardin System: Palustrine. Subsystem: Emergent, Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment Was Performed at This Site.

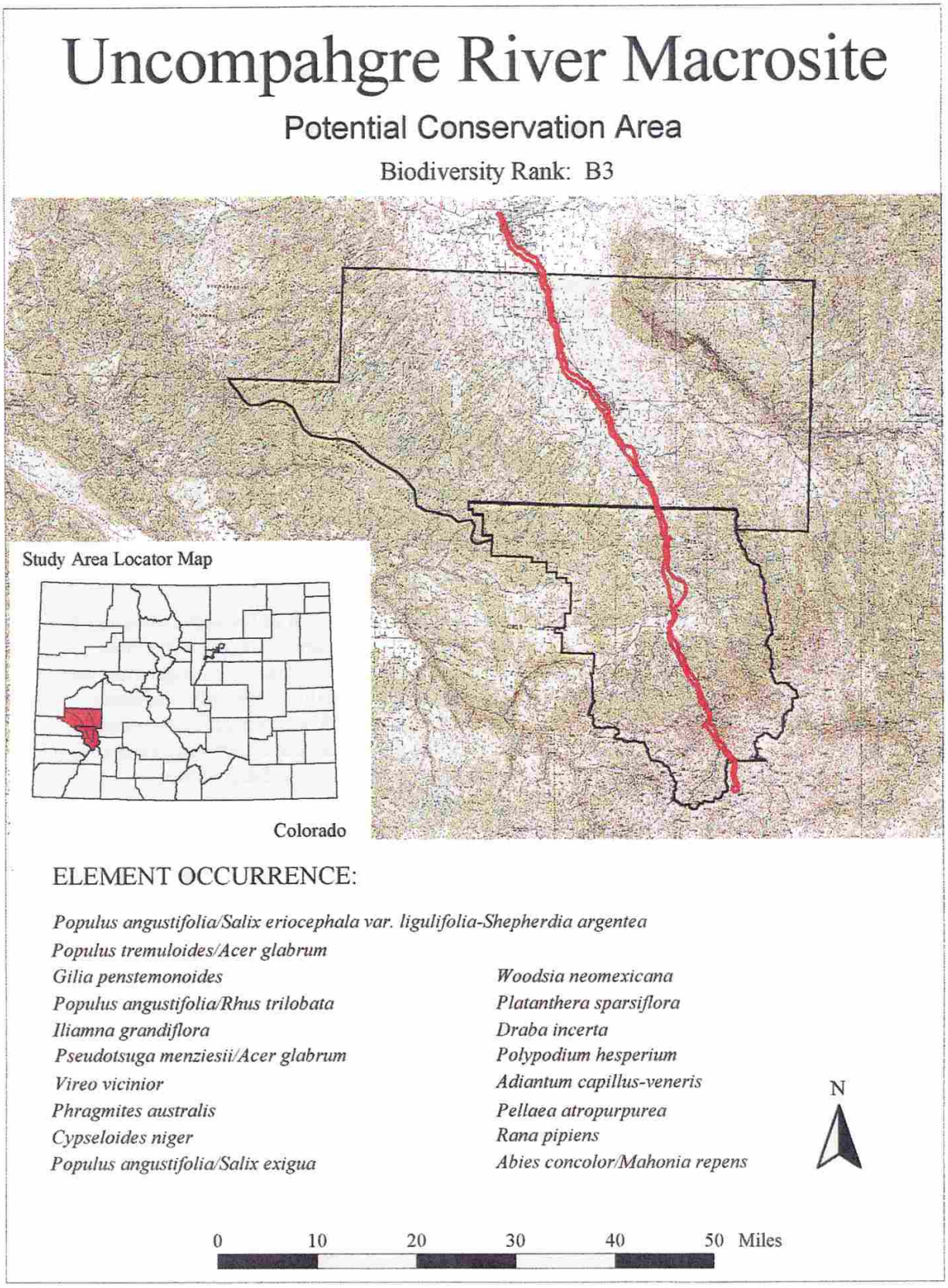


Figure 14. Map of Uncompahgre River Macrosite

Escalante Wetland Potential Conservation Area

Biodiversity Rank: B3 (Moderate significance)
The Escalante Wetland PCA is an alkaline wetland that supports two good examples of communities considered vulnerable throughout their range and rare in the state of Colorado; a salt meadows wetland, and a beaked spikerush emergent wetland.

Protection Urgency Rank: P2
The Escalante Wetland PCA is under the jurisdiction of the Bureau of Land Management, with no special designation. The high Protection rank reflects the fact that this wetland site is part of a much larger Escalante Canyon Macrosite, which partly occurs on private land.

Management Urgency Rank: M2
The Escalante Wetland PCA is threatened by gullying caused by runoff from the main road. Restoration should be a high priority.

Location: 12 miles southwest from Highway 50 along Escalante Canyon Road.
U.S.G.S. 7.5 min. quadrangle: Good Point
Legal Description: T51N R13W S 20, 21

General Description: The 12 acre Escalante Wetland PCA is a 5 acre alkaline slope wetland located in Escalante Canyon at an elevation of 5,600 ft. (1,707 m). The wetland site is located on a gently sloping south facing bench between Escalante Canyon Road and Escalante Creek. This wetland PCA is part of a larger Conservation Macro-Site with over 35 occurrences of elements tracked by CNHP (Colorado Natural Heritage Program 1999) encompassing almost the entire Escalante Valley. Seeps line the canyon walls at the base of high sandstone cliffs supporting several populations of hanging gardens (*Aquilegia micrantha-Mimulus eastwoodiae*).

Biodiversity Rank Justification: The Escalante Wetland PCA is located in one of the most unique and biologically diverse areas within the Uncompahgre River Basin. The Escalante Wetland PCA is an alkaline wetland that supports two good examples of communities considered rare throughout its range in the state of Colorado, a salt meadows wetland, and a beaked spikerush emergent wetland.

Natural Heritage elements associated with wetlands at the Escalante Wetland PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Eleocharis rostellata	**Emergent wetland**	**G2G3**	**S2S3**			**B**
Spartina gracilis	Western slope salt meadows	G4?	S2			B

*EO=Element Occurrence

Boundary Justification: The boundary is drawn to encompass the two element occurrences, cliff seeps and a 1,000 foot buffer from land use impacts (e.g., roads, recreation and cattle grazing). Some riparian area upstream is included to preserve hydrologic function. Long term conservation planning should encompass the entire Escalante Canyon Macrosite.

Protection Rank Justification: The Escalante Wetland PCA is under the jurisdiction of the Bureau of Land Management. Although the management plans for the area are unknown, the Bureau of Land Management has taken an interest in this unique canyon and its natural heritage values. Designation of the PCA as an ACEC (BLM Area of Critical Environmental Concern) is recommended. The high Protection rank reflects the fact that this wetland PCA is part of a much larger Escalante Canyon Macrosite, which partly occurs on private land.

Management Rank Justification: The Escalante Wetland PCA is in a very vulnerable area bordered to the north by Escalante Canyon Road, to the south by Escalante Creek, and to the east by a small 4WD road stemming from Escalante Canyon Road. The 4WD road skirts the edge of the salt meadows wetland (*Spartina gracilis*). Closing and revegetating the unimproved road is recommended. The wetland is also threatened by the Escalante Canyon Road. Runoff from the road has begun to create gullies downslope, adjacent to the wetland. These gullies may be lowering the water table that supports the salt meadows. Restoration should be a high priority, and could easily be accomplished by improving road drainage and repairing the gullies. Cattle should also be restricted from the wetland site.

Wetland Function and Value Assessment for the Escalante Wetland PCA:
Proposed HGM Class: Slope Wetland. Subclass: S4, with semi-permanent flooding.
Cowardin System: Palustrine. Subsystem: Emergent Wetland.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the Escalante Wetland PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	N/A	This wetland is not subject to in-channel or overbank flow.
Sediment/Shoreline Stabilization	N/A	The wetland is located above the river's floodplain and supplies water to the river, but does not contribute to flow dissipation.
Groundwater Discharge/ Recharge	High	The high potential for groundwater discharge is indicated by seeps within the wetland site. The seeps first appear at the base of cliffs above and reappear at the location of the wetland plant communities of concern. The seep maintains semi-permanent saturation levels to the wetland communities and contributes to the Escalante Rivers flow.
Dynamic Surface Water Storage	High	This wetland demonstrates its ability to capture water from precipitation, overland or subsurface flow by being semi-permanently saturated.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	Moderate	The wetlands ability to retain sediment and retain or remove nutrients and toxicants is based on the evidence of flooding or ponding and the >50% cover of emergent wetland vegetation. The potential for the wetland to detain these constituents is reduced by its lack of a restricted outlet to slow flow.
Biological Functions		
Habitat Diversity	Low	The wetland site consists of emergent wetland habitat.
Listed/Proposed/Candidate T&E Species Habitat	None	None observed.
CO Natural Heritage Program Species Habitat	High	This site supports two good examples of wetland communities considered rare throughout their range and in the state of Colorado; a salt meadows wetland (*Spartina gracilis*), G4/S2, and an emergent wetland (*Eleocharis rostellata*), G2G3/S2S3.
General Wildlife Habitat	Low	Due to the limited habitat diversity and small size of the wetland, use by most animal species is low.
General Fish/Aquatic Habitat	N/A	This wetland does not provide habitat for fish.

Function	Ratings	Comments
Values		
Production Export/Food Chain Support	Moderate	The Assessment Area is moderate in size, has a low habitat diversity, and no open water with an outlet.
Uniqueness	Moderate	Although the wetland does not have a high diversity rating and there is some disturbance to the wetland perimeter, this wetland is considered rare because the wetland communities found on this site are the only known occurrences within the study area.
Recreation/Education Potential	Low	Based on the location, diversity and size of the wetland the potential for recreation/education is low, but there is some opportunity for scientific study.

General Soil Description

Texture	Sandy loam
Color	7.5YR 4/3 in wettest areas, in dry areas 10YR 7/2
Cobble Size	None
Percent Mottling	None

Figure 15. Beaked spikerush emergent wetland community at the Escalante Wetland PCA

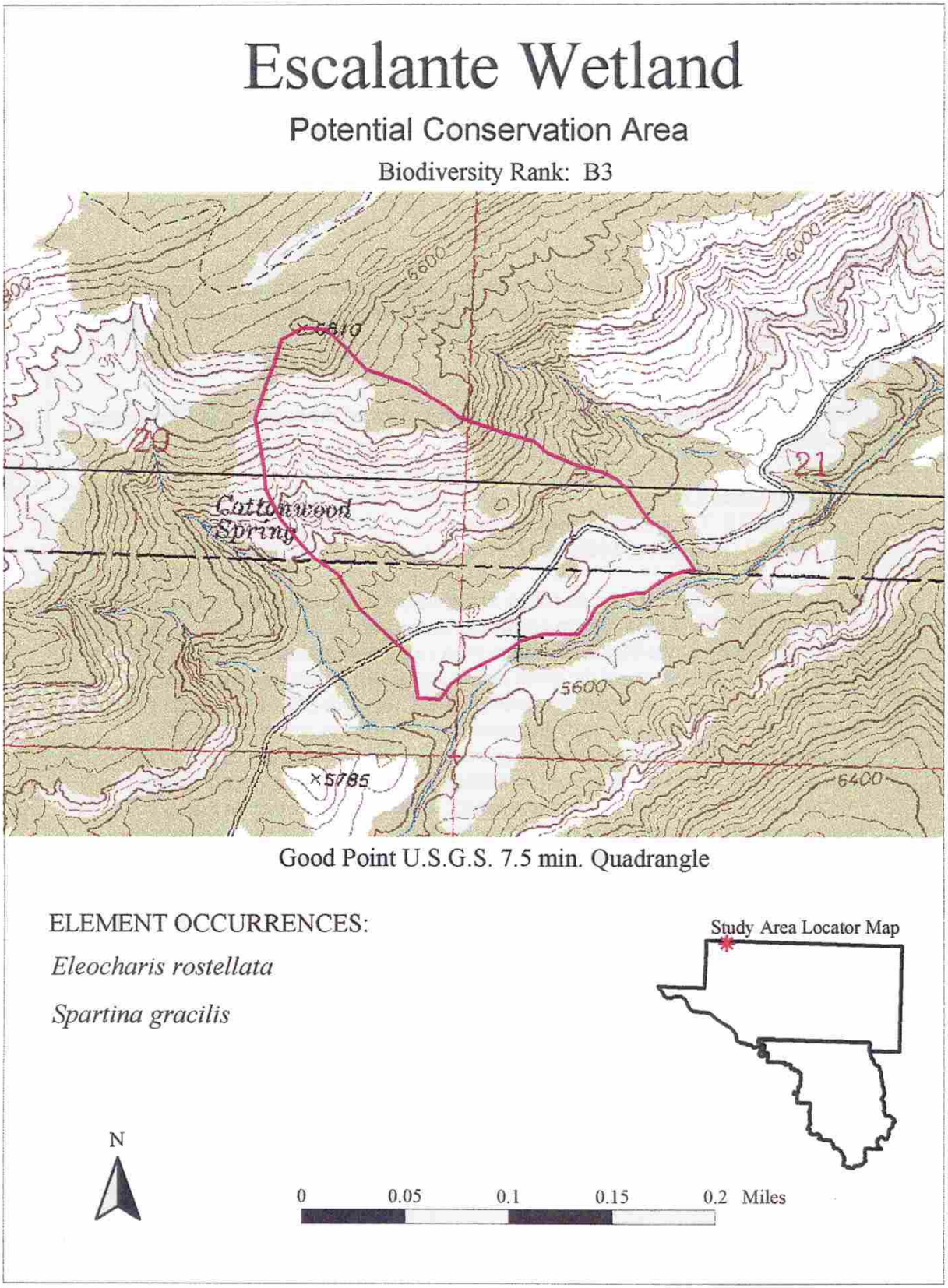


Figure 16. Map of Escalate Wetland PCA

McKenzie Creek Potential Conservation Area

Biodiversity Rank: B4 (Moderate significance)
The McKenzie Creek PCA supports examples of globally and state rare riparian communities, in fair to good condition.

Protection Urgency Rank: P4
The lower 2/3 of the PCA, which is mostly in a narrow sandstone canyon, is publicly owned and managed by the BLM with no special protection designation. The upper part of the PCA is in a broader valley, and is privately owned.

Management Urgency Rank: M3
There are significant grazing impacts in the upper parts of the canyon. Exotic species should be controlled.

Location: Ouray County
U.S.G.S. 7.5 min. quadrangle: Colona
Legal Description: T46N R8W S 5-8

General Description: McKenzie Creek forms a narrowing sandstone canyon as it flows east from Log Hill, at the southern end of the Uncompahgre Plateau, to the Uncompahgre River. Elevations in the McKenzie Creek PCA range from 6,600 to 7,400 ft.. (2,000 to 2,250 m). The upper parts of the creek have a low gradient, and support a riparian community of large, mature cottonwoods (*Populus angustifolia*) and dense thickets of hawthorn (*Crataegus rivularis*). Other native species present are wild rose (*Rosa woodsii*), Rocky Mountain juniper (*Juniperus scopulorum*), blue spruce (*Picea pungens*), red-osier dogwood (*Cornus sericea*), skunkbrush (*Rhus trilobata*), coyote willow (*Salix exigua*), and Oregon grape (*Mahonia rapines*). Cattle graze this part of the creek. Several exotic weeds are present, including burdock (*Arctium minus*), houndstongue (*Cynoglossum officinale*), Canada thistle (*Cirsium arvense*) and common plantain (*Plantago major*). Uplands are wooded with pinyon (*Pinus edulis*), juniper, and oak (*Quercus gambelii*). Downstream, as the canyon narrows, Douglas fir (*Pseudotsuga menziesii*) and red-osier dogwood replace the cottonwoods. Here the creek is inaccessible to cattle, and in better condition.

Biodiversity Rank Justification: The McKenzie Creek PCA supports examples of globally and state rare riparian communities, in fair to good condition.

Natural Heritage elements associated with wetlands at the McKenzie Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia/ Crataegus rivularis	**Montane riparian forests**	**G2?**	**S2?**			**C**
Pseudotsuga menziesii/Cornus sericea	Lower montane riparian forests	G4	S2			B

*EO = Element Occurrence

Boundary Justification: The boundary encompasses the two occurrences of riparian communities and the steep canyon-sides of McKenzie Creek. Long term conservation plans should consider processes in the upper watershed.

Protection Rank Justification: The lower 2/3 of the PCA, which is mostly in a narrow sandstone canyon, is publicly owned and managed by the BLM with no special protection designation. The upper part of the PCA is in a broader valley, and is privately owned.

Management Rank Justification: There are significant grazing impacts in the upper parts of the canyon. Fencing off the riparian area, or limiting cattle occupancy to the dormant season is recommended. Exotic species should be controlled as part of a countywide weed control program.

Wetland Function and Value Assessment for the McKenzie Creek PCA.
Proposed HGM Class: Riverine. Subclass: R3 Lower Perennial, subject to periodic flooding.
Cowardin System: Palustrine. Subsystem: Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment Was Performed at the McKenzie Creek PCA.

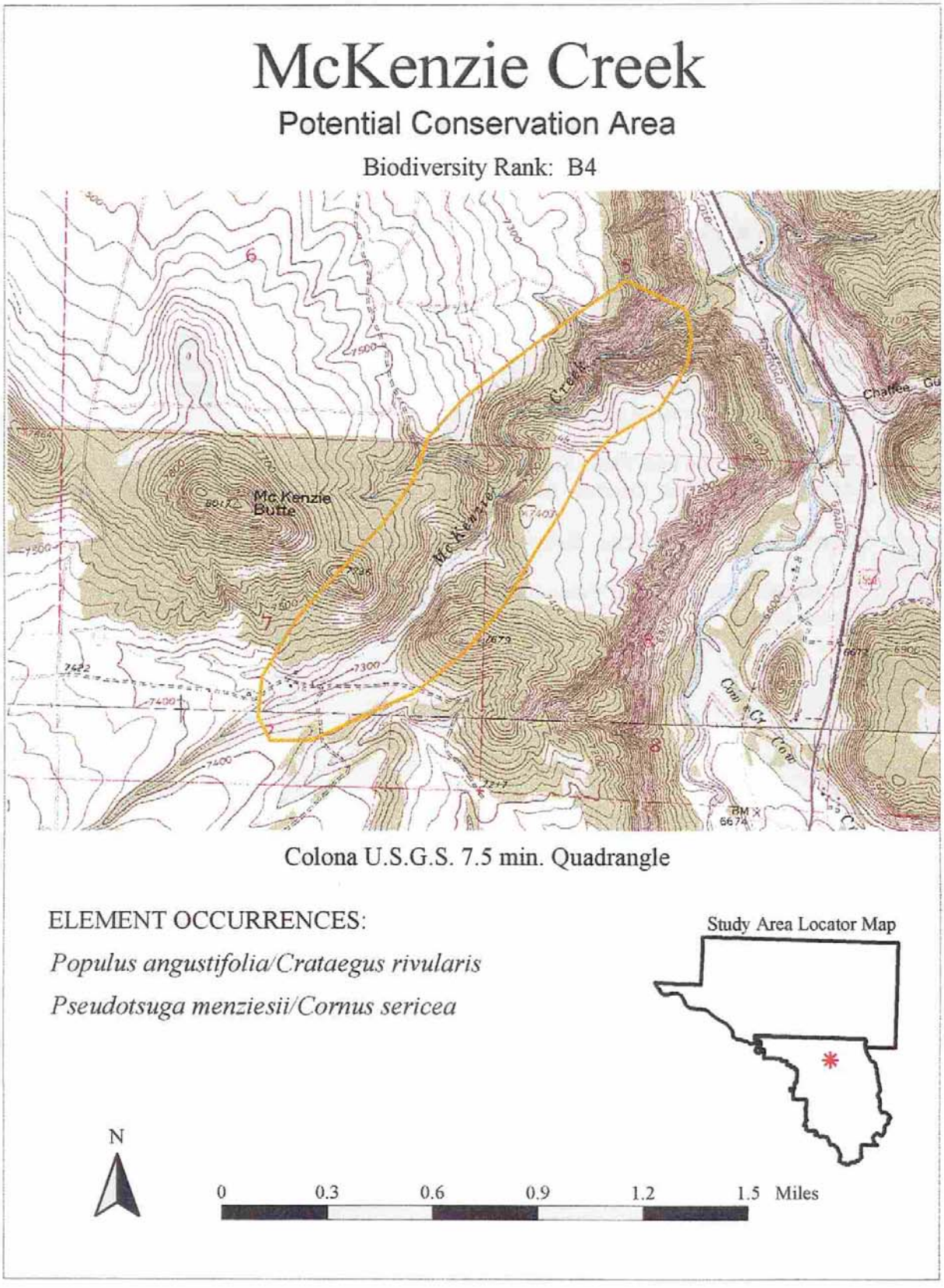


Figure 17. Map of McKenzie Creek PCA

Jade Road Wetland Site of Local Significance

Location: Approximately 4 air miles northwest of Montrose, Colorado.
U.S.G.S. 7.5 min. quadrangle: Olathe
Legal Description: T50N R9W S31

General Description: The Jade Road area is an irrigated wetland created in a partnership between the NRCS Wetland Conservation Reserve Program and two neighboring landowners. The 60 acre wetland, at an elevation of 6,620 ft.. (2,020 m), is in the heart of the Lower Uncompahgre River Valleys irrigated croplands, mostly farmed on silt-clay soils derived from the underlying Mancos Shale formation. The wetland is fed primarily by agricultural tail water. The NRCS Conservation Reserve Program has the goals of aiding farmers with irrigation needs and reducing salinity inputs to the Colorado River drainage system, while creating or conserving wetland habitat. The created wetland habitat also functions to stabilize sediment runoff and detoxify agricultural inputs such as pesticides, herbicides and fertilizer.

There are several small ponds created by blasting, a medium sized shallow pond, and a large lake. The wetland area also supports the most extensive (approximately 45 acres) narrowleaf cattail marsh (*Typha latifolia*) observed during the 1998 field season, as well as a good example of a saltgrass community (*Distichlis spicata*). Both natural communities are considered vulnerable throughout their range in the state of Colorado.

The mosaic of various classes of open water and emergent vegetation provide a high diversity of wildlife habitat for migratory and breeding waterfowl, songbirds, raptors, small mammals, amphibians, fish, and aquatic insects. During one visit to the wetland many wildlife species were observed, including: Brewer's, yellow-headed and black-winged blackbirds; great blue heron, sandhill crane, white-faced ibis; mallard, teal, and various diving ducks; American bittern, northern harrier, red-tailed hawk, American kestrel, muskrat, northern leopard frog, and common garter snake.

However, the third or fourth generation irrigation water used irrigate the wetland caries high concentrations of selenium, which can bio-accumulate to levels that prevent successful reproduction in species of bottom feeding waterfowl (Kruger 1999). In a semi-arid climate, surface waters in open tail-water fed ponds evaporate quickly, concentrating selenium and causing it to precipitate out in bottom sediments. Benthic invertebrates are eaten by bottom feeding ducks, which in turn suffer reproductive failure. In studies conducted by the U.S. Fish and Wildlife Service at the large pond in the Jade Road Wetland, no bottom feeding ducks who have attempted to breed have succeeded in hatching their eggs. Selenium does not seem to be a problem for non-bottom feeding waterfowl, amphibians, and songbirds using the area, which mostly feed on terrestrial insects.

Protection Considerations: Ownership of the Jade Road property is comprised of two adjacent separately owned properties. In return for participation in the NRCS Wetland Conservation Reserve Program, 70% of the cost for construction of the wetlands and irrigation improvements was borne by the agency. The private landowners must agree to maintain the wetland for the expected life of the project, generally estimated at 20 years. A conservation easement should be considered to afford longer-term protection. The joint property is currently for sale.

Management Considerations: There is some concern about the high selenium levels associated with the large pond and its effects on breeding success of bottom feeding waterfowl. It may be that tailwater should not be used to create large bodies of open water wildlife habitat. Further studies on the wetland complex may provide information that will help guide the design of irrigation-induced wetlands in the Valley.

Current management practices seem sufficient to maintain the function and values of the shallow water emergent wetlands. The Jade Road Wetland is currently fenced from cattle grazing; however, a few horses are pastured in the area during the dormant season, but this grazing strategy does not appear to impact the wetland vegetation. Water levels are not allowed to fluctuate more than 1 foot in the larger ponds. Being in an agricultural setting, there are some weedy and alien plant species growing in and around the wetland. Tall wheatgrass (*Thinopyrum ponticum*) has been planted in some upland areas to create wildlife cover. Salt-cedar tamarisk (*Tamarix ramosissima*) is being aggressively managed.

Figure 18. Jade Road Wetland, irrigation induced wetland habitat

Wetland Function and Value Assessment for the Jade Road Wetland Site:
Proposed HGM Class: Depressional. Subclass: D2, wetland with permanent saturation and continuous inundation.
Cowardin System: Palustrine. Subsystem: Unconsolidated Bottom, Aquatic Bed, and Emergent Wetland.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the Jade Road Wetland site.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	N/A	This wetland is not subject to in-channel or overbank flow.
Sediment/Shoreline Stabilization	High	This constructed wetland is supplied with water year-round by accessing the canal system. Agricultural tail-water is transported through a heavily vegetated channel with intermittent pools and lakes, dissipating flow and stabilizing sediment.
Groundwater Discharge/ Recharge	Unknown	Groundwater discharge and recharge are not desirable functions on the Mancos Shale, as deep percolation has been implicated in salt loading of the Colorado River System. It is thought that clay lining of the ponds and wetlands prevents deep percolation, but actual Discharge/Recharge status is unknown.
Dynamic Surface Water Storage	High	Due to the wetlands size (60 acres) and flood frequency, the potential to capture water from precipitation or overland flow, including agricultural runoff, is high.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	High	The high potential of this wetland to retain sediments and retain and remove nutrients and toxicants is driven by its proximity to agricultural tail-water, with evidence of flooding, a restricted outlet to slow flow and high vegetative cover contributing to the high ranking.
Biological Functions		
Habitat Diversity	Very High	The wetland consists of aquatic bed, emergent wetland, and unconsolidated bottom open water habitats.
Listed/Proposed/Candidate T&E Species Habitat	None	None known or suspected.
CO Natural Heritage Program Species Habitat	High	The area supports the most extensive narrowleaf cattail marsh (*Typha latifolia*), G5/S3, observed during the 1998 field season, as well as a good example of a saltgrass community (*Distichlis spicata*), G5/S3. Northern leopard frogs (*Rana pipiens*) G5/S3 are abundant. Although breeding status is unknown, the following species tracked by CNHP were observed in the area: northern harrier, great blue herons, white-faced ibis and American bitterns .

Function	Ratings	Comments
General Wildlife Habitat	High	Many aquatic/semi-aquatic birds, song birds, raptors, muskrat, common garter snake and northern leopard frogs were observed at the site with many other species known or suspected to use the area, such as deer and elk. The large number of verified species using the wetland site combined with the diverse habitat yields a high general wildlife habitat rating.
General Fish/Aquatic Habitat	High	The wetland has verified introduced game fish (green sunfish, bluegill) populations in the perennial shallow pond and large lake.
Production Export/Food Chain Support	High	The potential to produce and export food/nutrients for living organisms is driven by the wetlands large area (60acres), high habitat diversity rating, presence of an outlet to transport food/nutrients, and perennial surface water.
Values		
Uniqueness	Moderate	This wetland is considered rare within the boundaries of the study area and has high habitat diversity. However, we cannot say that it is irreplaceable because there is the potential to create similar irrigation-induced wetlands.
Recreation/Education Potential	Low	Since the wetland is privately owned and not an undisturbed natural wetland the potential for recreational and educational opportunities is low, but the site may be used as a model for neighboring landowners considering wetland creation or enhancement.

General Soil Description

Texture	Clay silt, shale derived soils.
Color	10YR 6/2 on dryer sites.
Cobble Size	N/A
Percent Mottling	N/A

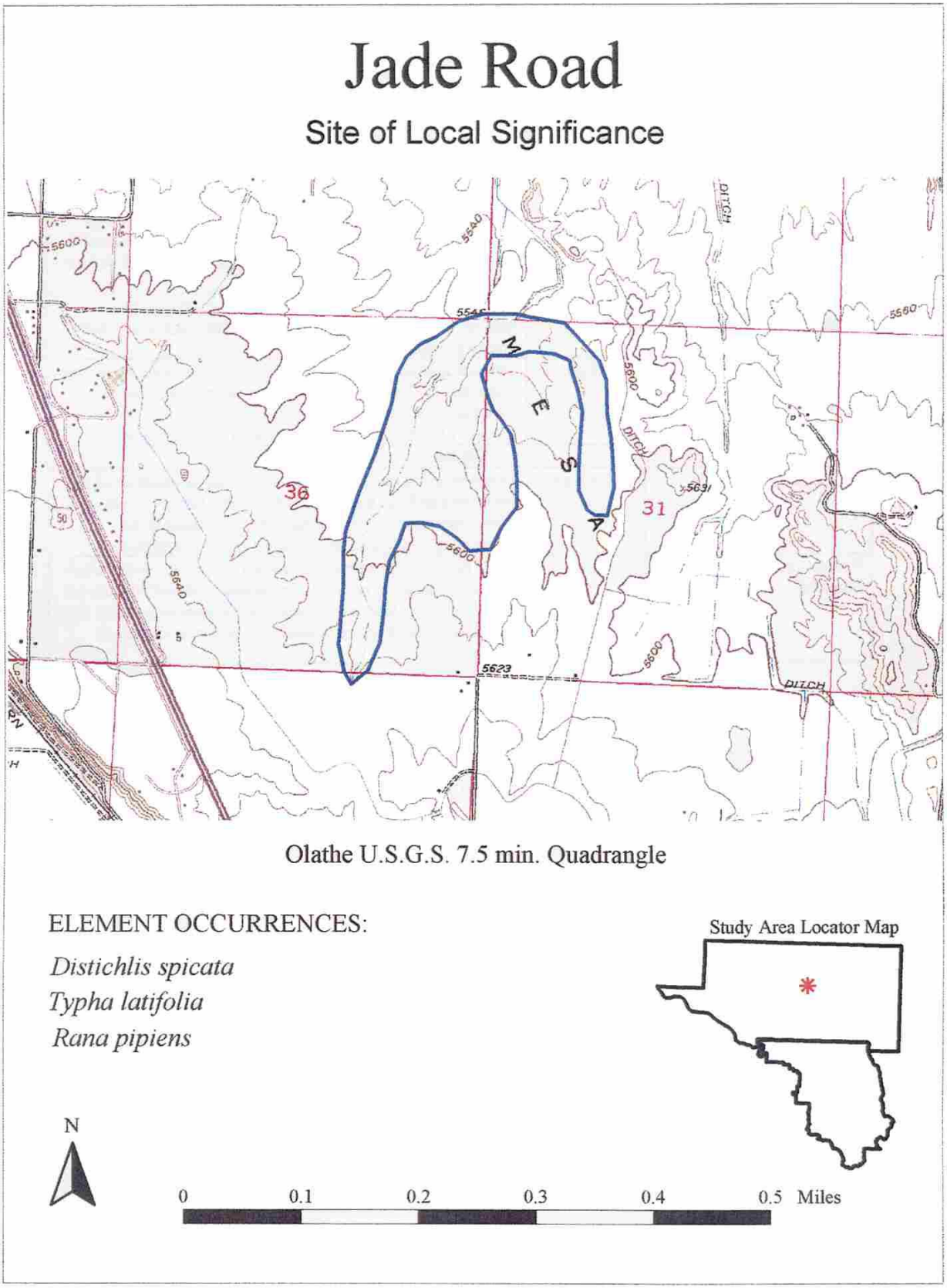


Figure 19. Map of Jade Road Site of Local Significance

Sazama Wetland Site of Local Significance

Location: 10 miles north-northwest of Montrose on the Uncompahgre River.
U.S.G.S. 7.5 min. quadrangle: Olathe
Legal Description: T50N R10W S22

General Description: The Sazama wetland is an irrigated wetland created in a partnership between the NRCS and the landowner under the NRCS Wetland Conservation Reserve Program. The 5 acre wetland at an elevation of 5,416 ft.. (1,650 m) is situated along the Uncompahgre River and supports emergent vegetation. Mature narrowleaf cottonwoods (*Populus angustifolia*) and Russian olive (*Eleagnus angustifolia*) dominate the rest of the floodplain.

Historically the broad river bottoms of the Lower Uncompahgre River Valley supported extensive and diverse riparian woodlands with large willow carrs and cattail marshes, and open water could be found in abandoned oxbows and sloughs. Over the past 100 years, river bottoms have been drained and cleared for farm land, livestock grazing has degraded the understory in remaining cottonwood stands, and dam construction has resulted in channelization of the river and loss of natural flooding processes (USDA 1981). The Sazama wetland was created in the spring of 1998 utilizing a relict oxbow on the floodplain of the Uncompahgre River. Agricultural tailwater from cropland above is piped down to the site and held by a berm. The landowner controls the gated inlet and a drainpipe controls the water level. At the time of the site visit, the wetland was only 5 months old, yet supported three communities of concern; a western slope marsh (*Phragmites australis*) (G5/S3), a salt meadows (*Distichlis spicata*) (G5/S3) community, and a narrowleaf-cattail marsh (*Typha latifolia*) (G5/S3), as well as an abundant population of northern leopard frogs (*Rana pipiens*) (G5/S3 FS SC).

Protection Considerations: In return for participation in the NRCS Wetland Conservation Reserve Program the land owner receives 70% of the cost for construction of the wetlands and irrigation improvements from the agency. The individual must agree to maintain the wetland for the expected life of the project, generally estimated at 20 years. A conservation easement should be considered to afford longer-term protection.

Management Considerations: Projects such as the Sazama site are an important step in recreating the historical pattern of wetland community distribution along the Uncompahgre River bottom lands. The Sazama wetland is a model for the establishment of a series of irrigated wetlands along the river, demonstrating that dramatic results are possible with a minimal investment of time and effort. In addition to the creation of habitat diversity, these irrigation induced river bottom wetlands perform the critical functions of filtering sediment, retaining toxicants and removing excess nutrients from agricultural tail waters before they enter the river.

Aggressive knapweed control is needed in the dryer areas of the floodplain surrounding the Sazama wetland. All wetland vegetation on the site was established by natural colonization without reseeding or transplants. Future irrigated wetlands may elect to include a reseeding and transplant program to direct vegetation composition and to discourage weedy and alien species.

Wetland Function and Value Assessment for the Sazama Wetland Site of Local Significance:

Proposed HGM Class: Riverine. Subclass: R5 Lower Perennial; Class: Depressional. Subclass: D2 depressional wetland with seasonal saturation and seasonal flooding. Cowardin System: Palustrine. Subsystem: Emergent, Scrub-Shrub and Forested Wetland.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the Sazama Wetland.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	Moderate	The mature riparian forest and scrub-shrub vegetation no longer appears to flood regularly. The emergent wetland's moderate size lowers the ranking to moderate. The wetland does contain a restricted outlet (berm) to slow flow.
Sediment/Shoreline Stabilization	High	High vegetative cover and the wetland's proximity to the perennial Uncompahgre River results in a high ability to dissipate flow and stabilize sediment, reducing erosion.
Groundwater Discharge/ Recharge	High	Being a created wetland there are no natural springs or seeps, but during the growing season water is piped down from above agricultural fields onto the permeable alluvium floodplain of the Uncompahgre River. The river's floodplain may be drier given that the river no longer overflows its banks. This wetland, or others like it, can effectively raise the water table in the wetland area and benefit the surrounding riparian vegetation.
Dynamic Surface Water Storage	High	The high frequency (annually) of flooding drives the high potential rating to capture water from precipitation or overland flow even though the wetland is of moderate size.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	High	The high potential of this wetland to retain sediments and retain and remove nutrients and toxicants is driven by its proximity to agricultural tail-water, with evidence of flooding, a restricted outlet to slow flow and high vegetative cover contributing to the high ranking.
Biological Functions		
Habitat Diversity	High	The wetland area includes mature riparian woodland, emergent wetland and unconsolidated bottom open water habitats.
Listed/Proposed/Candidate T&E Species Habitat	None	None known or suspected.
CO Natural Heritage Program Species Habitat	High	This wetland supported two communities of concern; a western slope marsh (*Phragmites australis*), G4/S3, and a salt meadows community (*Distichlis spicata*), G5/S3, and an abundant population of northern leopard frogs (*Rana pipiens*) G5/S3 SC FS.

Function	Ratings	Comments
General Wildlife Habitat	High	Northern leopard frogs and non-aquatic birds were observed during the site visit, with many other species suspected to utilize the wetland (i.e., various ducks, muskrat and deer).
General Fish/Aquatic Habitat	N/A	The emergent wetland does not provide habitat for fish.
Production Export/Food Chain Support	High	The presence of an outlet drove the high rating for potential to produce and export food/nutrients with a moderate wetland size, high habitat diversity rating, and seasonal surface water also contributing.
Values		
Uniqueness	Low	Considering that this is a created and easily replicable emergent wetland, the uniqueness rating is low. If the larger Assessment Area is included, the ranking formula would result in a High rating because of the inclusion of the mature forest and associated high habitat diversity.
Recreation/Education Potential	Medium	Since the wetland is privately owned and is a disturbed weedy hydrologically impacted riparian area, there are minimal recreational opportunities; however, the site may be considered educational because it can serve as a model for wetland creation and enhancement along the Uncompahgre River floodplain.

General Soil Description

Texture	Sandy alluvial soils
Color	N/A
Cobble Size	N/A
Percent Mottling	N/A

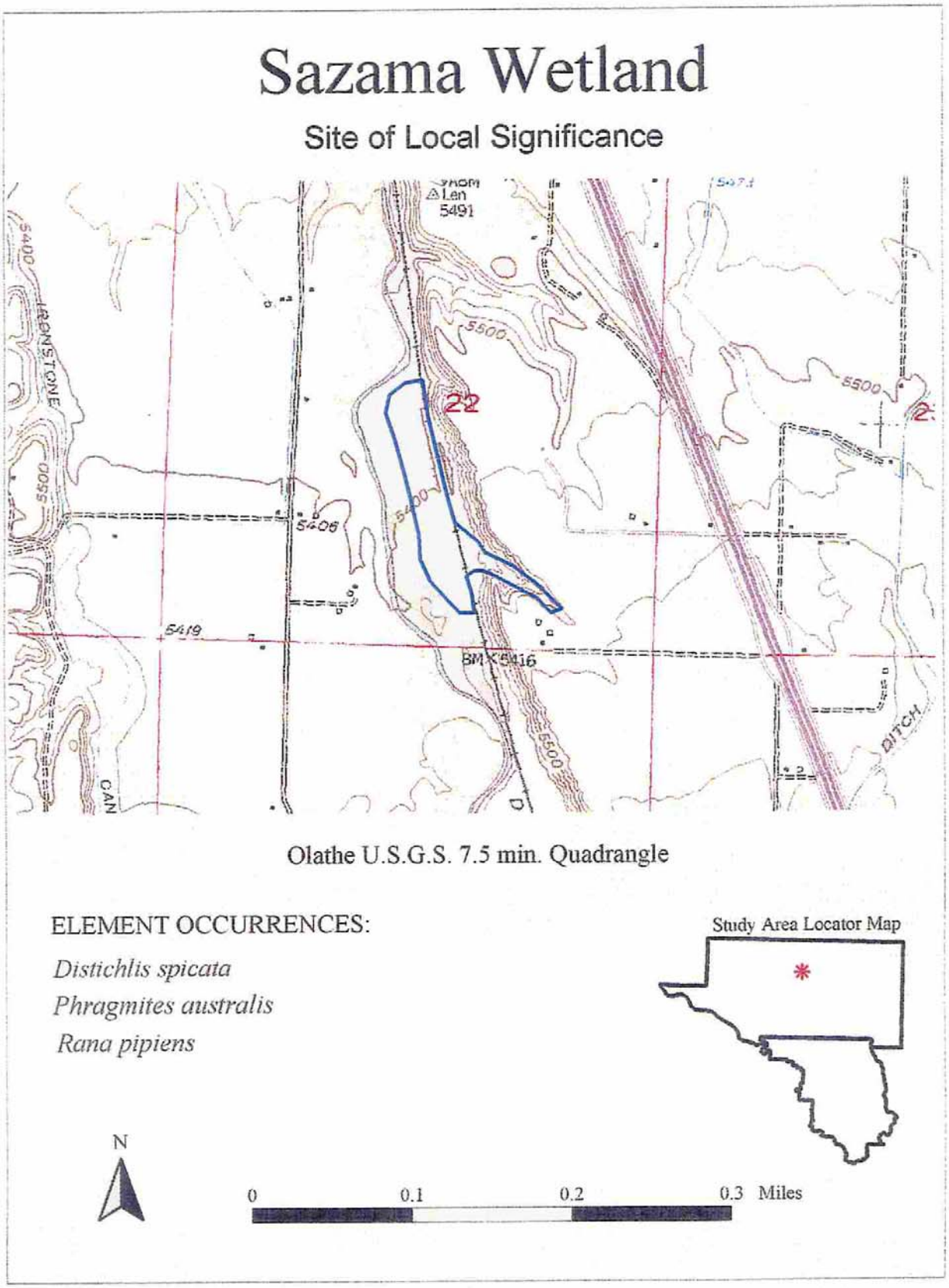


Figure 20. Map of Sazama Site of Local Significance

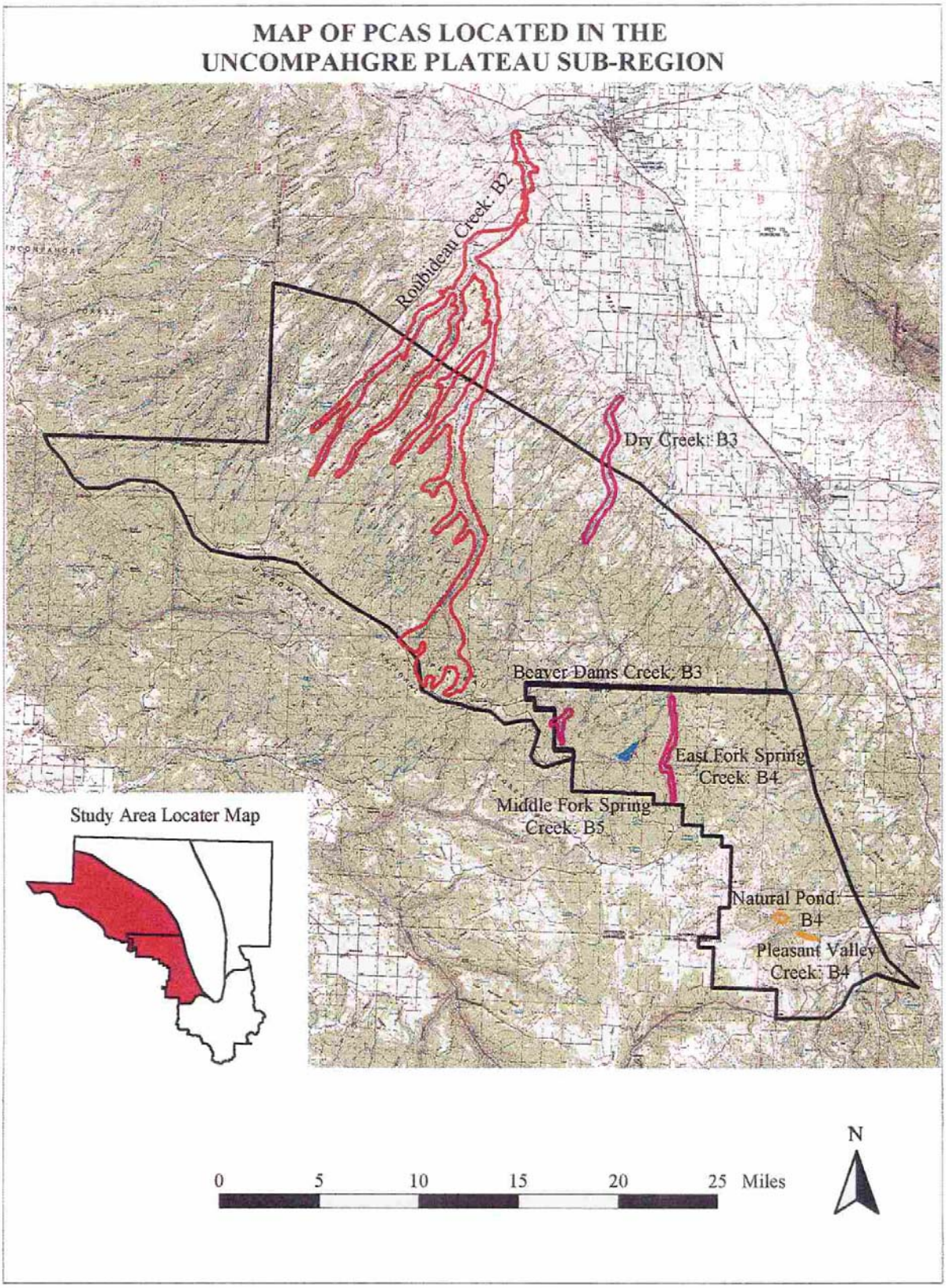


Figure 21. Map of PCAs Located in the Uncompahgre Plateau Sub-region.

Roubideau Creek Potential Conservation Area

Biodiversity Rank: B2 (Very high significance)
The Roubideau Creek PCA contains six rare and imperiled riparian communities, including a globally and state imperiled type of narrowleaf cottonwood riparian forest, as well as an excellent occurrence of a northern leopard frog population.

Protection Urgency Rank: P4
The Roubideau Creek PCA encompasses a small amount of private land, and large areas of BLM and Uncompahgre National Forest property. A portion of the PCA has been designated a "Special Management Area" under the Wilderness Act. This gives the PCA protection from timber sales and new roads. No motorized vehicles are allowed. However, water diversions and preexisting grazing rights are continued.

Management Urgency Rank: M2
The lower part of the PCA in Delta County has been heavily grazed and invaded by exotic weeds, which may spread upstream.

Location: Montrose and Delta counties.

U.S.G.S. 7.5 min. quadrangles: Antone Spring, Camel Back, Cottonwood Basin, Davis Point, Moore Mesa, Roubideau

Legal Description: T47R12W S 1, 4-10, 16-18
T48R12W S 3-5, 9, 10, 15, 16, 20, 21, 28, 29, 31-33
T49NR12W S 2-10, 15-22, 27-29, 32-34
T49NR13W S 2, 3, 9, 10, 12-14, 16, 17, 24
T50NR12W S 2-4, 8-11, 14-21, 23, 26-35
T50NR13W S 25, 35, 36
T51NR11W S 18, 19
T51NR12W S 13, 24-27, 34, 35

General Description: Roubideau Creek drains a large portion of the Uncompahgre Plateau. The 24,363 acre PCA ranges in elevation from 9,000 to 4,874 ft... (2,743 to 1,485 m). It is notable because the hydrology is mostly unaltered by major water developments or diversions (although there is one diversion ditch from the main stem). This PCA includes the main stem as well as the major tributaries of Roubideau Creek. Except for the last few miles before its confluence with the Gunnison River, it lies entirely within Montrose County. Except for a few small private parcels, the upper half of the PCA is within the Uncompahgre National Forest, and the lower half on BLM land. The National Forest special management area is managed with emphasis on backcountry recreation.

At its upper elevations, Roubideau Creek forms a deep and wide canyon with broken stair-step sandstone cliffs and steep slopes on both sides. The upper slopes are wooded with scattered pinyon (*Pinus edulis*) and juniper (*Juniperus scopulorum*) trees. A mosaic of narrowleaf cottonwood trees (*Populus angustifolia*) with a mixed shrub understory of

skunkbrush (*Rhus trilobata*), river birch (*Betula glandulosa*), willows (*Salix* sp.), Rocky Mountain maple (*Acer glabrum*) and red-osier dogwood (*Cornus sericea*) dominates the valley floor. Gambel's oak (*Quercus gambelii*) forms thick stands on the adjacent mesa flats to the west (Traver Mesa, West Basin, Pine Mesa, Davis Mesa, Goddard Bench, and Murray Park). The river itself is sinuous and the floodplain consists of many point bars, low terraces and higher benches. Wetter and more shaded areas are dominated by river birch and dogwood, while higher terraces have older cottonwood stands. Northern leopard frogs (*Rana pipiens*) were found in small ponds on Roubideau Bench.

Tributaries are very steep and originate on the open mesas to the west. These creeks run parallel to each other in a northeasterly direction, and are separated by long narrow mesas. Tributaries include Monitor, Little Monitor, Potter, Criswell, Moore, Taver, Wright, Terrible, Bull, Goddard, and Pool Creeks.

The headwaters of Potter Creek, a tributary of Roubideau Creek, supports a good condition riparian zone of blue spruce (*Picea pungens*) and red-osier dogwood. Other species present include thinleaf alder (*Alnus incana*), willows (*Salix sp*.), snowberry (*Symphoricarpos oreophilus*) and Utah serviceberry (*Amelanchier utahensis*). The natural disturbance regime, including flooding and beaver activity, appears to be intact. There is some grazing at the PCA, and a few exotic species are present. Grassy terraces are dominated by Kentucky bluegrass (*Poa pratensis*). With good grazing management, the site could be improved.

Monitor Creek supports a good condition riparian area several miles long, consisting of blue spruce, aspen (*Populus tremuloides*), and Drummond's willow (*Salix drummondiana*), with a variety of other riparian shrubs and forbs. The area experiences light grazing. Reproduction of riparian species is good. Other than dandelions (*Taraxacum officinal*), there are few exotic species in the PCA.

Another tributary, Little Monitor Creek, is just below 25 Mesa Road, and is subject to impacts from the road and grazing. However, the steep side slopes and dense vegetation minimize direct impacts. The riparian zone has a solid cover of trees and shrubs, dominated by narrowleaf cottonwood and blue spruce, with lesser amounts of aspen and Ponderosa pine. Hawthorn (*Crataegus rivularis*) grows thick away from the riverbank, along with red-osier dogwood, chokecherry (*Prunus virginiana*) and Utah serviceberry. The major forb species is false solomonseal (*Maianthemum stellatum*), while the major grass is the exotic Kentucky bluegrass.

Elements occurring in the Roubideau Creek PCA that are not specifically tied to wetland and riparian habitat are profiled in the companion volume to this report, the Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999).

Biodiversity Rank Justification:
The Roubideau Creek PCA contains six rare and imperiled riparian communities, including the globally and state rare narrowleaf cottonwood riparian forest, as well as an excellent occurrence of a northern leopard frog population.

Natural Heritage elements associated with wetlands at the Roubideau Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia*/*Salix ligulifolia*-*Shepherdia argentea	**Narrowleaf cottonwood riparian forests**	**G1**	**S1**			**C**
***Betula occidentalis*/mesic forb**	**Foothills riparian shrublands**	**G3**	**S2**			**A**
Picea pungens/*Cornus sericea*	Montane riparian forests	G4	S2			B
Picea pungens/*Cornus sericea*	Montane riparian forests	G4	S2			B
Populus angustifolia/ *Cornus sericea*	Montane riparian forests	G4	S3			C
Populus angustifolia/*Rhus trilobata*	Narrowleaf cottonwood/ Skunkbrush riparian forests	G3	S3			B
Populus angustifolia/*Rhus trilobata*	Narrowleaf cottonwood/ Skunkbrush riparian forests	G3	S3			B
Pseudotsuga menziesii/ *Cornus sericea*	Lower montane riparian forests	G4	S2			B
Rana pipiens	Northern leopard frog	G5	S3	FS	SC	A
Salix exigua/mesic graminoid	Coyote willow/mesic graminoid	G5	S5			A

*EO = Element Occurrence

Boundary Justification: The Roubideau Creek PCA boundary was drawn to include Roubideau Creek and the major tributaries including: Monitor, Little Monitor, Potter, Criswell, Moore, Taver, Wright, Terrible, Bull, Goddard, and Pool Creeks. The boundary was also drawn to encompass occurrences of non-wetland and riparian elements, which are profiled in the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment Vol.I (Lyon et al. 1999).

Protection Rank Justification: The Roubideau Creek PCA encompasses a small amount of private land, and large areas of BLM and Uncompahgre National Forest property. A portion of the site has been designated a "Special Management Area" under the Wilderness Act, and has been removed from grazing use.

Management Rank Justification: The lower part of the PCA in Delta County has been heavily grazed and invaded by exotic weeds, which may spread upstream. Weed control at this site should be integrated with an aggressive countywide weed control program.

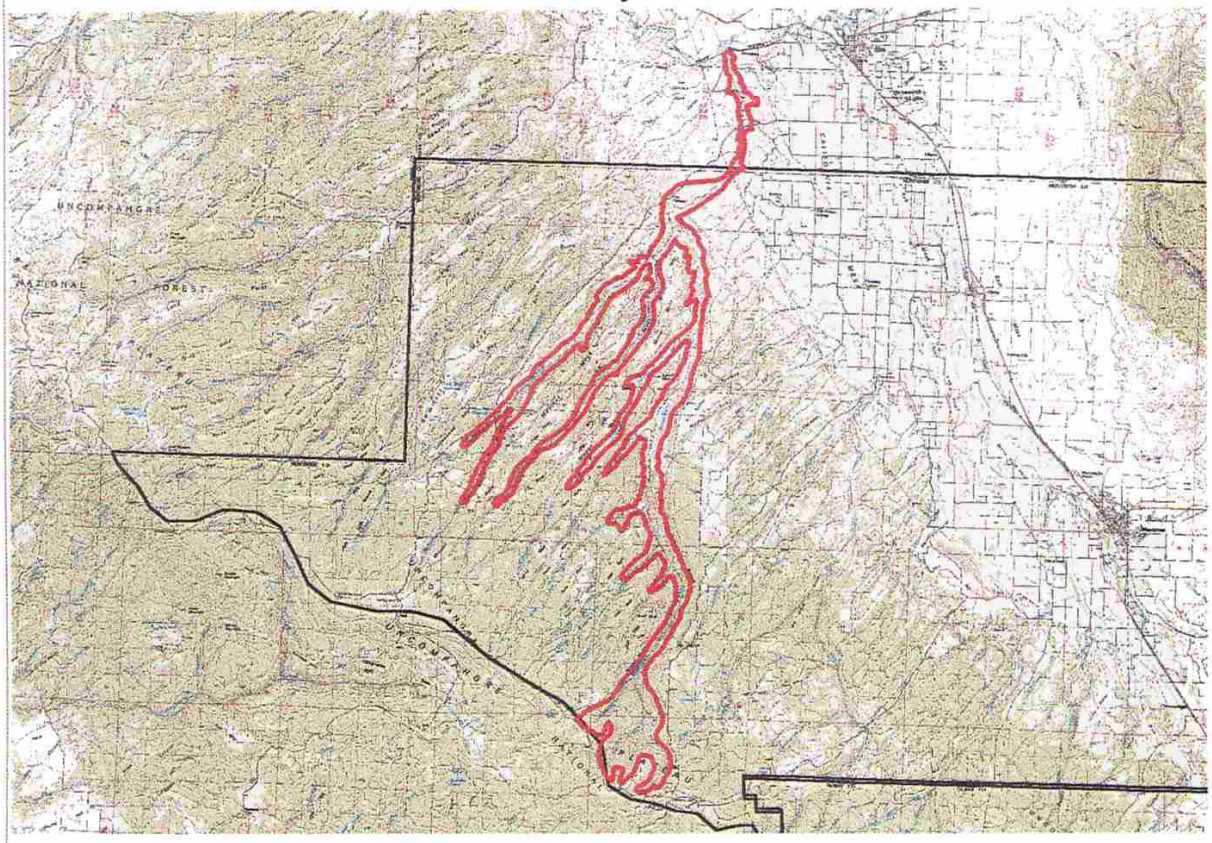
Wetland Function and Value Assessment for the Roubideau Creek Macrosite.
Proposed HGM Class: Riverine. Subclass: R3 Lower Perennial, subject to periodic flooding.
Cowardin System: Palustrine. Subsystem: Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment Was Performed at the Roubideau Creek Macrosite.

Roubideau Creek

Potential Conservation Area

Biodiversity Rank: B2



Antone Springs, Camel Back, Cottonwood Basin, Davis Point, Moore Mesa and Roubideau U.S.G.S. 7.5 min. Quadrangles

ELEMENT OCCURRENCES:

Betula occidentalis/mesic forb
Picea pungens/Cornus sericea
Populus angustifolia/ Cornus sericea
Populus angustifolia/Rhus trilobata
Populus angustifolia/Salix eriocephala var. ligulifolia-Shepherdia argentea
Pseudotsuga menziesii/Cornus sericea
Rana pipiens
Salix exigua/mesic graminoid

Figure 22. Map of Roubideau Creek PCA

Beaver Dams Creek Potential Conservation Area

Biodiversity Rank: B3 (High significance)
The Beaver Dams Creek PCA contains a good example of an aspen wetland forest that is apparently secure on a global scale. However, the high biodiversity rank reflects the presence of several non-wetland or riparian elements within the PCA, which are discussed in further detail in the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment (Lyon et al. 1999).

Protection Urgency Rank: P4
This PCA is located within the Uncompahgre National Forest, which is managed for multiple use. Since the area has already been logged, it is probably secure for the near future.

Management Urgency Rank: M3
Road maintenance or improvements and grazing could threaten the riparian vegetation.

Location: Montrose and Ouray counties
U.S.G.S. 7.5 min. quadrangle: Pryor Creek
Legal Description: T47N R11W S 20, 21, 29, 32

General description: Beaver Dams Creek, at the top of the Uncompahgre Plateau, is a small tributary of Dry Creek. The 363 acre PCA ranges from 8,800 to 9,480 ft.. (2,680 to 2,890 m). There is a dirt road that follows the east fork of the creek, terminating above the confluence of the two forks. A trail continues from the end of the road, crossing the creek. Douglas fir (*Pseudotsuga menziesii*) dominates the riparian zone along Beaver Dams Creek, with some aspen (*Populus tremuloides*) and Engelmann spruce (*Picea engelmannii*). The narrow, shady canyon has a sparse shrub layer, including twinberry honeysuckle (*Lonicera involucrata*), and snowberry (*Symphoricarpos oreophilus*). There are few exotic species in the riparian zone, except for Kentucky bluegrass (*Poa pratensis*) and red top (*Agrostis stolonifera*). However, there is a serious infestation of Canada thistle (*Cirsium arvense*) along the trail, and dandelions (*Taraxacum officinal*) are common in open disturbed areas. Although not included in the PCA, there is a northern goshawk nest within a mile, and this area is probably part of the raptor's hunting territory.

Biodiversity Rank Justification: The Beaver Dams Creek PCA contains a good example of an aspen wetland forest vulnerable throughout its range. However, the high Biodiversity Rank reflects the presence of several non-wetland or riparian elements within the PCA, which are discussed in further detail in the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999).

Natural Heritage elements associated with wetlands at the Beaver Dams Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus tremuloides/ Pteridium aquilinum	**Aspen wetland forests**	**G4**	**S3S4**			**B**

*EO = Element Occurrence

Boundary Justification: The boundary is drawn to include element occurrences in the riparian zone and adjacent forested areas above the headwaters of Beaver Dams Creek.

Protection Rank Justification: This PCA is located within the Uncompahgre National Forest, which is managed for multiple use. Since the area has already been logged, it is probably secure for the near future. Potential threats are additional road building and grazing.

Management Rank Justification: Road maintenance or improvements and grazing could threaten the riparian area.

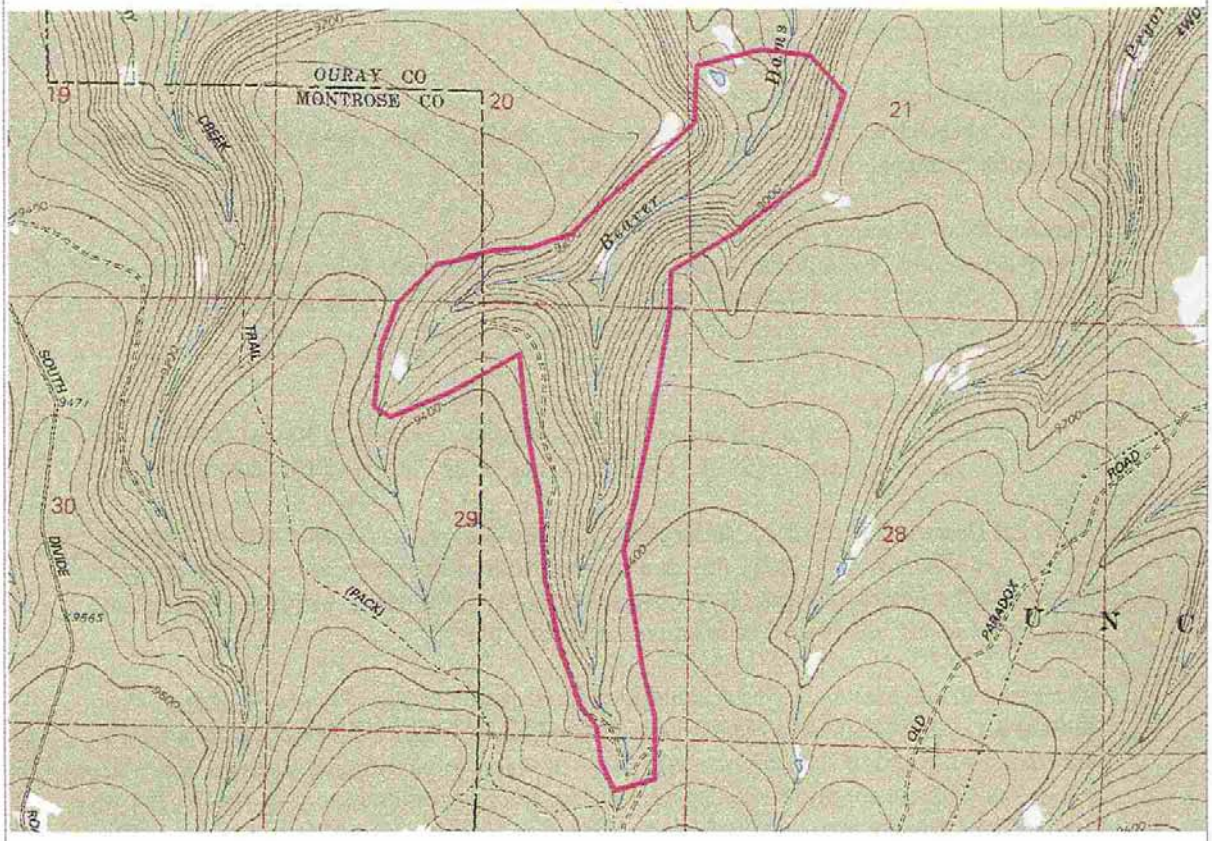
Wetland Function and Value Assessment for the Beaver Dams Creek PCA:
Proposed HGM Class: Riverine. Subclass: R2 Upper Perennial with seasonal flooding. Cowardin System: Palustrine. Subsystem: Forested Wetland.

No Wetland Function and Value Assessment Was Performed at the Beaver Dams Creek PCA.

Beaver Dams Creek

Potential Conservation Area

Biodiversity Rank: B3



Pryor Creek U.S.G.S. 7.5 min. Quadrangle

ELEMENT OCCURRENCE:

Populus tremuloides/Pteridium aquilinum

Figure 23. Map of Beaver Dams Creek PCA

Dry Creek Potential Conservation Area

Biodiversity Rank: B3 (High significance)
The Dry Creek PCA contains a good example of a narrowleaf cottonwood riparian forest vulnerable throughout its range.

Protection Urgency Rank: P4
The PCA is relatively secure, occurring mostly on BLM land, except for a small parcel at the southern end of the PCA which is privately owned.

Management Urgency Rank: M3
Tamarisk should be controlled in the riparian zone. There are only a few tamarisk plants, therefore the site is a good candidate for successful control. There does not appear to be much cattle usage in the creek due to the dense shrub cover.

Location: Montrose County
U.S.G.S. 7.5 min. quadrangles: Hoovers Corner, Dry Creek Basin
Legal Description: T49N R11W S 1, 2, 11-14, 23, 26, 35; T48N R11W S 3, 4, 9

General Description: The 1,736 acre PCA ranges in elevation from 5,600 to 6,600 ft.. (1,700 to 2,000 m). Dry Creek drains a large portion of the Uncompahgre Plateau, and flows into the Uncompahgre River a few miles north of the Delta-Montrose county line. The slopes of the valley are shrub and grasslands.

The riparian corridor of Dry Creek supports large cottonwoods (*Populus angustifolia*) and dense, almost impenetrable thickets of skunkbrush (*Rhus trilobata*), in spite of the fact that by the end of the summer only pools of water remain on the surface. The stream meanders with curves up to 180 degrees, within a broad floodplain up to 300 ft.. (91 m) wide. The immediate stream banks have a band of coyote willow (*Salix exigua*). Other native species present are wild *rose* (*Rosa woodsii*), silver buffaloberry (*Shepherdia argentea*), and Gambel's oak (*Quercus gambelii*). The condition of the riparian community is good, with only small patches of tamarisk (*Tamarix racemosa*), Canada thistle (*Cirsium arvense*), Kentucky bluegrass (*Poa pratensis*), and red top (*Agrostis stolonifera*), comprising less than 5% of the total cover. There is good regeneration of cottonwoods. The dense vegetation provides excellent cover for wildlife.

Elements occurring in the Dry Creek PCA that are not specifically tied to wetland and riparian habitats are profiled in the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999).

Biodiversity Rank Justification: The Dry Creek PCA contains a good example of a riparian forest vulnerable throughout its range.

Natural Heritage elements associated with wetlands at the Dry Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia*/*Rhus trilobata	**Narrowleaf cottonwood/ Skunkbrush riparian forests**	**G3**	**S3**			**B**

*EO = Element Occurrence

Boundary Justification: The boundary is drawn to include the riparian zone of Dry Creek based on a field survey of the north half of the PCA, and aerial photo interpretation of the south half.

Protection Rank Justification: The PCA is relatively secure, occurring mostly on BLM land, except for a small parcel at the southern end of the PCA which is privately owned.

Management Rank Justification: Tamarisk should be controlled in the riparian zone. There are only a few Tamarisk plants, therefore the site is a good candidate for successful control. There does not appear to be much cattle usage in the creek due to the dense shrub cover. Increased ATV use in the upland greasewood community would probably lead to reduction of the soil crust and invasion of exotic species such as cheatgrass or annual mustards.

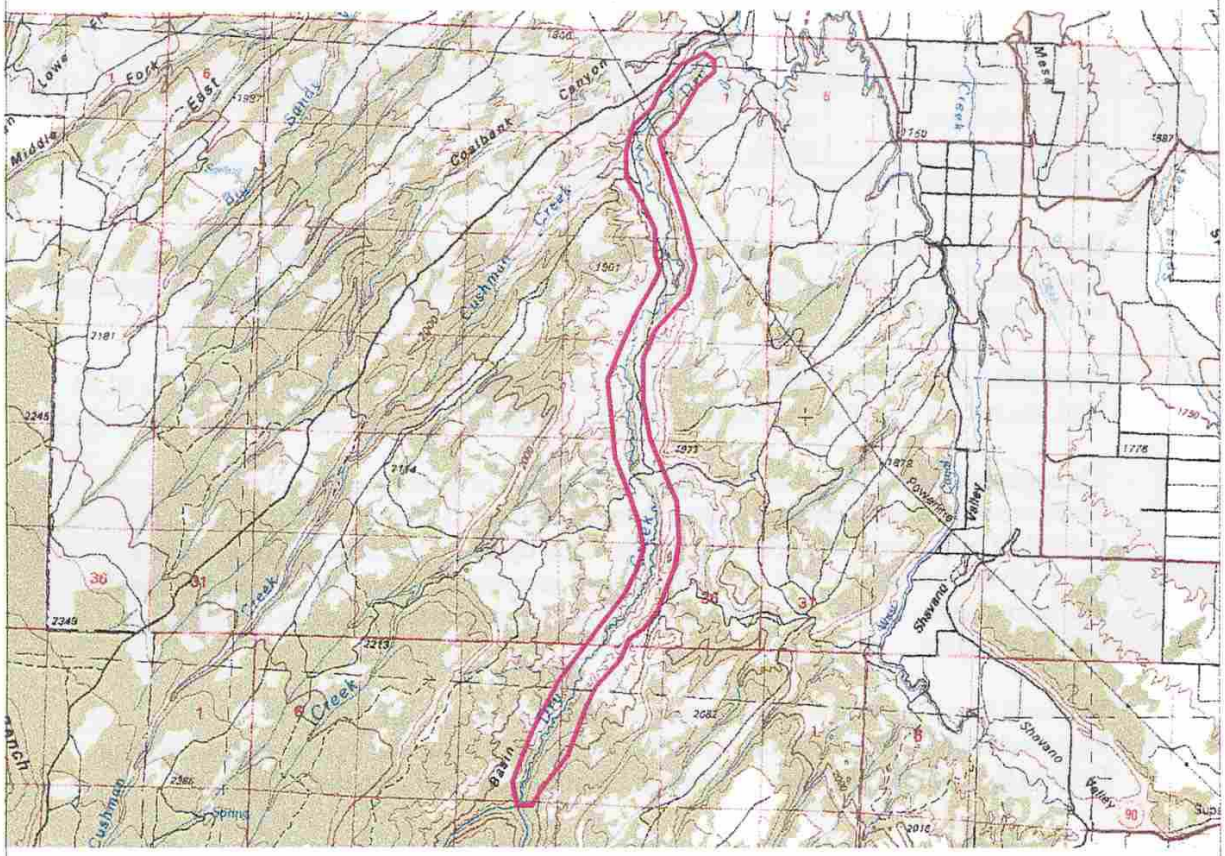
Wetland Function and Value Assessment for the Dry Creek PCA:
Proposed HGM Class: Riverine. Subclass: R4 Lower Perennial with seasonal flooding. Cowardin System: Palustrine. Subsystem: Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment Was Performed at the Dry Creek PCA.

Dry Creek

Potential Conservation Area

Biodiversity Rank: B3



Dry Creek Basin, Hoovers Corner U.S.G.S. 7.5 min. Quadrangles

ELEMENT OCCURRENCE:

Populus angustifolia/Rhus trilobata

Study Area Locator Map

N

0 1 2 3 4 5 Miles

Figure 24. Map of Dry Creek PCA

East Fork Spring Creek

Biodiversity Rank: B4 (Moderate biodiversity significance)
The PCA includes an unranked occurrence of Colorado River cutthroat trout, a globally vulnerable species.

Protection Urgency Rank: P4
The PCA is entirely within the Uncompahgre National Forest. There is no special protection in place at this time.

Management Urgency Rank: M5
No management needs are known. Current management has resulted in the present excellent condition of the stream.

Location: Ouray County. On the Uncompahgre Plateau, about fourteen miles west of Colona.

U.S.G.S. 7.5 min. quadrangles: Pryor Creek, Government Springs
Legal Description: T47N R10W S 17, 20, 29, 31, 32; T46N R10W S 5, 6, 8.

General Description: The East Fork of Spring Creek flows northward, from the top of the Uncompahgre Plateau, to join the Middle Fork just south of the Montrose County line. The PCA encompasses approximately six miles of the stream, and ranges in elevation from 7,200 to 8,900 ft.. (2,195 to 2,713 m). A dirt road and a pack trail cross the stream, otherwise the area is roadless. The East Fork of Spring Creek was determined by the Forest Service to be in excellent condition, and has been recommended for designation as a representative reach. Cutthroat trout were identified by sight in the stream in 1997. No genetic work has been done yet to determine the purity of the population.

Biodiverstity Rank Justification: The PCA includes an unranked occurrence of Colorado River cutthroat trout, a globally vulnerable species.

Natural Heritage elements at the East Fork Spring Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Oncorhynchus clarki pleuriticus	**Colorado River cutthroat trout**	**G3T3**	**S3**	**FS**	**SC**	**E**

*EO = Element Occurrence

Boundary Justification: The boundary encompasses the entire East Fork of Spring Creek, including the known location of Colorado River cutthroat trout, and additional habitat both upstream and downstream.

Protection Rank Justification: The PCA is entirely within the Uncompahgre National Forest. There is no special protection in place at this time.

Management Rank Justification: No management needs are known. Current management has resulted in the present excellent condition of the stream.

Wetland Function and Value Assessment for the East Fork Spring Creek PCA:
Proposed HGM Class: Riverine. Subclass: R3 Middle Elevation Moderate Gradient, with seasonal flooding.
Cowardin System: Palustrine. Subsystem: Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment was Performed at the East Fork of Spring Creek PCA.

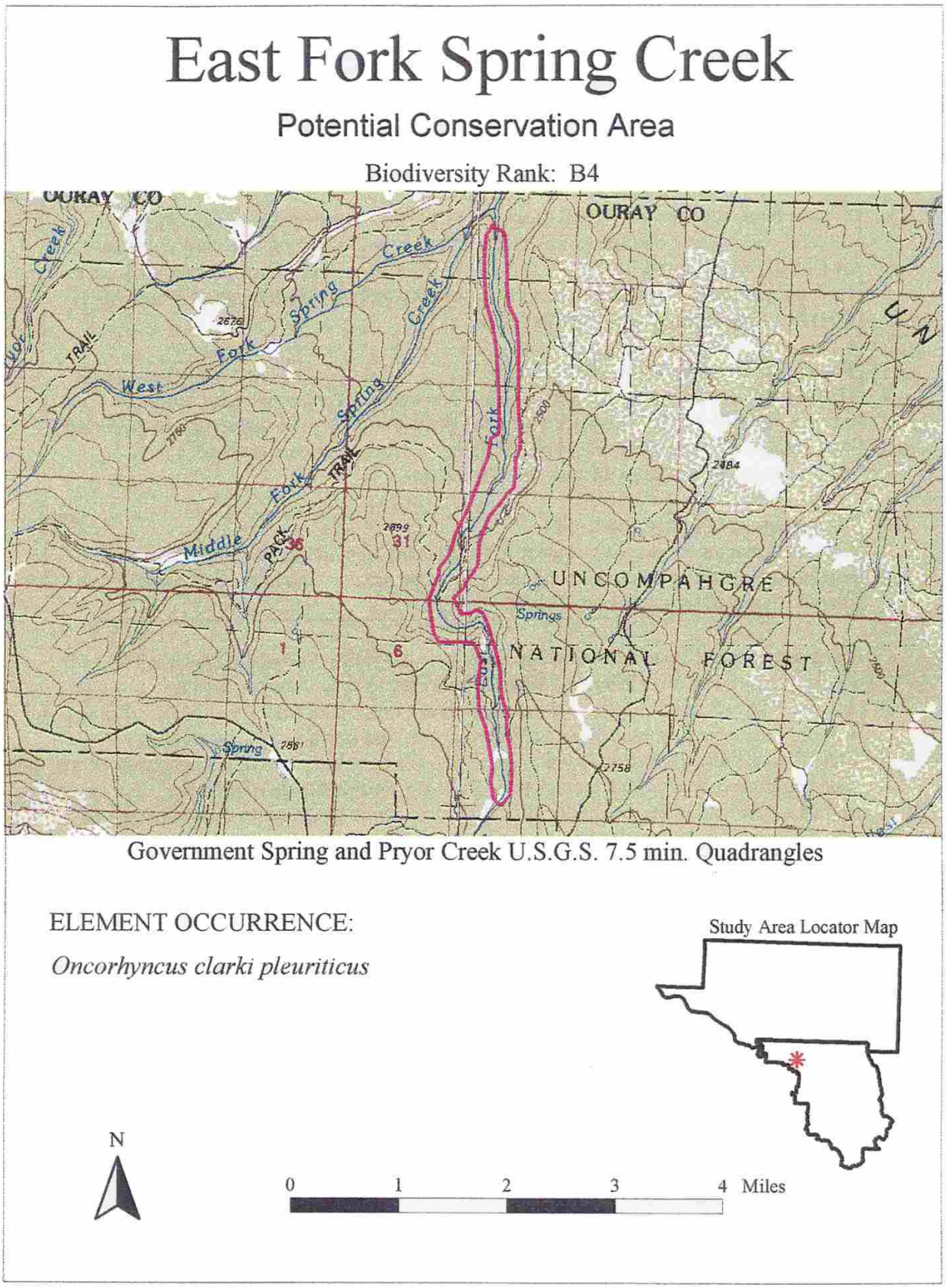


Figure 25. Map of East Fork Spring Creek PCA

Natural Pond Potential Conservation Area

Biodiversity Rank: B4 (Moderate Significance)
Natural Pond supports very good examples of a water smartweed and a pondweed wetland community, both ranked as vulnerable throughout their global and state ranges by CNHP. The Natural Pond PCA is the only example of a closed depression palustrine wetland without any modifications to its natural hydrology observed on private lands in Ouray County during the 1998 field season.

Protection Urgency Rank: P3
Definable threat but not in the next 5 years. Development is encroaching upon the privately owned ranch. There are no known plans to develop the property, but with rising land values, the possibility must be considered. A conservation easement is recommended to ensure protection for the wetland.

Management Urgency Rank: M4
Current management practices appear to be adequate to maintain the site in its current condition; however, ecological condition should be monitored and grazing management adapted to any change in wetland health.

Location: Natural Pond is located approximately 6.5 miles due west of the town of Ridgway. Driving from Ridgway, take Highway 62 west for 3 miles, then turn north on 24D road for 0.5 miles, make a left turn and travel west on 24 road for another 0.5 miles. Just before the road crosses Pleasant Valley Creek, turn north on the gravel "Lazy Dog Ranch" road and continue as it winds uphill for approximately two miles, where there is a four wheel drive road with a locked gate. Take the four-wheel drive road for approximately 0.5 miles and park. Hike 200 yards uphill to the north on winding cattle and game trails to Natural Pond.

U.S.G.S. 7.5 min. quadrangle: Horsefly Peak
Legal Description: T45N R9W S8

General Description: Natural Pond sits in a depression on a moderately sloping south facing hillside at an elevation of 8,560 ft.. (2,609 m), below the sandstone cliffs of Spruce Mountain. The 11 acre PCA encompasses a one acre bottom spring fed shallow pond, with no surface inlet or outlet, supporting an aquatic bed pondweed community (*Potamogeton foliosus*), with water smartweed (*Polygonum amphibium*) growing in the shallow pond margins, encircled by a band of *Eleocharis palustris* (spike rush) at the waters edge. The upland vegetation is a mix of Gambel oak and pinyon-juniper woodlands. The PCA is part of the privately owned Telluray ranch. Cattle graze the pasture containing Natural Pond for 2 to 3 weeks in June. A very rough four-wheel drive ranch road passes within 200 yards of the pond. Deer, elk, waterfowl, and other local wildlife frequent the site.

Biodiversity Rank Justification: The Natural Pond PCA is the best example of a closed depression palustrine wetland found in the 1998 CNHP Uncompahgre River Basin

Wetland Inventory occurring on private land. It is the only wetland observed on private land with its hydrology intact and unaffected by human "improvements". The short duration pasture rotation has minimized the impact of grazing on the aquatic bed and emergent vegetation. The Gambel oak and pinyon-juniper uplands are in relatively good shape in comparison to similar sites observed in the study area, with only moderate amounts of weedy, alien, and introduced species such as cheatgrass (*Bromus tectorum*), Kentucky bluegrass (*Poa pratensis*) and a few Canada thistle (*Cirsium arvense*) plants. The ranch manager practices aggressive weed control on the property.

Natural Heritage elements associated with wetlands at the Natural Pond PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Potamogeton foliosus	**Montane floating/ submergent palustrine wetlands**	**G3**	**S3**			**A**
Polygonum amphibium	**Montane wet meadows**	**G4**	**S3**			**A**

*EO=Element Occurrence

Boundary Justification: The boundary drawn encompasses the wetland, and includes a 1,000 foot buffer encompassing the small basin extending to the cliffs to the north-west, which is thought to be the hydrological source.

Protection Rank Justification: The PCA is privately owned, and the current owner intends to keep the property a working ranch. Ranches adjacent to the Telluray ranch have been subdivided, and are currently being developed into residential home sites and larger mini-ranch parcels. The realities of skyrocketing land values in eastern Montrose and Ouray counties and the uncertain economic future of cattle ranching combine to pose a real threat to open rangelands in theUncompahgre River Basin. A conservation easement is recommended to ensure protection for the elements of concern, as well as for general biodiversity and open space values of the ranch.

Management Rank Justification: The current grazing management practices of restricting cattle grazing in the Natural Pond pasture to a period of 2 to 3 weeks in June appears to be adequate maintain the site in its current condition. Ecological condition should be monitored and grazing management adapted to any change in wetland health.

Wetland Function and Value Assessment for the Natural Pond PCA:
Proposed HGM Class: Depressional Wetland. Subclass: D1 with continuous saturation. Cowardin System: Palustrine. Subsystem: Emergent Wetland.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the Natural Pond PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	N/A	This wetland is not subject to in-channel or overbank flow.
Sediment/Shoreline Stabilization	N/A	This wetland does not contribute to channel flow dissipation.
Groundwater Discharge/ Recharge	High	The source of water for Natural Pond is a bottom spring.
Dynamic Surface Water Storage	Moderate	A high flood frequency supplied by a bottom fed spring on a small wetland (<1 acre) yields a moderate potential to capture water from precipitation, overland, subsurface flow.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	High	Evidence of flooding, a restricted outlet to slow flow and a high vegetative cover yields a high rating to retain sediments and retain and remove nutrients and toxicants. The wetland is also located below a pinyon-juniper community that is capable of delivering significant sediment loads during high intensity rainstorms, especially if the area is grazed.
Biological Functions		
Habitat Diversity	Very High	The wetland site consists of aquatic bed, emergent wetland and unconsolidated bottom open water habitats.
Listed/Proposed/Candidate T&E Species Habitat	None	None known.
CO Natural Heritage Program Species Habitat	High	Natural Pond supports very good examples of water smartweed (*Polygonum amphibium*), G5/S3, and pondweed (*Potamogeton foliosus*), G5/S3, wetland communities. It is also the best example of a closed depression palustrine wetland observed on private lands in Ouray County.
General Wildlife Habitat	High	Various song birds, ducks, deer, waterbugs and Colorado hairstreak butterflies were seen during the wetland site visit. Many other species are suspected to utilize the area, i.e., garter snakes and chorus or northern leopard frogs.
General Fish/Aquatic Habitat	N/A	This wetland does not supply habitat for fish.
Production Export/Food Chain Support	Low	Small size (<1 acre) and no outlet gives this wetland a low potential to produce and export food/nutrients regardless of its high habitat diversity and perennial surface water.
Values		
Uniqueness	Moderate	Being the only undeveloped natural wetland found on private land during the 1998 wetland survey the site is considered rare within the boundaries of the study area, but closed depressional wetlands are relatively common resulting in a moderate uniqueness rating.
Recreation/Education	Low	Based on the wetlands small size (<1 acre) and private

Potential		ownership, minimal rec. and ed. opportunities.

General Soil Description

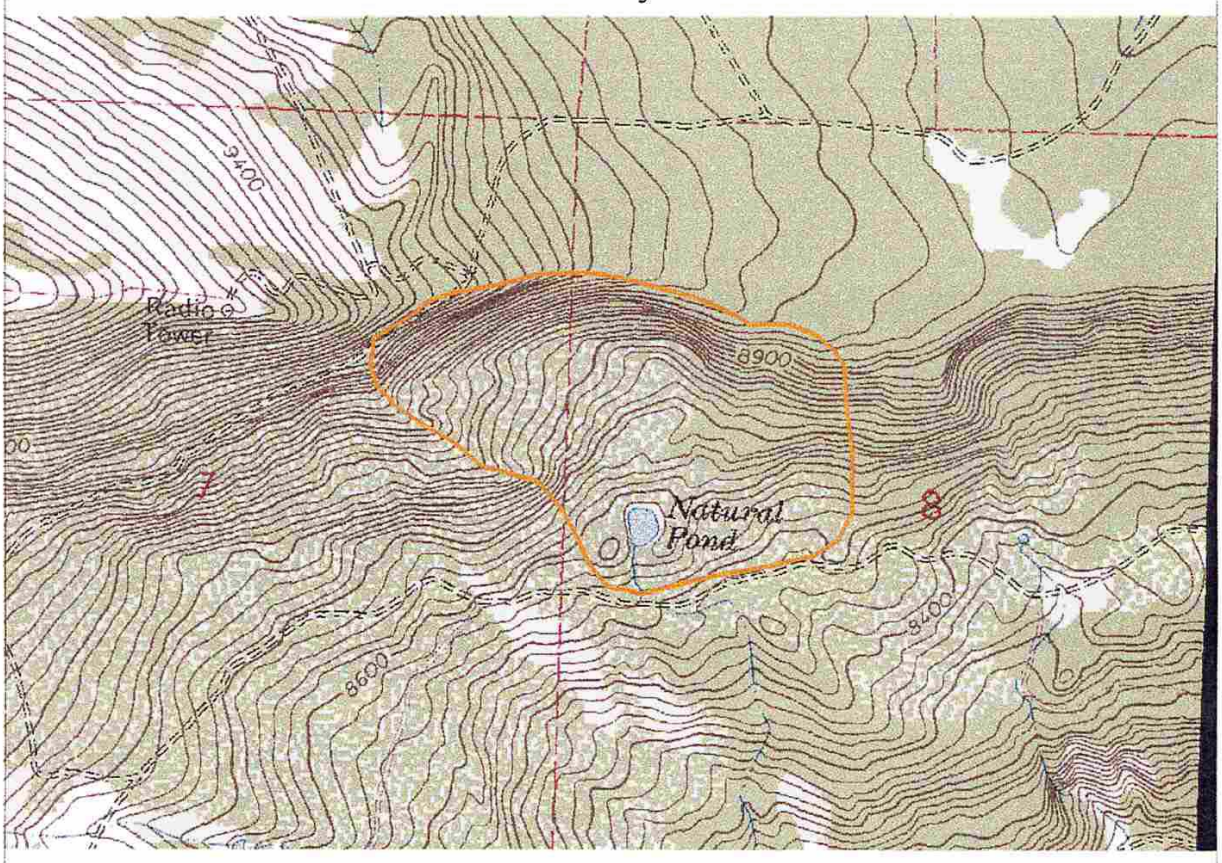
Texture	10 cm of organic muck, mildly sulfur smelling, then clay
Color	10YR 3/1
Cobble Size	N/A
Percent Mottling	N/A

Figure 26. Wetland communities at the Natural Pond PCA

Natural Pond

Potential Conservation Area

Biodiversity Rank: B4



Horsefly Peak U.S.G.S. 7.5 min. Quadrangle

ELEMENT OCCURRENCES:

Polygonum amphibium

Potamogeton foliosus

Study Area Locator Map

N

0 0.05 0.1 0.15 0.2 0.25 Miles

Figure 27. Map of Natural Pond PCA

Pleasant Valley Creek Potential Conservation Area

Biodiversity Rank: B4 (Moderate significance)
The Pleasant Valley Creek PCA supports a fair occurrence of a narrowleaf cottonwood/Rocky Mountain juniper montane riparian forest and a canyon bog-orchid rare throughout their range, and in the state of Colorado.

Protection Urgency Rank: P3
Definable threat, but not in the next five years. Development is encroaching upon the privately owned ranch. There are no known plans to develop the property, but with rising land values, the possibility of development must be considered. A conservation easement is recommended to ensure protection for the riparian area and associated wetland.

Management Urgency Rank: M4
Current management practices appear to be adequate to maintain the site in its current condition; cattle are fenced out of the riparian area for the growing season and are fed while they pasture during the winter. However**,** it is always a good idea to monitor ecological conditions in order to adapt grazing management to any change in riparian health**.**

Location: Ouray County
U.S.G.S. 7.5 min. quadrangle: Ridgway
Legal Description: T45N R9W S 16

General Description: Pleasant Valley Creek supports a riparian zone with large mature and regenerating cottonwoods (*Populus angustifolia*), mixed with Rocky Mountain juniper (*Juniperus scopulorum*). The 75 acre Pleasant Valley Creek PCA contains a 36 acre riparian wetland, and ranges from 7,500 to 7,900 ft. (2,280 to 2,400 m). The creek is somewhat entrenched at the lower part of the PCA, but apparently floods periodically over a 300 ft. wide (91 m) broad floodplain in the upper section. Narrowleaf cottonwoods form a canopy with up to 90% cover, while Rocky Mountain juniper grows below, with about 20% cover. There are a few scattered Ponderosa pines (*Pinus ponderosa*) and Douglas firs (*Pseudotsuga menziesii*). Shrubs in the community include wild rose (*Rosa woodsii*), Utah serviceberry (*Amelanchier utahensis*), snowberry (*Symphoricarpos oreophilus*), Gambel's oak (*Quercus gambelii*), red-osier dogwood (*Cornus sericea*) and western white clematis (*Clematis ligusticifolia*). The understory consists of elk sedge (*Carex geyeri*), and a mixture of native and introduced pasture grasses. A small (0.05 acre) spring fed beaked sedge (*Carex utriculata*) wetland adjacent to the stream was the site of the canyon bog orchid (*Platanthera sparsiflora*).

Biodiversity Rank Justification: The riparian vegetation is in fairly good shape overall, and in excellent shape in comparison to similar riparian habitat occurring in the heart of ranching country. There are some weeds and pasture grasses mixed with native grasses in the understory such as: white sweet clover (*Melilotus alba*), alfalfa (*Medicago officinalis*), gray aster (*Aster glaucodes*) and smooth brome (*Bromus inermis*).

Natural Heritage elements associated with wetlands at the Pleasant Valley Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia/ Juniperus scopulorum	**Montane riparian forests**	**G2G3**	**S2**			**C**
Platanthera sparsiflora	Canyon bog- orchid	G4G5T3	S2			B

*EO = Element Occurrence

Boundary Justification: The boundary is drawn to include the riparian plant community and the occurrence of the canyon bog orchid, with a small buffer. A comprehensive conservation plan for the riparian area should integrate management of the upper watershed.

Protection Rank Justification: The PCA is privately owned, and the current owner intends to keep the property a working ranch. Ranches adjacent to the Telluray ranch have been subdivided, and are currently being developed into residential home sites and larger mini-ranch parcels. The realities of skyrocketing land values in eastern Montrose and Ouray counties and the uncertain economic future of cattle ranching combine to pose a real threat to open rangelands in the Uncompahgre Rive Basin. A conservation easement is recommended to ensure protection for the elements of concern, as well as for general biodiversity and open space values of the ranch. A conservation easement may also assist in preserving the ranching way of life that is fast disappearing from the landscape.

Management Rank Justification: The current management practices of restricting cattle occupancy of the riparian area to the winter months when plants are dormant, and of supplying them with sufficient feed, minimizes grazing stress on the plant communities and permits the riparian vegetation to regenerate. The ranch manager also practices aggressive noxious weed control. These management practices are an example of how livestock production and natural heritage values can co-exist. As always, ecological monitoring and adaptive range management is recommended to protect the natural systems upon which a sustainable livestock operation depends.

Wetland Function and Value Assessment for the Pleasant Valley Creek PCA:
Proposed HGM Class: Riverine. Subclass: R3, Middle Elevation Perennial, with seasonal saturation and occasional flooding.
Cowardin System: Palustrine. Subsystem: Forested, Scrub-Shrub and Emergent wetland.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the Pleasant Valley Creek PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	High	The 35 acre forested and scrub-shrub riparian zone is subject to frequent flooding.
Sediment/Shoreline Stabilization	High	There is a high percentage of rooted vegetation next to a perennial to intermittent stream.
Groundwater Discharge/ Recharge	High	Springs were observed in the small emergent wetland.
Dynamic Surface Water Storage	N/A	Area is subject to in-channel and overbank flow.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	Moderate	There is evidence of flooding and percent cover of emergent and woody vegetation exceeds 50%, but the wetland does not receive direct discharge of managed water.
Biological Functions		
Habitat Diversity	High	There is open water in the river channel, riparian woodlands, and emergent vegetation.
Listed/Proposed/Candidate T&E Species Habitat	Low	None known.
CO Natural Heritage Program Species Habitat	High	The small emergent wetland provides habitat for the canyon bog-orchid (*Platanthera sparsiflora*), G4G5/S2.
General Wildlife Habitat	High	An estimated 80% of vertebrate fauna in the semi-arid West commonly use riparian areas and wetlands for year round habitat or for migratory stopovers. Songbirds, raptors, deer, bear, small mammals were directly observed or detected from tracks and scat.
General Fish/Aquatic Habitat	N/A	The creek does not appear to support fish.
Production Export/Food Chain Support	High	The wetland area is large with a high habitat diversity rating, the river is perennial to intermittent and has an outlet.
Values		
Uniqueness	High	Despite the fact that the Assessment Area is common in the basin, and is encroached upon, a mature riparian forest has a high habitat diversity rating that is hard to replace if destroyed.
Recreation/Education Potential	Low	Because the wetland area is privately owned, there is little Recreation/Education Potential.

General Soil Description: for emergent wetland.

Texture	Muck, 15 cm sapric sandy clay loam with slight sulfur smell.
Color	2.5Y 5/1 black.
Cobble Size	N/A
Percent Mottling	N/A

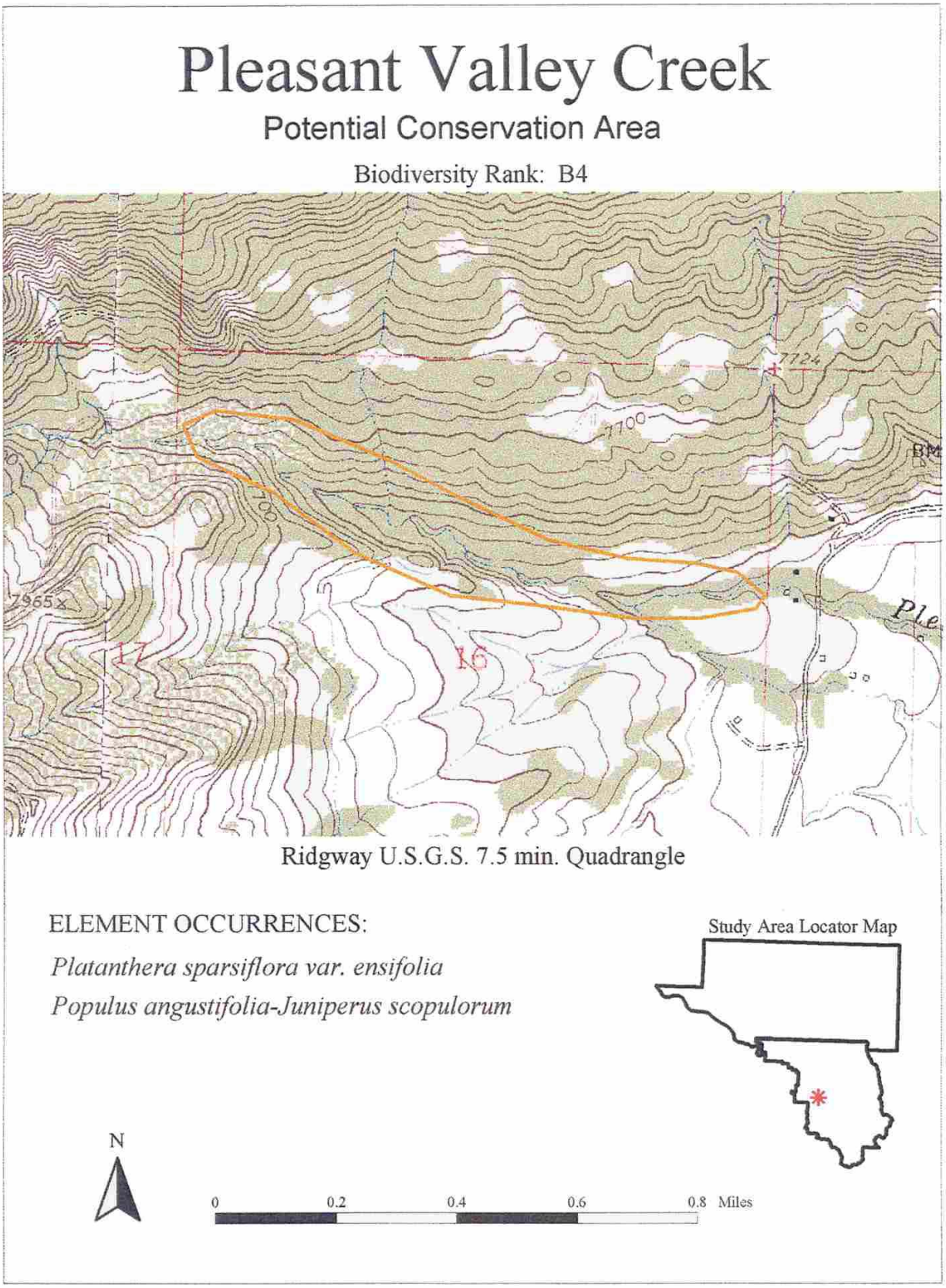


Figure 28. Map of Pleasant Valley Creek PCA

Middle Fork Spring Creek Potential Conservation Area

Biodiversity Rank: B5 (General biodiversity significance)
The Middle Fork Spring Creek PCA includes a good example of a globally secure riparian forest.

Protection Urgency Rank: P5
The PCA is within the Uncompahgre National Forest. There is no additional protection needed.

Management Urgency Rank: M3
Grazing upstream may be contributing to poor water quality and erosion.

Location: Ouray County
U.S.G.S. 7.5 min. quadrangle: Pryor Creek
Legal Description: T47N R11W S 25, 35, 36

General Description: The 115 acre PCA ranges in elevation from 8,200 to 8,800 ft. (2,500 to 2,680 m). The Middle Fork of Spring Creek forms a narrow valley with a steep gradient at this site. The riparian area is forested with Engelmann spruce (*Picea engelmannii*), with an understory of thinleaf alder (*Alnus incana*), Rocky Mountain willow (*Salix monticola*), and Drummond's willow (*Salix drummondiana*). Erosion of banks was higher than expected, possibly due to grazing upstream.

Biodiversity Rank Justification: The Middle Fork Spring Creek PCA includes a good example of a common riparian community.

Natural Heritage elements associated with wetlands at the Middle Fork of Spring Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Abies lasiocarpa-Picea engelmannii/Salix drummondiana	**Montane riparian forests**	**G5**	**S4**			**B**

*EO = Element Occurrence

Boundary Justification: The boundary encompasses the riparian community occurrence, and includes additional riparian areas both upstream and downstream.

Protection Rank Justification: The PCA is within the Uncompahgre National Forest. There is no additional protection needed.

Management Rank Justification: Grazing upstream may be contributing to poor water quality and erosion. A comprehensive conservation plan for the PCA should integrate management of the upper watershed, and consider management effects on areas located downstream.

Wetland Function and Value Assessment for the Middle Fork Spring Creek PCA:
Proposed HGM Class: Riverine. Subclass: R3 Middle Elevation Moderate Gradient, with seasonal flooding.
Cowardin System: Palustrine. Subsystem: Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment was Performed at the Middle Fork of Spring Creek PCA.

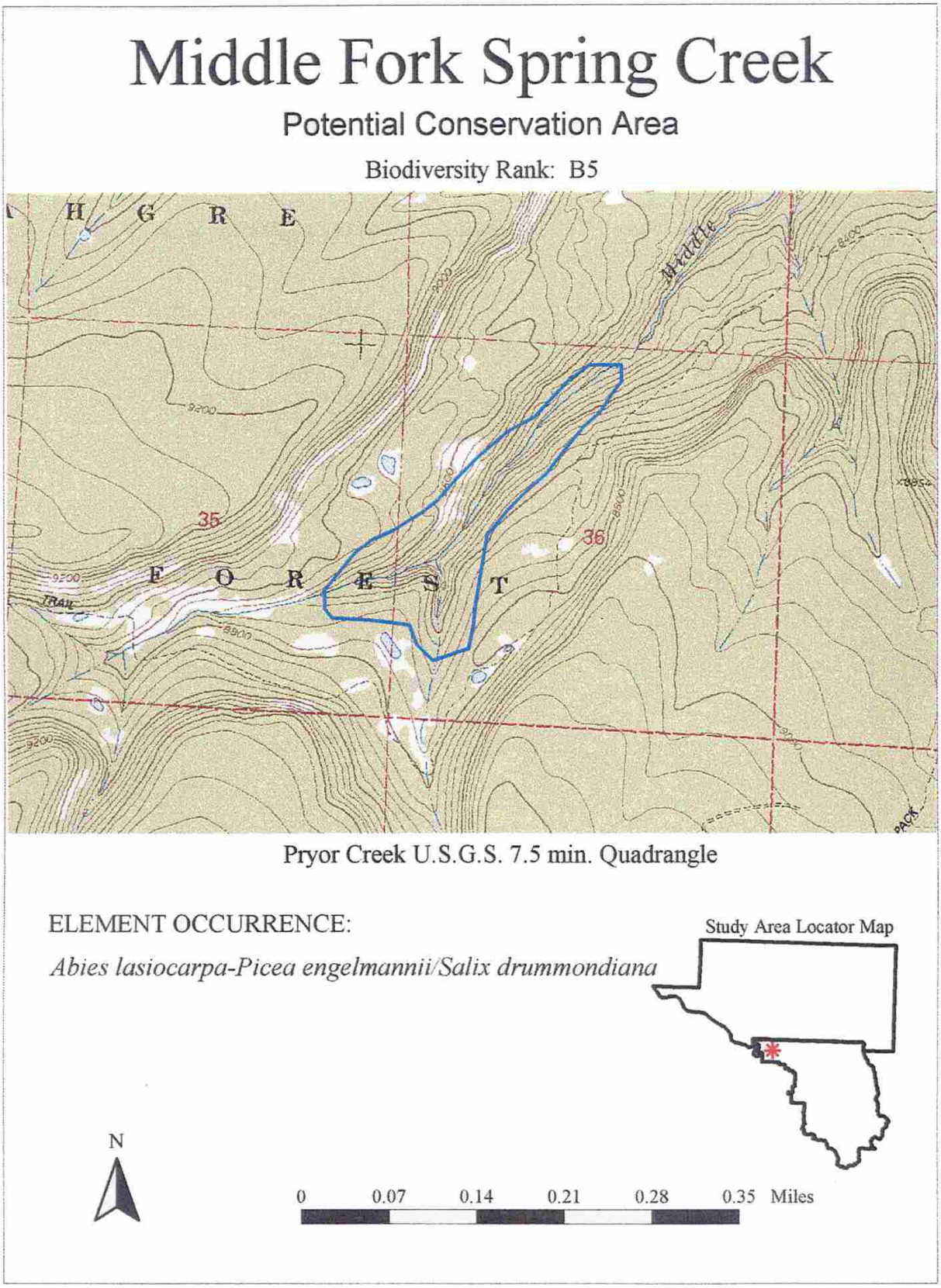


Figure 29. Map of Middle Fork Spring Creek PCA

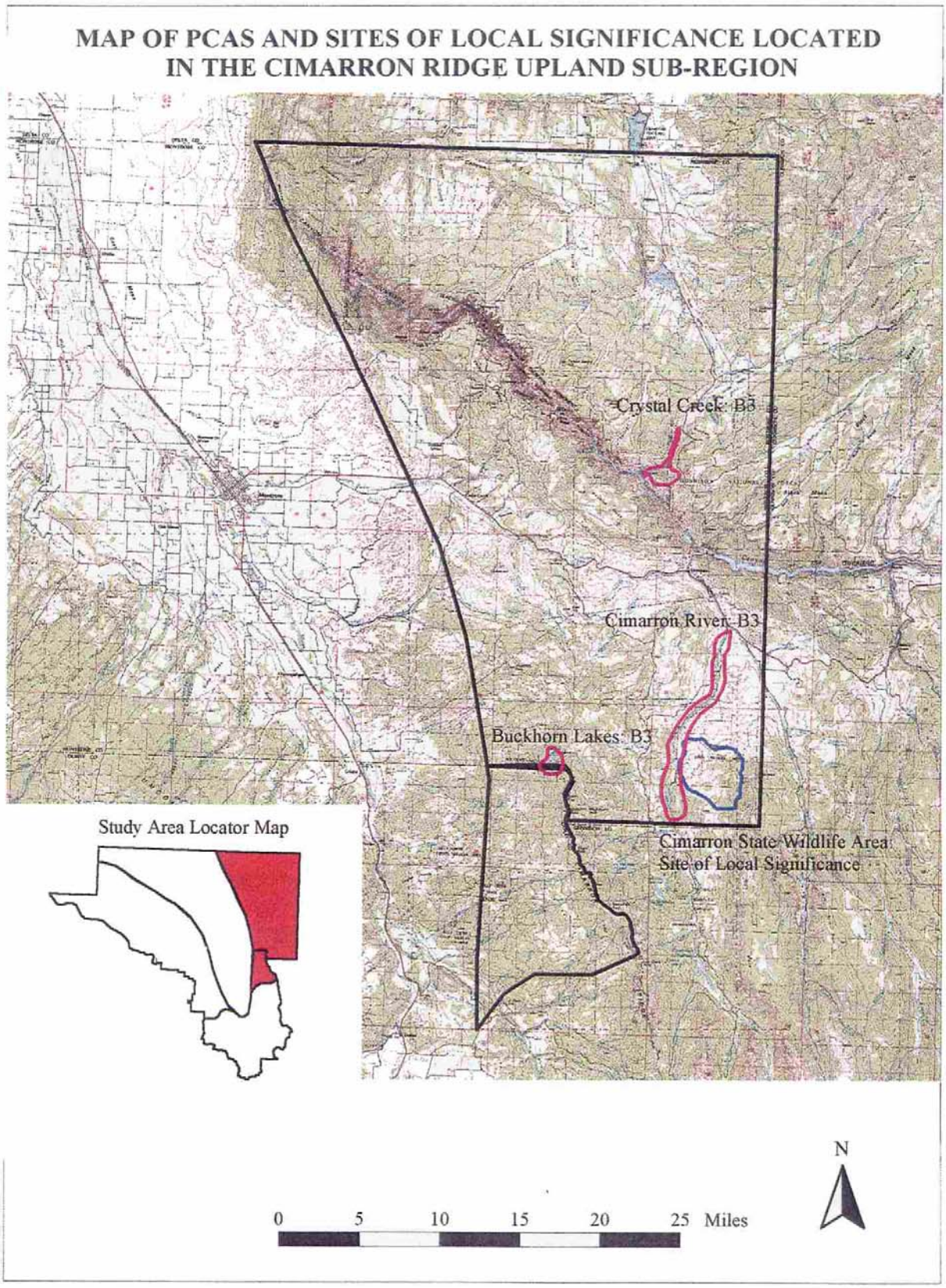


Figure 30. Map of PCAs and Sites of Local Significance Located in the Cimarron Ridge Upland Subregion

Buckhorn Lakes Potential Conservation Area

Biodiversity Rank: B3 (High significance)
The Buckhorn Lakes PCA supports and excellent example of a state rare montane riparian willow community.

Protection Urgency Rank: P4
The majority of the PCA is owned by the city of Montrose and the BLM, with no special status.

Management Urgency Rank: M3
New management actions may be needed in five years if recreational use escalates, especially near the ponds. Threats to the occurrence could include grazing, OHV, and trampling from camping.

Location: Nine miles due east of Colona.
U.S.G.S. 7.5 min. quadrangle: Buckhorn Lakes
Legal Description: T47N R7W S16

General Description: Buckhorn lakes Potential Conservation Area is adjacent to Buckhorn Lakes Park, a heavily utilized fishing and recreational park, and source of water for the city of Montrose. The 200 acre PCA is a wetland complex of small lakes and ponds, wetland seeps supporting emergent vegetation (*Carex utriculata*, *Eleocharis palustris*) and willow thickets (*Salix monticola*, *Salix planifolia, Salix ligulifolia*) surrounded by an evergreen forest (*Abies lasiocarpa*, *Picea engelmannii*). The hydrology is intact and is supplied by groundwater discharge, supplemented by precipitation and snowmelt. There is some encroachment by a two-track road, but several ponds are only accessible by foot.

Biodiversity Rank Justification: The montane riparian willow community (*Salix monticola/* mesic forb) is large (80 acres) and in excellent shape. There is no evidence of grazing, and the shrubs and grasses appear to be regenerating well.

Natural Heritage elements associated with wetlands at the Buckhorn Lakes PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
***Salix monticola*/mesic forb**	**Montane riparian willow carr**	**G3**	**S3**			**A**

*EO=Element Occurrence

Boundary Justification: The boundary is drawn to encompass the elements of concern, and includes a large buffer to incorporate the larger landscape level hydrologic processes of groundwater discharge and recharge.

Protection Rank Justification: The majority of the PCA is owned by the city of Montrose and the BLM, therefore it is considered well protected.

Management Rank Justification: New management actions may be needed in five years if recreational use escalates, especially near the ponds. Threats to the occurrence could include grazing, OHV, and trampling from camping.

Figure 31. Montane Riparian Willow Carr at Buckhorn Lakes PCA

Wetland Function and Value Assessment for the Buckhorn Lakes PCA:
Proposed HGM Class: Depressional. Subclass D1, with permanent saturation and flooding.
Cowardin System: Palustrine. Subsystem: Emergent and Scrub-Shrub Wetland.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the Buckhorn Lakes PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	Low	Only a small percentage (< 2 acres) of the wetland area is subject to periodic flooding.
Sediment/Shoreline Stabilization	High	A high percent vegetative cover adjacent to a perennial body of water yields a high ability to dissipate flow and stabilize sediment, reducing erosion.
Groundwater Discharge/ Recharge	High	Multiple seeps and springs supply perennial water to the wetland site giving the area a high rating for groundwater discharge.
Dynamic Surface Water Storage	High	A large area is seasonally inundated.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	Moderate	The wetland area does not receive direct discharge of managed water, but it contains a restricted outlet, and the percent cover of emergent vegetation exceeds 50%.
Biological Functions		
Habitat Diversity	High	The Assessment Area contains open water, scrub-shrub, and emergent habitat types.
Listed/Proposed/Candidate T&E Species Habitat	None	None known.
CO Natural Heritage Program Species Habitat	High	This wetland supports two communities of concern: montane riparian willow carr (*Salix monticola*/mesic forb), G3/S3, and a montane riparian forest (*Abies lasiocarpa-Picea engelmanii/ Mertensia ciliata*), G5/S5.
General Wildlife Habitat	High	Waterfowl, raptors, songbirds, deer and small mammals use this diverse habitat.
General Fish/Aquatic Habitat	N/A	The smaller ponds do not provide habitat for fish.
Production Export/Food Chain Support	High	The wetlands large size (200 acres), high habitat diversity, presence of an outlet and perennial water all contribute to the high potential to produce and export food/nutrients.
Values		
Uniqueness	Moderate	The wetland is considered rare within the boundaries of the study area, but the area has some disturbance and the wetland type is relatively common (compared to a fen, bog, or warm spring) resulting in a moderate rating for uniqueness.
Recreation/Education Potential	Moderate	Public ownership of a slightly disturbed wetland yields a moderate rating to support recreational or educational activities.

General Soil Description

Texture	In seep area: sapric peaty soils in first 30 cm. Gleyed clay soils at 60 cm and greater
Color	N/A
Cobble Size	N/A
Percent Mottling	N/A

Figure 32. Montane Riparian Willow Carr at Buckhorn Lakes PCA

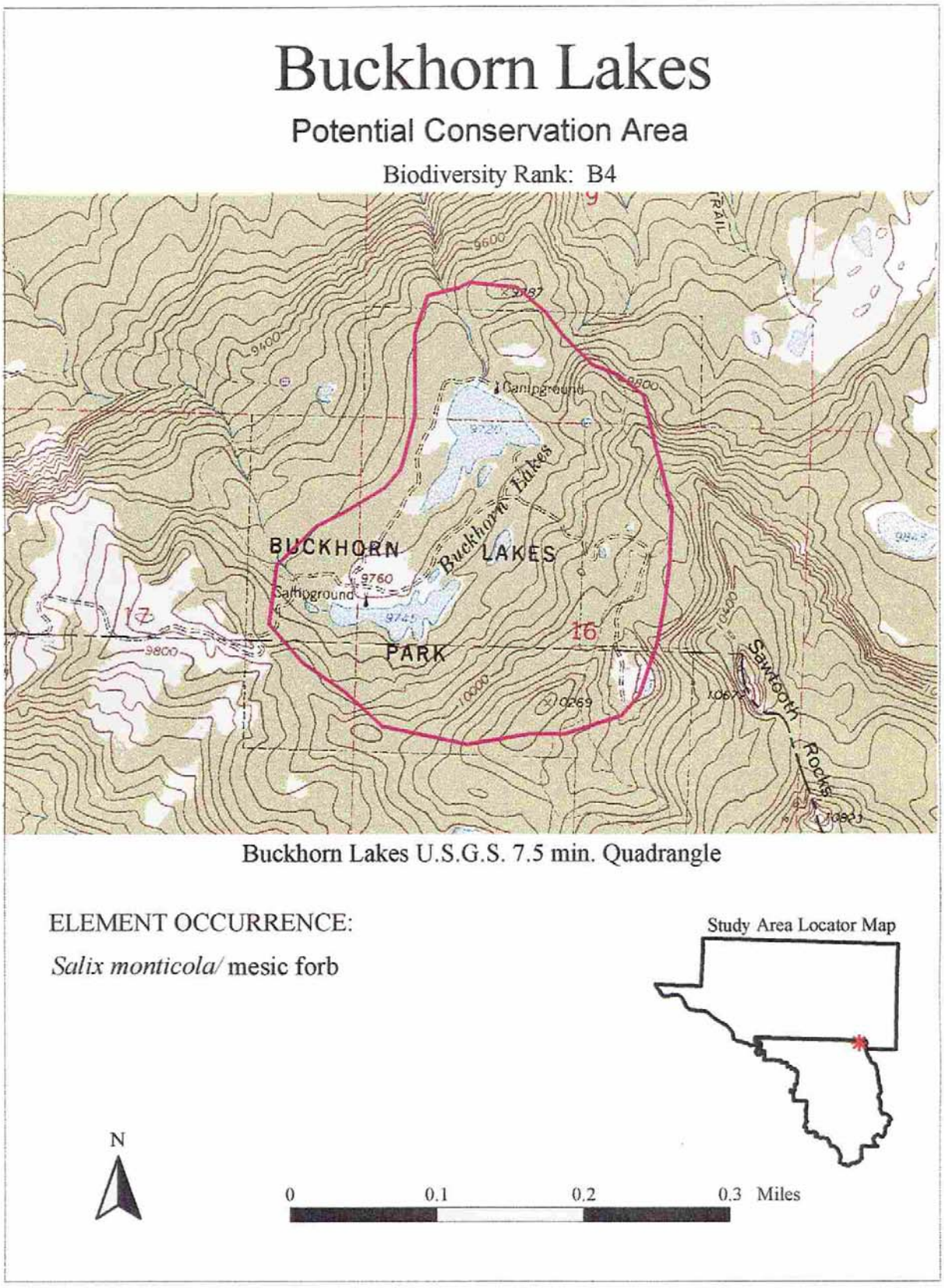


Figure 33. Map of Buckhorn Lakes PCA

Cimarron River Potential Conservation Area

Biodiversity Rank: B3 (High significance)
The Cimarron River PCA supports a good example of a montane riparian forest vulnerable throughout its range, and an active great blue heron breeding ground.

Protection Urgency Rank: P3
This is a long continuous riparian corridor that can be broken into several sections of land ownership: the upper 3.75 miles are bordered to the east by the Cimarron State Wildlife Area, and to the west by private land; the lower parts of the river are almost all privately owned, except for a few small parcels of land owned by the BLM. The portions of this PCA adjacent to the Cimarron State Wildlife Area are probably secure. However, the balance of private land may be subject to development.

Management Urgency Rank: M4
Present management appears to be adequate to maintain the occurrence in its present condition. Exotic and invasive plant species may need to be managed.

Location: Montrose County
U.S.G.S. 7.5 min. quadrangles: Cimarron and Washboard Rock
Legal Description: T48N R6W S 21, 28, 32, 33; T47N R6W S 5-8, 17-20, 29, 30

General description: The Cimarron River flows north from its headwaters in the Uncompahgre National Forest in Gunnison County. The 2,265 acre PCA ranges in elevation from 7,160 to 8,020 ft. (2,180 to 2,560 m) at the county line. It supports a long, narrow corridor of riparian vegetation, dominated by narrowleaf cottonwood (*Populus angustifolia*) and blue spruce (*Picea pungens*), which continues upstream into Gunnison County for approximately 1.5 miles. From the county line the river runs north, and is bordered to the east by the Cimarron State Wildlife Area for approximately 3.75 miles. Here, the trees are widely spaced, and there is a sparse understory of thinleaf alder (*Alnus incana*) and red-osier dogwood (*Cornus sericea*). This area is probably a transition between communities dominated by blue spruce upstream, and those with narrowleaf cottonwood downstream (Kittel 1994). There are some steep and highly erosive side slopes cutting through unconsolidated volcanic soils, and water quality is questionable. However, there is little direct human disturbance, as there are no roads or trails in the valley bottom. The globally rare Black Canyon gilia was found in crevices of granite cliffs in 1937, but has not been relocated since. Most of the northern (downstream) part of the site is on private land, with a few small BLM parcels intermixed. Farther downstream, the steep-sided canyon widens to a broad floodplain. A good condition riparian area four miles south of highway 50 was documented by CNHP riparian ecologists in 1998. The area is not accessible to the public, and is undisturbed. Vegetation is similar to the upstream site, but with a higher percentage of narrowleaf cottonwood, and the addition of coyote willow (*Salix exigua*) in the understory, along

with thinleaf alder and red-osier dogwood. The cottonwoods provide a nesting area for great blue herons. Gambel's oak (*Quercus gambelii*) and big sagebrush (*Artemisia trilobata*) dominate uplands here.

Elements occurring in the Cimarron River PCA that are not specifically tied to the wetland and riparian habitat are profiled in more detail in the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999).

Biodiversity Rank Justification:
The PCA encompasses a long continuos riparian corridor that is relatively inaccessible, with no roads or trails along the river bottom. Few exotic species were observed, except for some Canada thistle (*Cirsium arvense*) and red top (*Agrostis stolonifera*) located near a day use area.

Natural Heritage elements associated with wetlands at the Cimarron River PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia-Picea pungens/Alnus incana	**Montane riparian forests**	**G3**	**S3**			**B**
Ardea herodias	Great blue heron	G5	S3BSZN			E

*EO = Element Occurrence

Boundary Justification: The boundary is drawn to include the riparian corridor of the Cimarron River, and a buffer zone to mitigate impacts from the road.

Protection Rank Justification: This is a long continuous riparian corridor that can be broken into several sections of land ownership: the upper 3.75 miles are bordered to the east by the Cimarron State Wildlife Area, and to the west by private land; the lower parts of the river are almost all privately owned, except for a few small parcels of land owned by the BLM. The portions of this PCA adjacent to the Cimarron State Wildlife Area are probably secure. However, the balance of private land may be subject to development. Potential threats to the area include increased demands for irrigation water and development of vacation home properties upstream.

Management Rank Justification: Current management practices appear to be adequate to maintain the element occurrence in its present condition. Invasive and exotic weedy species may need to be managed. If there is leakage from the vacation home's septic tanks, water quality may be affected, therefore water quality should be monitored.

Wetland Function and Value Assessment for the Cimarron River PCA:
Proposed HGM Class: Riverine. Subclass: R3 Middle Elevation Perennial, with seasonal flooding.
Cowardin System: Palustrine. Subsystem: Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment Was Performed at the Cimarron River PCA.

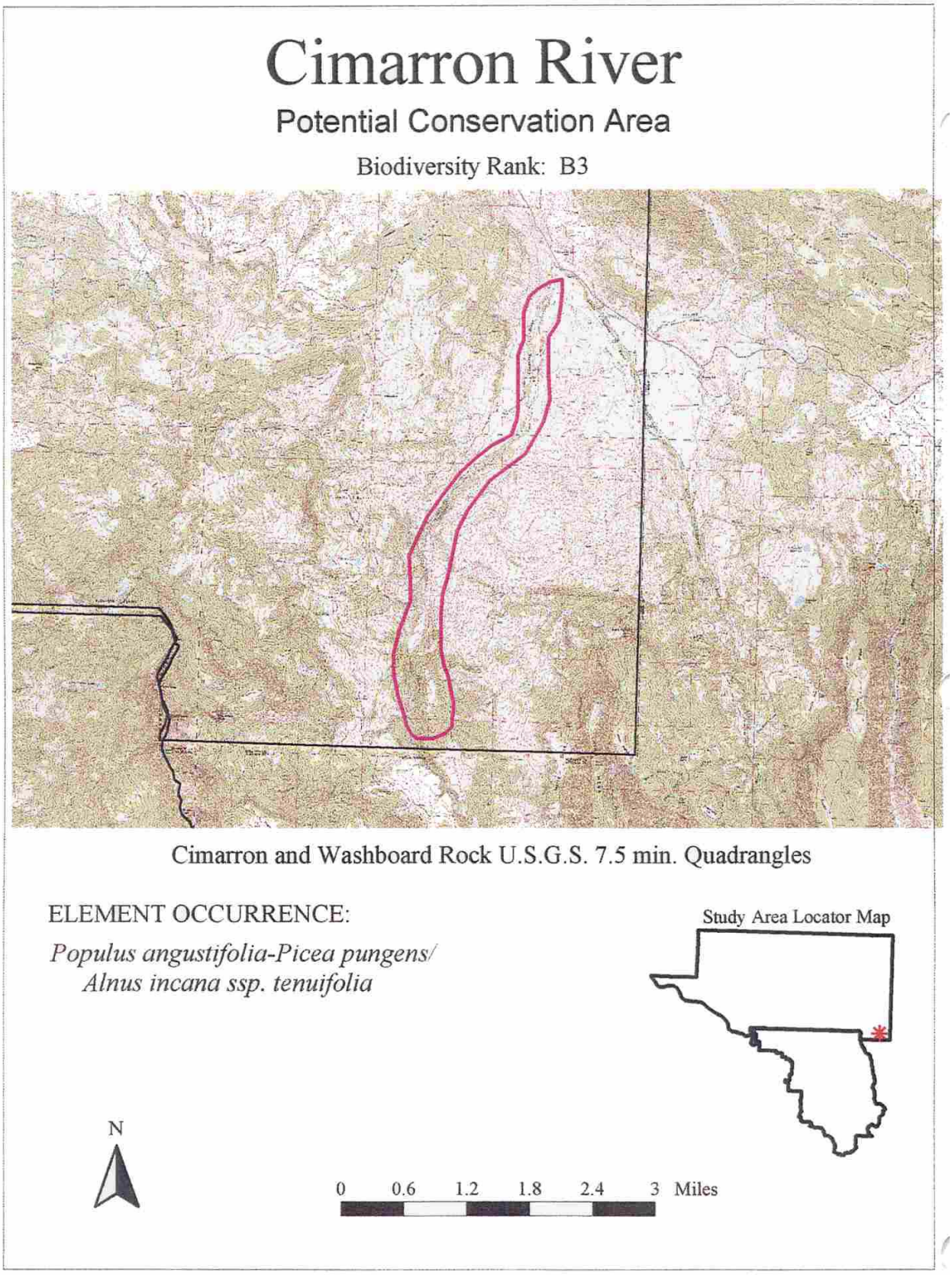


Figure 34. Map of Cimarron River PCA

Crystal Creek

Biodiversity Rank: B3 (High significance)
The PCA contains a good occurrence of globally vulnerable montane riparian plant community.

Protection Urgency Rank: P4
The PCA is located in the Gunnison National Forest and Curecanti National Recreation Area.

Management Urgency Rank: M2
There is a threat of weed invasion in the canyon from degraded areas upstream. Private land and the National Forest lands upstream are heavily grazed, and could contribute weed seeds to downstream areas. Present management of the upland forested area within the site appears to be adequate.

Location: Montrose County. About 15 miles east of Montrose, on the north rim of the Black Canyon.

U.S.G.S. 7.5 min. quadrangles: Cathedral Peak, Cimarron
Legal Description: T48N R6W S 8, 17, 19, 20

General description: Crystal Creek, a tributary of the Gunnison River, flows from the North Rim of the Black Canyon, through a narrow gorge in its final two miles to its confluence at Crystal Reservoir. Elevations in the 538 acre PCA range from 6,800 to 8,894 ft.. (2,072 to 2,711 m). The Crystal Creek PCA includes the canyon, which supports a good occurrence of montane riparian forest, and the adjacent uplands to the south, accessible from the Crystal trail.

The canyon is accessible only by foot. Within the canyon, both hydrology and vegetation dramatically change from the degraded valley above. Cattle do not come into the canyon. However, water quality and flows are probably affected by upstream grazing and irrigation diversions. In the canyon bottom, large boulders create a series of small waterfalls and deep, quiet pools. The tree canopy is dominated by blue spruce (*Picea pungens*), with about 40% cover, and narrowleaf cottonwood (*Populus angustifolia*), with about 20% cover. There are scattered Rocky Mountain junipers (*Juniperus scopulorum*) and Ponderosa pine (*Pinus ponderosa*). The shrub layer consists primarily of thinleaf alder (*Alnus incana*), red-osier dogwood (*Cornus sericea*) and chokecherry (*Prunus virginiana*). Other shrubs present were wild rose (*Rosa woodsii*), raspberry (*Rubus idaeus*), wolf currant (*Ribes wolfii*), twinberry honeysuckle (*Lonicera invulcrata*), and coyote (*Salix exigua*), Rocky Mountain (*Salix monticola*) and Drummond's (*Salix drummondiana*) willows. Occasional wet hillsides and cliffs in the canyon support a rich cover of ferns, mosses, baneberry (*Actaea rubra*), violets (*Viola* sp.), and false solomonseal (*Maianthemum stellatum*).

Upland communities that are not specifically tied to the wetland and riparian habitat are profiled in the companion volume of this report, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999).

Biodiversity Rank Justification: The PCA contains a good occurrence of globally vulnerable montane riparian plant community

Natural Heritage elements associated with wetlands at the Crystal Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia-Picea pungens/Alnus incana	**Montane riparian forests**	**G3**	**S3**			**B**

*EO = Element Occurrence

Boundary Justification: The boundary is drawn to include only the good condition part of Crystal Creek, within the narrow canyon, and the adjacent upland forested area.

Protection Rank Justification: The PCA is in the Gunnison National Forest and the Curecanti National Recreation Area, adjacent to the Black Canyon National Monument. A trail leading to an overlook with a spectacular view of Crystal Lake goes through the PCA.

Management Rank Justification: There is a threat of weed invasion in the canyon from degraded areas upstream. Private land and the National Forest lands upstream are heavily grazed, and could contribute weed seeds to downstream areas. Present management of the upland forested area within the PCA appears to be adequate.

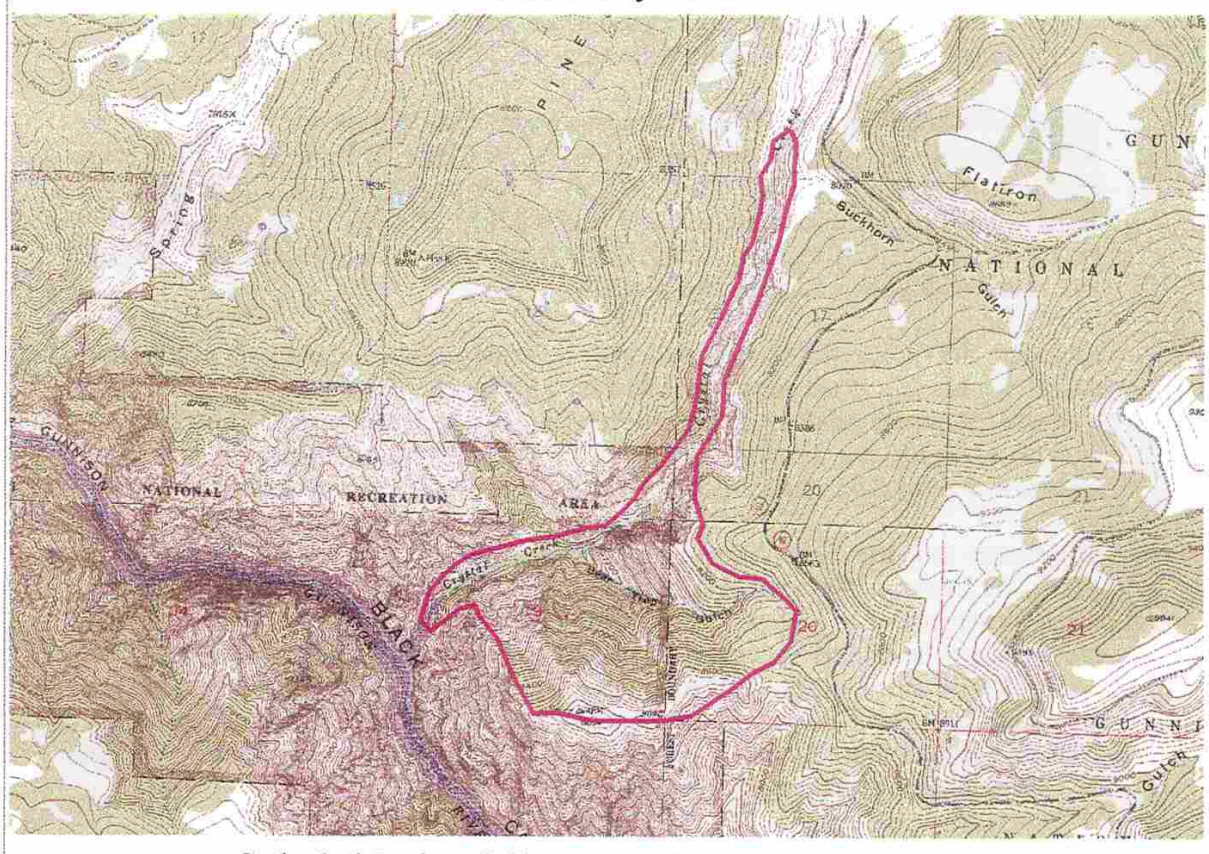
Wetland Function and Value Assessment for the Crystal Creek PCA:
Proposed HGM Class: Riverine. Subclass: R3 Middle Elevation Perennial wetland subject to periodic flooding.
Cowardin System: Palustrine. Subsystem: Forested and Scrub-Shrub Wetland.

No Wetland Function and Value Assessment Was Performed at the Crystal Creek PCA.

Crystal Creek

Potential Conservation Area

Biodiversity Rank: B3



Cathedral Peak and Cimarron U.S.G.S. 7.5 min. Quadrangles

ELEMENT OCCURRENCES:

Populus angustifolia-Picea pungens/Alnus incana

Study Area Locator Map

N

0 0.1 0.2 0.3 Miles

Figure 35. Map of Crystal Creek PCA

Cimarron State Wildlife Area Wetland Site of Local Significance

Location: 22 air miles west of Montrose, along the main road of the Cimarron State Wildlife Refuge.

U.S.G.S. 7.5 min. quadrangle: Washboard Rock
Legal Description: T47N R6W Sections 16, 17

General Description: The 277 acre Cimarron State Wildlife Area Site of Local Significance is situated in the southwest corner of the Cimarron State Wildlife Area at an elevation of approximately 8,480 ft. (2,585 m). Cattle grazed the land until the early 1980s when the CDOW obtained the land for a wildlife refuge. The undulating west facing hillsides of the Cimarron State Wildlife Area are covered by sagebrush shrublands, and dotted with dozens of spring fed ponds.

Slumping and sliding of loosely consolidated volcanic and alluvial outwash debris over underlying Mancos Shale creates the undulating topography. Groundwater cannot easily infiltrate the impermeable Mancos Shale, resulting in a high water table. Groundwater surfaces in depressions forming small ponds. Some ponds appear to have been enhanced by beaver activity, and others are have been developed into larger stock ponds.

The 50 acre Cimarron State Wildlife Area Wetland contains five small to medium sized ponds, the largest measuring 325 ft. by 100 ft. (100 m by 30 m). All ponds were in existence when acquired by the CDOW. Although the majority of ponds in this wetland area appear to be natural features and enhanced by beaver, there is little evidence of current beaver activity. The CDOW has observed that some of the ponds have been shrinking, and believe that this may represent natural variation in the hydrology due to climatic cycles or other factors (Sherman 1999). The decline in beaver activity may also be related to these water table fluctuations.

Beaked sedge (*Carex utriculata*) and narrow-leaf cattail (*Typha latifolia*) dominate the wetland vegetation. Several alien and weedy species are present in the wetland areas, including Canada thistle (*Cirsium arvense*), nettle (*Urtica gracilis*) and redtop (*Agrostis gigantea*). Two of the largest ponds are deep with steep banks, restricting wetland vegetation to a narrow band along the pond perimeter. The other ponds are shallow with gently sloping banks, favoring the development of hydric soils and emergent wetland vegetation.

In the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999), there is a separate PCA described which is adjacent to the wetland complex in the Cimarron State Wildlife Area. The driving element for the creation of the upland PCA is a rare and imperiled native thistle (*Circium perplexans*), which gives the upland PCA a B2 rank.

Protection Considerations: The wetland is situated within the boundaries of the Cimarron State Wildlife Area, under the jurisdiction of the CDOW.

Management Considerations: The CDOW has not undertaken any physical improvements to the Cimarron Wetland area since it has come under their ownership. Management history under the previous owner is unknown, except that the land was managed for cattle production. One pond in the area appears to have been constructed as a stock pond, with little wetland vegetation growing on the banks. It is possible that several other ponds may have been modified by berm construction at some time in the past. Management should encourage beaver recolonization. Aggressive weed control is recommended, especially targeting the prolific Canada thistle (*Cirsium arvense*). Management practices intended to improve deer habitat such as prescribed burning should take into consideration ecological factors (e.g., season and intensity) that may have a positive or negative effect weedy species.

Wetland Function and Value Assessment for the Cimarron State Wildlife Area Site of Local Significance:
Proposed HGM Class: Depressional. Subclass D2, with semipermanent saturation.
Cowardin wetland System: Palustrine. Subsystem: Emergent Wetland.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.
Wetland functional evaluation for the Cimarron State Wildlife Area Wetland:

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	N/A	The wetland area is not subject to in-channel or overbank flow.
Sediment/Shoreline Stabilization	N/A	The wetlands are to shallow to be subject to wave action.
Groundwater Discharge/ Recharge	High	The ponds are bottom spring fed and permanently flodded during drought periods.
Dynamic Surface Water Storage	High	A large wetland (50 acres) that frequently floods has a high potential to capture water from precipitation, overland and subsurface flow.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	Moderate	There is evidence of flooding and ponding water and a high percent vegetative cover, but the wetland is not likely to receive an excessive sediment/nutrient load, and is therefore ranked moderate.
Biological Functions		
Habitat Diversity	High	The wetland site consists of emergent wetland, scrub-shrub, and open water habitats.
Listed/Proposed/Candidate T&E Species Habitat	None	None known.
CO Natural Heritage Program Species Habitat	High	The wetland site supports regular to occasional use by marsh wrens (G5/S3B,SZN); a northern harrier (G5/S3B,SZN) and a great blue heron (G5/S3B,SZN) were observed.
General Wildlife Habitat	High	Deer and ducks, dragonflies and various butterflies were observed during the wetland site visit, and many other species are suspected to utilize the area, i.e., aquatic/semi aquatic and songbirds.

Function	Ratings	Comments
General Fish/Aquatic Habitat	High	This wetland supports and introduced population of trout.
Production Export/Food Chain Support	High	A large wetland size (50 acres), high habitat diversity ranking, and perennial surface water yields a high potential to produce and export food/nutrients.
Values		
Uniqueness	Moderate	A complex of similar ponds is a rare occurrence, and has a high habitat diversity, and is encroached upon by roads and recreational use.
Recreation/Education Potential	High	The wetland area is a known recreation site.

General Soil Description

Texture	Adjacent to the ponds, in emergent wetlands, the soil is mucky, black organic sapric slightly sulfur smelling down to 20 cm.
Color	Black
Cobble Size	N/A
Percent Mottling	N/A

Figure 36. Wetland Communities at the Cimarron State Wildlife Area Site of Local Significance

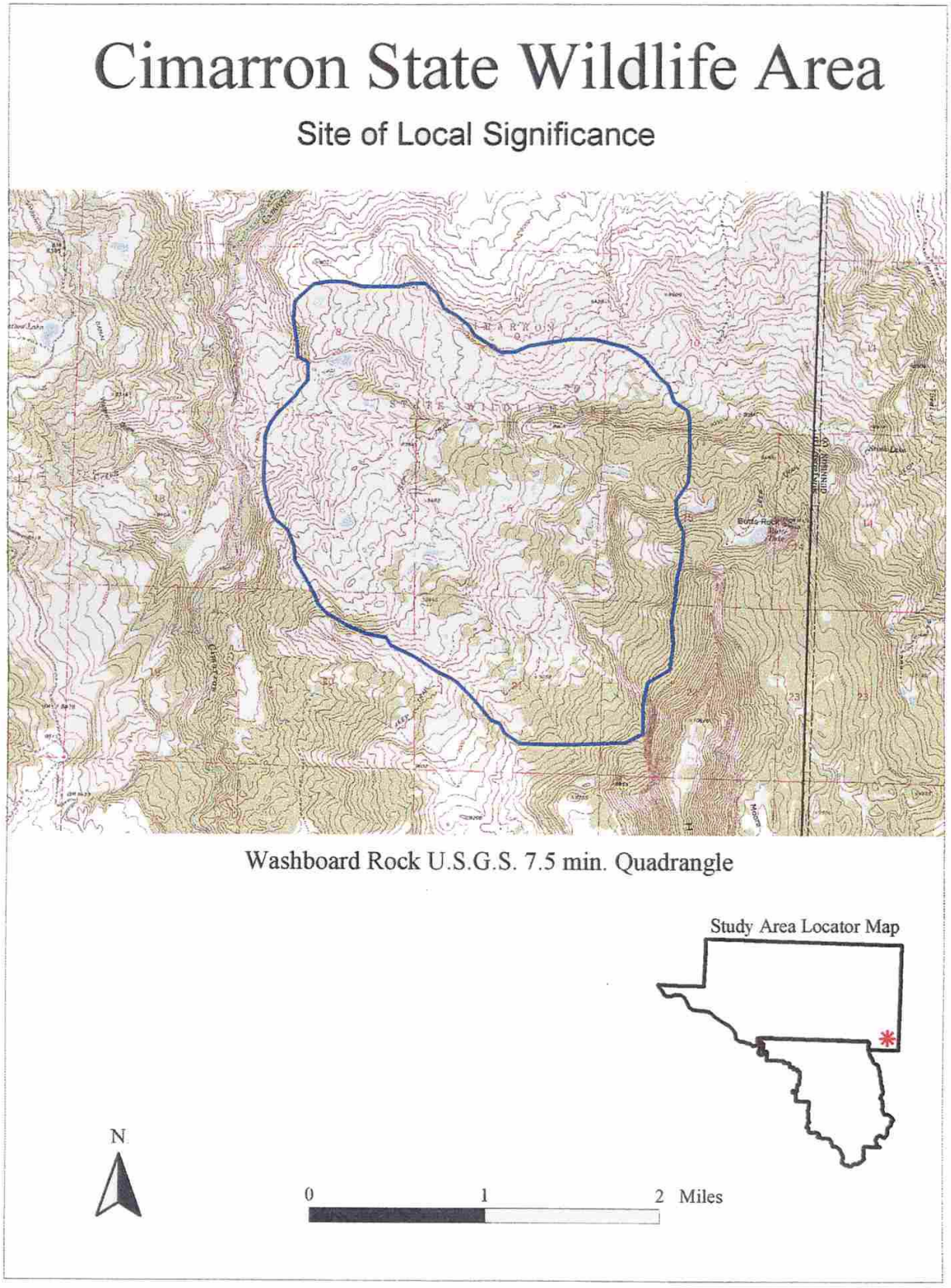


Figure 37. Map of Cimarron State Wildlife Area Wetland Site of Local Significance

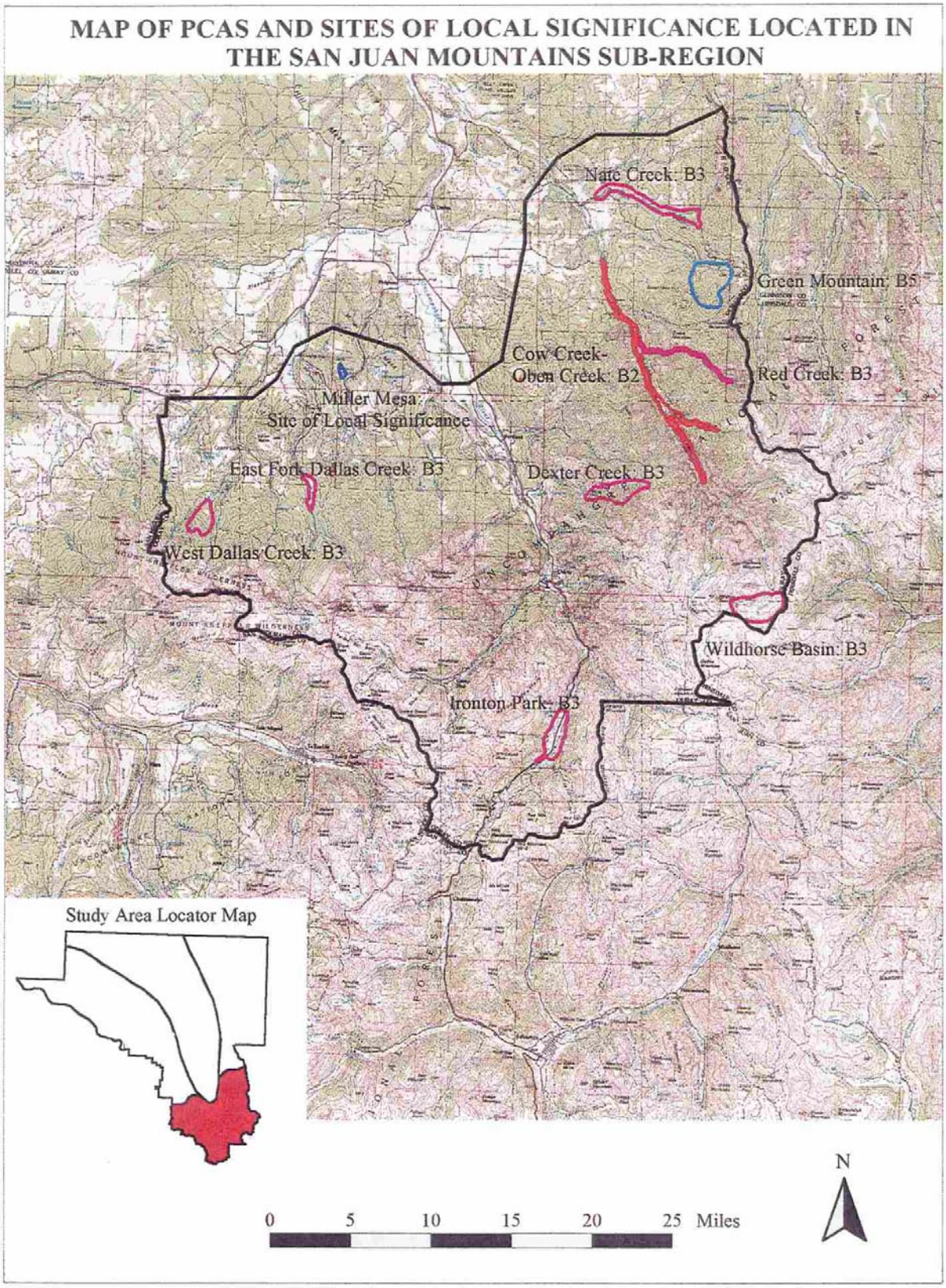


Figure 38. Map of PCAs and Sites of Local Significance Located in the San Juan Mountains Sub-region

Cow Creek-Oben Creek Potential Conservation Area

Biodiversity Rank: B2 (Very high significance)
The Cow Creek-Oben Creek PCA contains examples of three state rare montane riparian forest types in excellent condition.

Protection Urgency Rank: P2
The PCA includes private, BLM, and National Forest lands. The upstream portion of the PCA is protected as part of the Big Blue Wilderness. Private land downstream has no special protection and could be developed in the future. The BLM owns a small parcel, but this small section contains some excellent riparian vegetation. It is recommended that the BLM land should remain public property in order to protect it from development. A conservation easement is recommended for the riparian corridor on the private land.

Management Urgency Rank: M3
Cattle graze on private, BLM and National Forest lands. Present management appears to be adequate, although there are some severe weed infestations on National Forest land in areas used heavily by recreationalists using pack animals.

Location: Ouray County
U.S.G.S. 7.5 min. quadrangles: Dallas, Ouray and Wetterhorn Peak
Legal Description: T45N R7W S 9, 16, 21, 22, 27, 34; T44N R7W S 1-3, 11, 13, 14.

General Description: Cow Creek is one of the major tributaries of the Uncompahgre River, with its headwaters in the Big Blue Wilderness, high in the San Juans. The 68 acre PCA ranges in elevation from 7,560 to 10,400 ft. (2,300 to 3,170 m). From the Wilderness, it passes through the Uncompahgre National Forest, BLM and finally, private land. Oben Creek joins Cow Creek at the beginning of a large roadless area. It has several waterfalls, one of which was the site of the black swift nest.

Both Cow Creek and Oben Creek have examples of riparian communities in excellent condition. Narrowleaf cottonwood (*Populus angustifolia*) and scattered blue spruce (*Picea pungens*), with thinleaf alder (*Alnus incana*), red osier dogwood (*Cornus sericea*) and willows (*Salix monticola* and *Salix drummondiana*) in the understory dominate the riparian zone. Uplands are forested with Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*) and aspen (*Populus tremuloides*) in the upstream section, and Gambel's oak (*Quercus gambelii*) and aspen in the lower section.

The upstream two miles of the Cow Creek PCA are within the Big Blue Wilderness Area. Along the creek are large cottonwoods, with good regeneration, large blue spruces, and thinleaf alder. Dense thickets of red-osier dogwood grow beneath the alders and slightly away from the creek. Where the canyon narrows, the cottonwoods drop out, while in wider places Rocky Mountain and Drummond's willows dominate the floodplain. Here, too, there are almost no exotic species present. Other common plants in the PCA include

Rocky Mountain maple (*Acer glabrum*), and twinberry honeysuckle (*Lonicera involucrata*). One small section has seeping cliffs with seep monkeyflower (*Mimulus* sp.), and New Mexican cliff ferns (*Woodsia neomexicana*).

Most disturbances in the PCA are from natural causes such as flooding and landslides. There are some impacts from grazing, hunting and mining in the downstream section, mostly in clearings in the forest, away from the riparian area. In general, the condition of the entire PCA is excellent.

Biodiversity Rank Justification:
The Cow Creek-Oben Creek Potential Conservation Area supports excellent examples of three state rare riparian communities. Elements occurring in the Cow Creek-Oben Creek PCA that are not specifically tied to the wetland and riparian habitat are discussed in detail in the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999).
Natural Heritage elements associated with wetlands at the Cow Creek-Oben Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia-Picea pungens/Alnus incana	**Montane riparian forest**	**G3**	**S3**			**A**
Populus angustifolia-Picea pungens/Alnus incana	Montane riparian forest	G3	S3			B
Abies lasiocarpa-Picea engelmannii/Mertensia ciliata	Montane riparian forests	G5	S5			A
Abies lasiocarpa-Picea engelmannii/Alnus incana	Montane riparian forests	G5	S5			A
Cypseloides niger	Black swift	G4	S3B			C

*EO = Element Occurrence

Boundary justification: The boundary is drawn to include the good condition riparian areas of Cow Creek and Oben Creek, to the confluence of Difficulty Creek. The PCA could be continued upstream, but was not included since that part was not visited in 1998 and its condition is unknown.

Protection Rank Justification: The PCA includes private, BLM and National Forest lands. The upstream portion of the PCA is protected as part of the Big Blue Wilderness. Private land downstream has no special protection and could be developed in the future. The BLM owns a small parcel, but this small section contains some excellent riparian vegetation. It is recommended that the BLM land should remain public property in order to protect it from development. A conservation easement is recommended for the riparian corridor on the private land
Management Rank Justification: Cattle grazing occurs on private, BLM and National Forest land. Present management appears to be good, although there are some severe weed infestations on National Forest land in areas used heavily by hunters. Participation in the certified weed free hay program is recommended for hunters using pack animals.

Wetland Function and Value Assessment for the Cow Creek-Oben Creek PCA (lower section):

Proposed HGM Class: Riverine. Subclass R2 Upper Perennial, subject to periodic flooding.

Cowardin System: Palustrine. Subsystem: Forested Wetland.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the Cow Creek-Oben Creek PCA (lower section only).

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	High	This large stretch of river with a high percent cover of scrub-shrub and forested vegetation yields a high capability to detain moving water.
Sediment/Shoreline Stabilization	High	High percent vegetative cover adjacent to a perennial stream gives a high ability to retain sediments and retain and remove nutrients and toxicants.
Groundwater Discharge/ Recharge	Low	No indicators of discharge/recharge noted.
Dynamic Surface Water Storage	High	A frequently flooded large stretch of river results in a high potential to capture water from precipitation and overland flow.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	Moderate	There is evidence of flooding and a high percent vegetative cover, but the wetland is not likely to receive an excessive sediment/nutrient load, and is therefore ranked moderate.
Biological Functions		
Habitat Diversity	High	The wetland site consists of scrub-shrub wetland, forested wetland and open water habitats.
Listed/Proposed/Candidate T&E Species Habitat	None	None known or suspected.
CO Natural Heritage Program Species Habitat	High	The wetland site supports an excellent occurrence of a montane riparian forest (*Populus angustifolia-Picea pungens/Alnus incana*), G3/S3.
General Wildlife Habitat	High	Deer, raptors and dippers were observed during the riparian site visit. Most vertebrate species that frequent the area are suspected to utilize riparian areas in the west.
General Fish/Aquatic Habitat	High	Native fish are suspected to utilize the perennial Cow and Oben Creeks.
Production Export/Food Chain Support	High	The large stretch of river with a moderate habitat diversity rating, presence of an outlet and perennial open water yields a high potential to produce and export food/nutrients.
Values		
Uniqueness	Low	This relatively common riparian community with moderate habitat diversity and some indirect disturbances has a low uniqueness rating.
Recreation/Education Potential	Low	Based on the moderate habitat diversity rating and the fairly remote location there is minimal recreational and educational opportunities.

General Soil Description

Texture	Alluvial soils with sand an cobbles
Color	N/A
Cobble Size	Variable
Percent Mottling	N/A

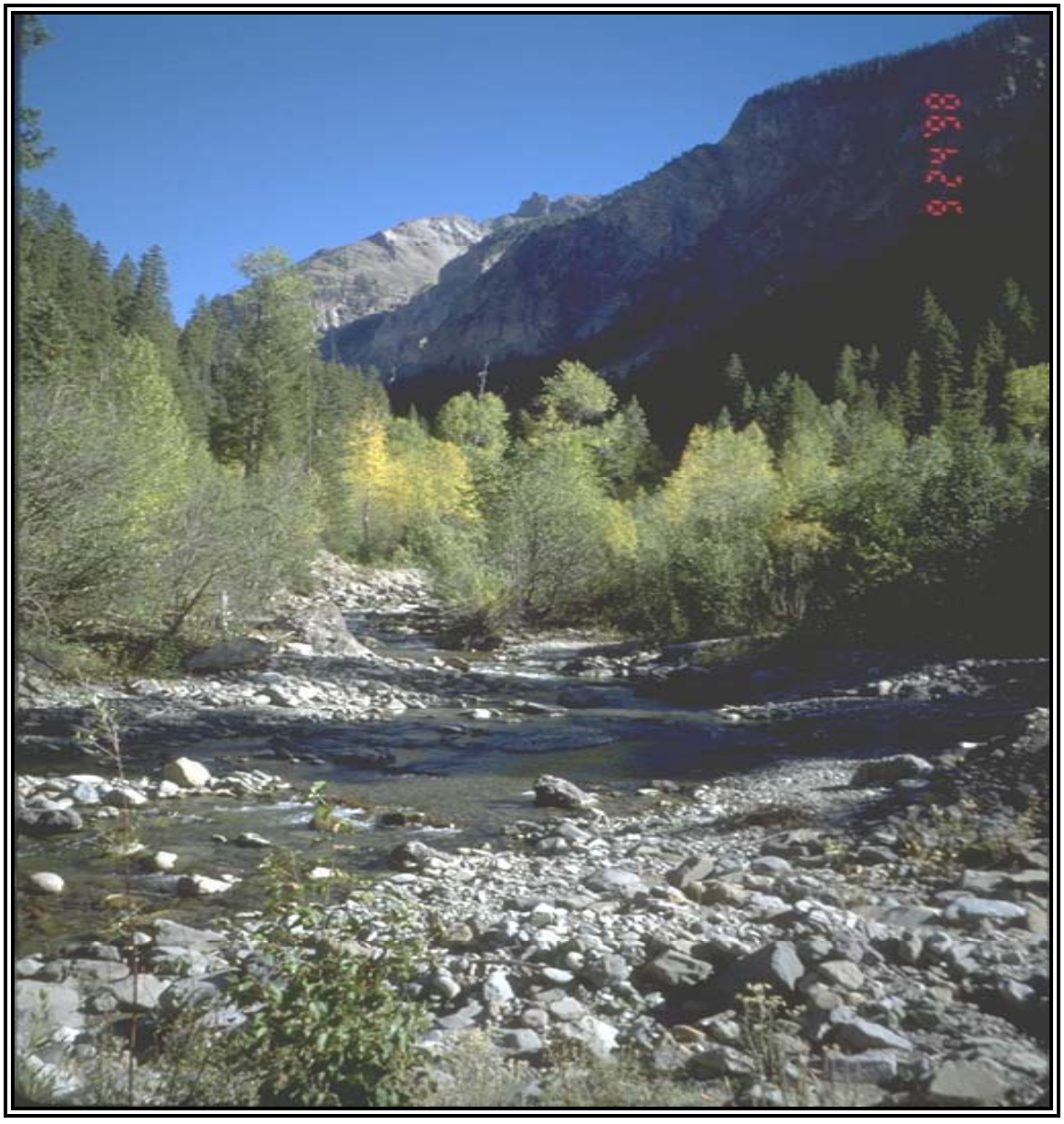
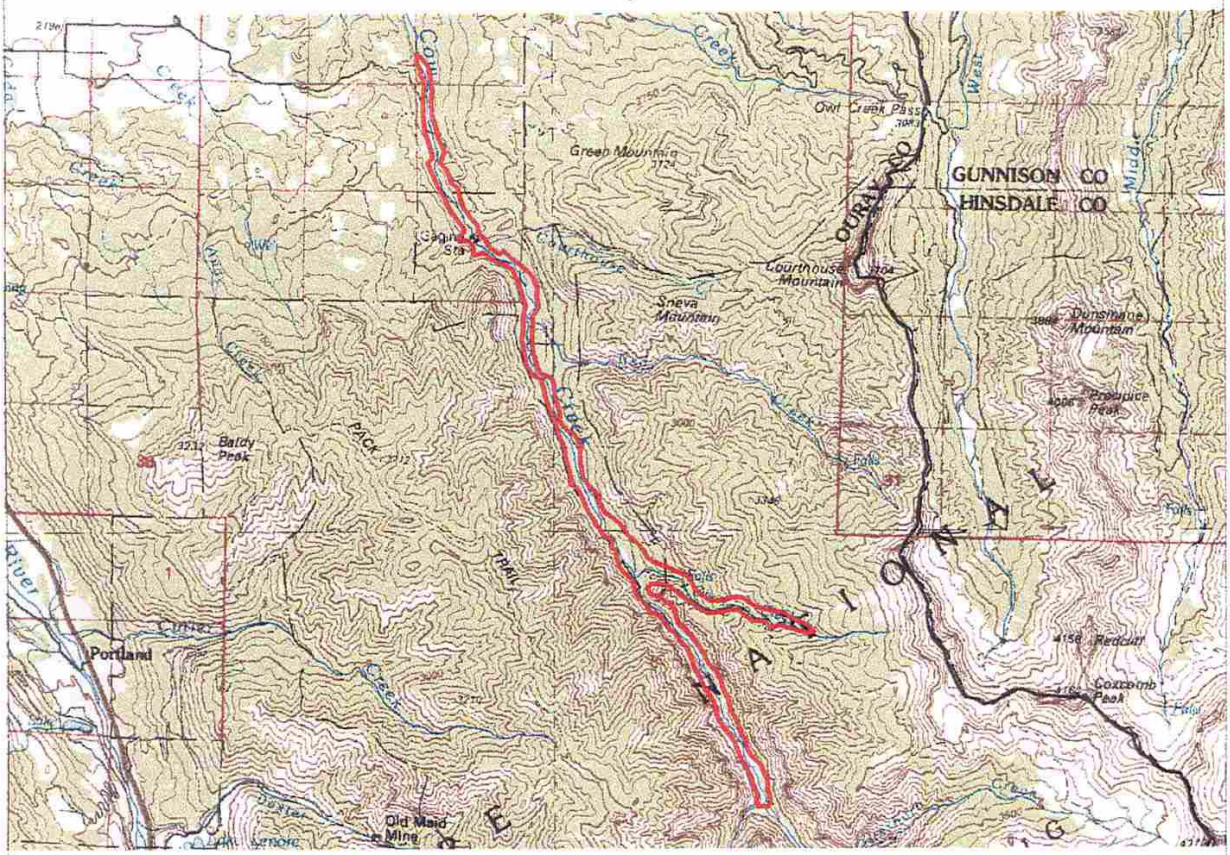


Figure 39. Riparian forest community at the Cow Creek-Oben Creek PCA

Cow Creek-Oben Creek

Potential Conservation Area

Biodiversity Rank: B2



Dallas, Ouray, and Wetterhorn Peak U.S.G.S. 7.5 min. Quadrangles

ELEMENT OCCURRENCES:

Abies lasiocarpa-Picea engelmannii/ Alnus incana ssp. tenuifolia

Abies lasiocarpa-Picea engelmannii/Mertensia ciliata

Populus angustifolia-Picea pungens/Alnus incana

Study Area Locator Map

N

0 0.3 0.6 0.9 1.2 1.5 Miles

Figure 40. Map of Cow Creek-Oben Creek PCA

Dexter Creek Potential Conservation Area

Biodiversity Rank: B3 (High significance)
The Dexter Creek PCA contains a good example of a lower montane riparian forest community rare in the state of Colorado.

Protection Urgency Rank: P5
The PCA is protected as part of the Big Blue Wilderness.

Management Urgency Rank: M3
There is a significant infestation of spruce budworm in the Douglas fir of this area. Although it may be part of a natural cycle, it should be monitored.

Location: Ouray County
U.S.G.S. 7.5 min. quadrangles: Ouray and Wetterhorn Peak
Legal Description: T44N R7W S 15-17, 20, 21

General description: The 521 acre Dexter Creek PCA is located on the eastern side of the Uncompahgre River Basin, on the slopes of the San Juan Mountains. Elevations range from 9,000 to 11,000 ft. (2,750 to 3,350 m). The PCA is in the Uncompahgre National Forest, and partly in the Big Blue Wilderness. Vegetation is a mosaic of forest communities that are typical of the Ouray area. Riparian species include narrowleaf cottonwood (*Populus angustifolia*), Rocky Mountain willow (*Salix monticola*), Drummond's willow (*Salix drummondiana*), and Rocky Mountain juniper (*Juniperus scopulorum*). The understory in riparian sites consists of a luxurious cover of Rocky Mountain maple (*Acer glabrum*), red-osier dogwood (*Cornus sericea*) and mosses grow in deep shade. There are a few weeds along the trail, including orchard grass (*Dactylis glomerata*), dandelion (*Taraxacum officinal*) and yellow sweet clover (*Melilotus officinal*), probably carried in by horses. Otherwise, there are few exotic species in the PCA. Spruce budworm moths and webs were observed on the new growth of Douglas fir (*Pseudotsuga menziesii*) throughout the area. There are several abandoned mines in the PCA. Natural disturbances in the PCA include landslides and avalanches.

Biodiversity Rank Justification: The Dexter Creek PCA contains a good example of a lower montane riparian forest community rare in the state of Colorado. Elements occurring in the Dexter Creek PCA that are not specifically tied to the wetland and riparian habitats are described in the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999).

Natural Heritage elements associated with wetlands at the Dexter Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Pseudotsuga menziesii/ Cornus sericea	**Lower montane riparian forests**	**G4**	**S2**			**B**

*EO = Element Occurrence

Boundary Justification: The boundary encompasses the forested area on the north side of the Dexter Creek drainage to encompass upland elements that are described in the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999), as well as the riparian habitat along Dexter Creek. This PCA is representative of a much larger area of forest in Ouray County. The PCA boundaries could probably be extended considerably with further investigation.

Protection Rank Justification: The PCA is protected as part of the Big Blue Wilderness.

Management Rank Justification: There is a significant infestation of spruce budworm in the Douglas fir of this area. Although it may be part of a natural cycle, it should be monitored.

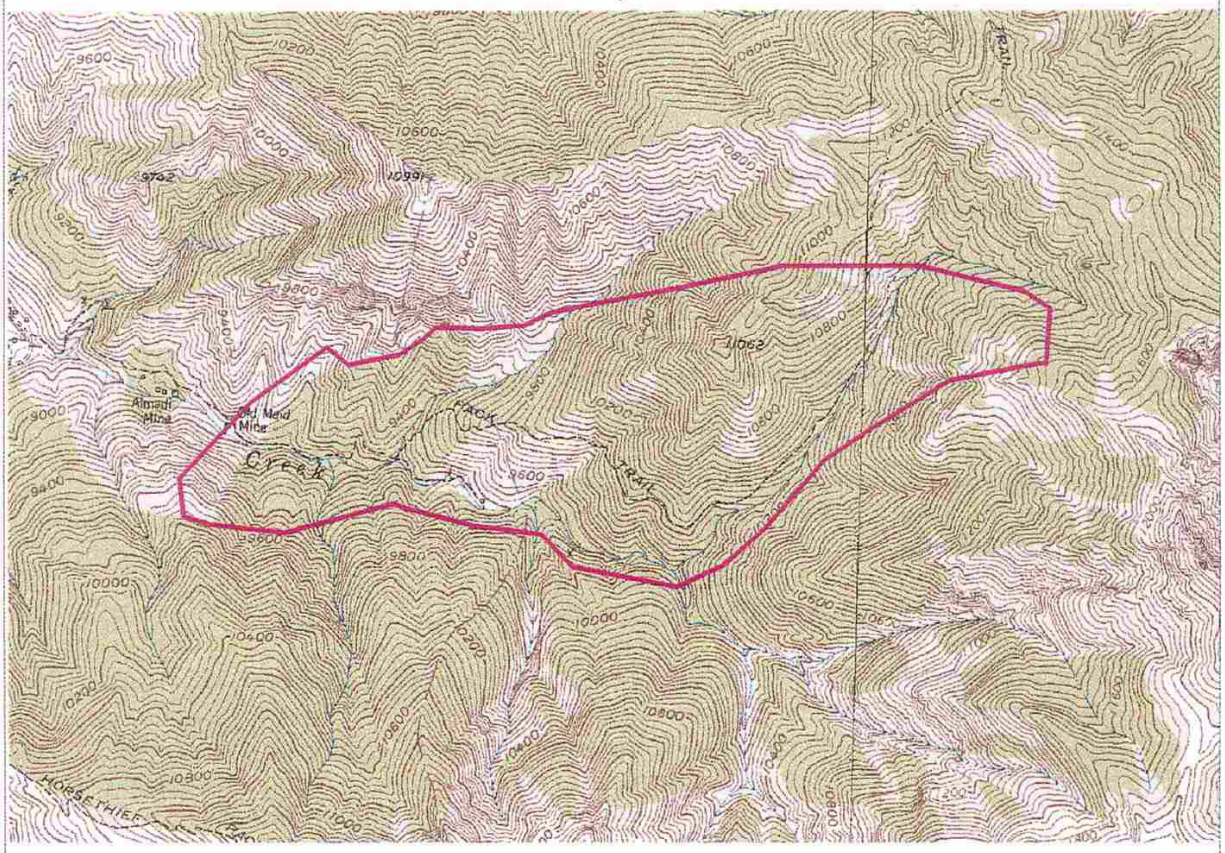
Wetland Function and Value Assessment for the Dexter Creek PCA:
Proposed HGM Class: Riverine. Subclass: R3 Middle Elevation Perennial, with seasonal flooding.
Cowardin System: Palustrine. Subclass: Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment Was Performed at the Dexter Creek PCA.

Dexter Creek

Potential Conservation Area

Biodiversity Rank: B3



Ouray and Wetterhorn Peak U.S.G.S. 7.5 min. Quadrangles

ELEMENT OCCURRENCE:

Pseudotsuga menziesii/Cornus sericea

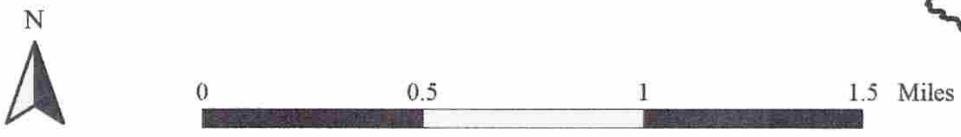


Figure 41. Map of Dexter Creek PCA

East Fork Dallas Creek

Biodiversity Rank: B3 (High significance)
The East Fork Dallas Creek PCA supports a fair occurrence of a globally vulnerable lower montane willow carr.

Protection Urgency Rank: P3
The East Fork Dallas Creek PCA is both privately and publicly owned. Approximately 2/3 of the PCA is under the jurisdiction of the Uncompahgre National Forest. The plans of the private landowner are unknown.

Management Urgency Rank: M2
This is an ideal site for restoration. An effort should be made to return this site back to its original ecological condition. Excluding cattle from the riparian area is recommended. It is likely that the wetland was once much larger, but has since been drained and seeded with pasture grasses.

Location: 7 air miles southwest of Ridgway on the East Fork of Dallas Creek. Take Highway 62 south 6 miles to 7 road. Head south approximately 7 mile to the East Fork Dallas Creek PCA.

U.S.G.S. 7.5 min. quadrangle: Mount Sneffels
Legal Description: T44N R9W Sections 13, 24

General Description: The 12 acre East Fork Dallas Creek PCA encompasses a riverine and depressional wetland complex occurring in a 1,000 foot (300 meter) wide valley on the East Fork of Dallas Creek. The PCA is approximately 80 acres at an elevation of 8,360 ft. (2,548 m). Beaver activity has created many large pools within the wetland site. A National Forest road used for range management and recreation borders the PCA. A parking lot at the northern edge of the East Fork Dallas Creek PCA provides access to several hiking trails in the surrounding spruce-fir forest uplands. The 1963 U.S.G.S. 7.5 min. quadrangle illustrates the wetland as occupying the entire width of the valley; however, the wetland is now narrow (approximately 160 ft. or 50 m), suggesting that the eastern portion of the wetland may have been converted to pasture. The section between the East Fork of Dallas Creek and the National Forest road has been seeded with hay grasses and is currently grazed.

Biodiversity Rank Justification: The East Fork Dallas Creek PCA supports a fair occurrence of a globally and state imperiled lower montane willow carr (*Salix drummondiana/ Calamagrostis canadensis*). This willow community is considered imperiled due to its rarity both globally and within the state of Colorado. The quality of the occurrence is only considered fair because of the abundance of introduced pasture grasses and weedy species.

Natural Heritage elements associated with wetlands at the East Fork Dallas Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Salix drummondiana/ Calamagrostis canadensis	**lower montane willow carr**	**G3**	**S3**			**C**

*EO=Element Occurrence

Boundary Justification: The boundary is drawn to encompass the present element occurrence and what is thought to be its historical extent to the east. The PCA includes both private and public lands. The boundary also provides a buffer from land use impacts (e.g., trail development and grazing) of at least 1,000 ft.. The PCA includes some riparian area upstream to preserve hydrologic function.

Protection Rank Justification: The East Fork Dallas Creek PCA is both privately and publicly owned. Approximately 2/3 of the PCA is under the jurisdiction of the Uncompahgre National Forest. The plans of the private landowner are unknown. There is currently no known threat of development in the area.

Management Rank Justification: Currently the wetlands are grazed on both private and public land. CNHP was not granted access to the private land, but a visual inspection from the road indicates grazing may be heavier than on adjacent public land. Excluding cattle from the riparian area is recommended. It is likely that the wetland was once much larger, but has since been drained and seeded with pasture grasses. Grazing continues to prevent the expansion of the willow community. This is an ideal site for restoration. An effort should be made to return this site back to its original ecological condition. There is currently beaver activity within the PCA, and management actions should be taken to maintain the population. A parking lot is located with in the public section of the PCA to allow for access to recreation trails. Recreation within the PCA is presently minimal, but use needs to be monitored.

Figure 42. Wetland communities at the East Fork Dallas Creek PCA

Wetland Function and Value Assessment for the East Fork Dallas Creek PCA:
Proposed HGM Class: Depressional. Subclass: D1 wetland with permanent flooding;
Class Riverine. Subclass R2, with seasonal flooding.
Cowardin System: Palustrine. Subsystem: Emergent and Scrub-Shrub Wetland.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the East Fork Dallas Creek PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	High	The wetlands large size (80 acres) and high percent scrub-shrub cover yields a high capability to detain moving water.
Sediment/Shoreline Stabilization	High	High percent vegetative cover adjacent to a perennial stream gives a high ability to dissipate flow and stabilize sediment, reducing erosion.
Groundwater Discharge/ Recharge	Unknown	There is insufficient information to determine whether the system performs discharge/recharge functions.
Dynamic Surface Water Storage	High	The wetlands large size and frequent flooding results in a high potential to capture water from precipitation, overland or subsurface flow.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	Moderate	There is evidence of flooding and ponding water and a high percent vegetative cover, but the wetland is not likely to receive an excessive sediment/nutrient load, is therefore ranked moderate.
Biological Functions		
Habitat Diversity	High	The wetland site consists of aquatic bed, scrub-shrub wetland and open water habitats.
Listed/Proposed/Candidate T&E Species Habitat	None	None known.
CO Natural Heritage Program Species Habitat	High	The wetland site supports a fair occurrence of lower montane willow carr (*Salix drummondiana/Calamagrostis canadensis*), G3/S3.
General Wildlife Habitat	High	Deer, beaver, raptors and flickers were observed during the wetland site visit with aquatic/semi-aquatic birds, northern leopard frogs and possible boreal toads suspected to utilize the site.
General Fish/Aquatic Habitat	High	There is a known native fish population in the perennial East Fork of Dallas Creek.
Production Export/Food Chain Support	High	A large wetland size (80 acres), high habitat diversity rating, presence of an outlet and perennial surface water yields a high potential to produce and export food/nutrients.
Values		
Uniqueness	Moderate	This wetland type is considered common within the boundaries of the study area and there is direct disturbance to the wetland site giving a moderate uniqueness rating.
Recreation/Education Potential	Moderate	The wetland, being directly disturbed by cattle grazing, has minimal recreational and educational opportunities as it is. However, the wetland is ideal as a potential restoration site, with potential to educate the public on restoration.

General Soil Description

Texture	Clay/loam
Color	10 YR 2/1
Cobble Size	Small pebbles
Percent Mottling	10%

Figure 43. Wetland communities at the East Fork Dallas Creek PCA

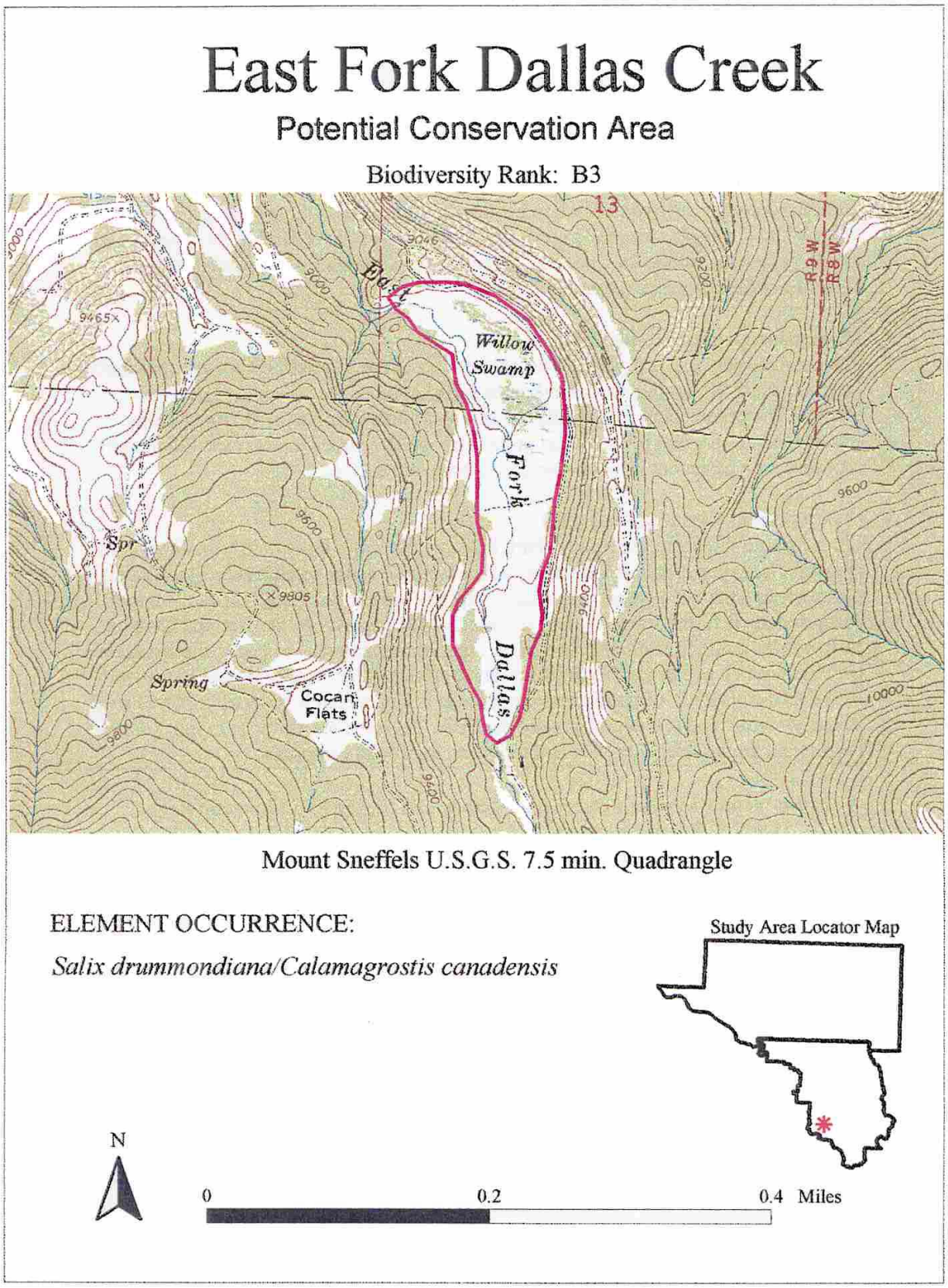


Figure 44. Map of East Fork Dallas Creek PCA

Ironton Park Potential Conservation Area

Biodiversity Rank: B3 (High significance)
The Ironton Park PCA supports a good occurrence of a bog birch subalpine riparian shrubland community considered to be rare throughout its range in the state of Colorado. The wetland complex may be a nutrient rich fen, a type of wetland that comprises only a small percentage of the total acreage of wetland in Colorado, and is essentially an irreplaceable ecological system.

Protection Urgency Rank: P1
Threat expected within 5 years. The northern $^{2}/_{3}$ of the Ironton Park PCA is privately owned, while the southern $^{1}/_{3}$ is under the jurisdiction of the Uncompahgre National Forest. The private land is currently for sale and under contract, with potential for development. Several preservation groups are seeking funds to purchase the property. A conservation easement is recommended to protect the PCA.

Management Urgency Rank: M3
Although no threats to the Ironton Park PCA are currently known, information on the biology, hydrology, and geochemistry of the wetland is not sufficient to specify what management may be needed to maintain improve the current quality of the element occurrence. If further investigation reveals that the integrity of the wetland has been affected by mining, road construction, or other human induced impacts, the Ironton Park PCA should be a high priority for restoration efforts. The PCA is bisected by a well-traveled designated Scenic Highway, and there is an accessible four-wheel drive road through public and private sections of the PCA. A recreation travel plan may be needed to prevent the proliferation of social trails and unofficial campsites.

Location: 6 miles south of Ouray on Highway 550 toward Red Mountain Pass.
U.S.G.S. 7.5 min. quadrangle: Ironton
Legal Description: T43N R7W S 19, 20, 29-31

General Description: The 420 acre Ironton Park PCA is located along Highway 550 at an elevation of 9,640 ft. (2,938 m) in an alluvium filled north facing glacial valley. The PCA encompasses approximately 300 acres of wetland, and supports a good example of a subalpine riparian shrubland community (*Betula glandulosa*/mesic forb-mesic graminoid). Portions of the wetland vegetation are dominated by bog-birch (*Betula Glandulosa*) 55%, with planeleaf willow (*Salix planifolia*) present. The understory is dominated by beaked sedge (*Carex utriculata*), with water sedge (*Carex aquatilis*), short-beaked sedge (*Carex simulata*), elephantella (*Pedicularis groenlandica*) water crowfoot (*Batrachium circinatum*), floating buttercup (*Ranunculus hyperboreus*), mare's tail (*Hipparus vulgaris*), hornwort (*Ceratophyllum demersum*) and water-milfoil (*Myriophyllum sibericum*) in the understory or growing in ponds. Spruce-fir and aspen forests grow on the steep hillsides above the valley floor.

Highway 550 bisects the occurrence, confining the once meandering Red Mountain creek to the eastern portion of the wetland. Full Moon Gulch is the main tributary feeding the

west side of the wetland and its five inactive beaver ponds. These ponds eventually drain into Crystal Lake, a constructed lake approximately of 14 acres with weedy berms and a controlled outlet. There is an open test pit and a mine tunnel opening on the west slope above the wetland. Drainage from the mine portal was measured to have an acidic pH of 4. Upstream from the Ironton Park PCA is the Idarado mine, which is in the process of stabilizing and revegetating its large tailings piles.

Four soil cores were taken in a transect from Full Moon Gulch to the highway. At each location, soils were found to have a high organic component, consisting of over 100 cm of fibric peat, smelling strongly of sulfur. pH was measured in the center of the wetland in the early fall, and found to be circumneutral (pH 6). Based on the organic composition of the soils, the groundwater driven hydrology, and the presence of woody vegetation that requires high nutrient availability, this wetland may fit the definition of a nutrient rich fen (USFWS 1998). The organic soils that characterize fens are formed by slow accumulation of plant debris in saturated conditions. Fens in the Rocky Mountains have particularly slow rates of decomposition due to the cold climate and limited growing season. The presence of iron pyrite and other iron bearing minerals in the mountains strongly suggest that the Ironton Park wetland may be an iron fen. An iron fen functions under distinctly different biogeochemical conditions than are normally found in fens which are limited by low concentrations of iron minerals. Iron fens are sometimes recognized by the flocculation and deposition of iron hydroxides "limonite", which result from the action on iron pyrite of microbes in anaerobic soils (Schlesinger 1991).

Further field investigation and research on the Ironton Park PCA is strongly recommended to determine the extent of peat soils, hydrologic dynamics, and biogeochemical processes. This additional information is necessary to make a complete ecological characterization of this complex system.

Biodiversity Rank Justification: Despite indirect (e.g., mining) and direct (e.g., road development) disturbances to the Ironton Park PCA, the system appears to have adjusted to a new equilibrium. The PCA is unusually large for this rare subalpine riparian shrubland community (*Betula glandulosa/mesic graminoid*), and the only community of this type found in the eastern Montrose-Ouray wetland survey. The wetland complex may be a nutrient rich iron fen, a type of wetland that comprises only a small percentage of the total acreage of wetlands in Colorado, and is essentially an irreplaceable ecological system (USFWS 1998).

Natural Heritage elements associated with wetlands at the Ironton Park PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Betula glandulosa/mesic forb-mesic graminoid	**Subalpine riparian shrubland**	**G3G4**	**S3**			**B**

*EO=Element Occurrence

Boundary Justification: The boundary is drawn to encompass the element occurrence and provide a buffer from land use impacts (e.g., road development and recreation) of at least 1,000 ft. The boundary includes some riparian area upstream to preserve hydrologic

function. A much larger area should be considered in any long-term management or protection plan because of the extent of past mining activity throughout the upper basin.

Protection Rank Justification: The northern $^{2}/_{3}$ of the Ironton Park PCA is privately owned, while the southern $^{1}/_{3}$ is under the jurisdiction of the Uncompahgre National Forest. The private land is currently for sale and under contract. Plans of the potential owners are not known, but there has been discussion of developing the area into a condominium or resort complex. Many fens in Colorado are over 10,000 years old, with rates of peat accumulation ranging from 13 to 41 cm per thousand years (USFWS 1998). Because of the geologic time scale necessary for fen formation, fens should be considered a truly irreplaceable resource, and the protection of all fens has been made a top priority for the USFWS in the Rocky Mountain Region (USFWS 1998). A conservation easement is recommended to protect the elements of concern, to preserve open space values, and to maintain critical wetland function.

Management Rank Justification: No threats to the Ironton Park PCA are currently known; however, information on the biology, hydrology, and geochemistry of the wetland is not sufficient to specify what management may be needed in the future to maintain or improve the current quality of the element occurrence

Although the natural communities appeared to be healthy, there may be impacts from past mining activity, the construction of the highway and confinement of Red Mountain Creek that were not evident in a brief site visit. Given the irreplaceable nature of the wetland, further investigation of the ecology of the site is crucial. If the wetland has suffered negative impacts from human land use actions, it would be an excellent candidate for restoration. The USFWS has stated that opportunities for restoration of fens should be an area of the agencies' focus for partnership opportunities with other agencies, citizen's organizations, and private landowners (USFWS 1998).

Recent research has revealed the important role wetlands play in treating acid mine drainage and improving water quality by removing metals through the anaerobic action of sulfate-reducing bacteria (Webb et al. 1997). Wetland vegetation of birch and willow has also been shown effective in collecting heavy metals resulting from above mine operation (Webb et al. 1998). The Ironton Park PCA is in a position to help mitigate negative environmental impacts resulting from the extensive mining in the area. It is possible that wetland function in this capacity could be enhanced, therefore management plans for the entire upper Red Mountain Creek basin should take into consideration the critical wetland functions of the Ironton Park PCA.

A travel management plan may be needed to regulate campsite and social trail proliferation along the four-wheel drive road. There are currently several unofficial campsites on public lands. Sections of this road could be closed to motor vehicle traffic, and designated as a nature trial with interpretive signs to educate the public about the importance of wetland ecosystems. The establishment and maintenance of a beaver population should also be encouraged through management actions.

Wetland Function and Value Assessment for the Ironton Park PCA:
Proposed HGM Class: Depressional. Subclass: D1 wetland with permanent to seasonal saturation.
Cowardin System: Palustrine. Subsystem: Emergent and Scrub-Shrub.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the Ironton Park PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	High	The wetlands enormous size (300 acres), scrub-shrub vegetation, Red Mountain Creek and multiple tributaries flowing into and through the wetland site combine to give the system a high capability to detain moving water.
Sediment/Shoreline Stabilization	High	High vegetative cover adjacent to the perennial Red Mountain Creek yields a high ability to dissipate flow and stabilize sediment, reducing erosion.
Groundwater Discharge/ Recharge	High	The Ironton Park site is a relict glacial lake that was filled with lake sediment alluvium and landslide debris (Blair 1996) and is therefore capable of storing a large quantity of water that sustains a high water table and contributes to the perennial flow of the Red Mountain Creek.
Dynamic Surface Water Storage	High	The large wetland area (300 acres) with a high flood frequency yields a high potential to capture water form precipitation, overland or subsurface flow.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	High	In addition to flooding evidence, presence of a restricted outlet, and a high percent vegetative cover, the wetland receives direct discharge from multiple mines and tailings piles giving the site a high potential to retain sediments and retain and remove nutrients and toxicants.
Biological Functions		
Habitat Diversity	Very High	The wetland site consists of aquatic bed, emergent wetland, scrub-shrub wetland and open water habitats.
Listed/Proposed/Candidate T&E Species Habitat	None	None known or suspected.
CO Natural Heritage Program Species Habitat	High	The wetland site supports a good occurrence of a subalpine riparian shrubland community (*Betula glandulosa/mesic graminoid*), G2G3/S2S3.
General Wildlife Habitat	High	Mallards, sandpipers, deer, coyote and freshwater shrimp were observed during the wetland site visit with more species suspected to utilize the area, i.e., non-aquatic birds and possible beaver although there is no recent activity.
General Fish/Aquatic Habitat	N/A	Red Mountain Creek does not provide habitat for fish due to its naturally high heavy metal concentrations and sediment load.
Production Export/Food Chain Support	High	The wetlands large size (300 acres), high habitat diversity rating, presence of an outlet, and perennial surface water all contribute to the high potential to produce and export food/nutrients.

Function	Ratings	Comments
Values		
Uniqueness	High	The wetland is considered rare due to its enormous size, unique plant community, possible classification as a fen, and the habitat diversity is high; however, the site is directly disturbed by Highway 550.
Recreation/Education Potential	Medium	Since the wetland is mostly privately owned and directly disturbed the ranking for recreation and educational opportunities is low under current conditions. However, the close proximity to a heavily traveled scenic highway makes the Ironton Park site an ideal spot for educational nature trails with interpretive signs on the ecology and importance of Colorado's wetlands.

General Soil Description

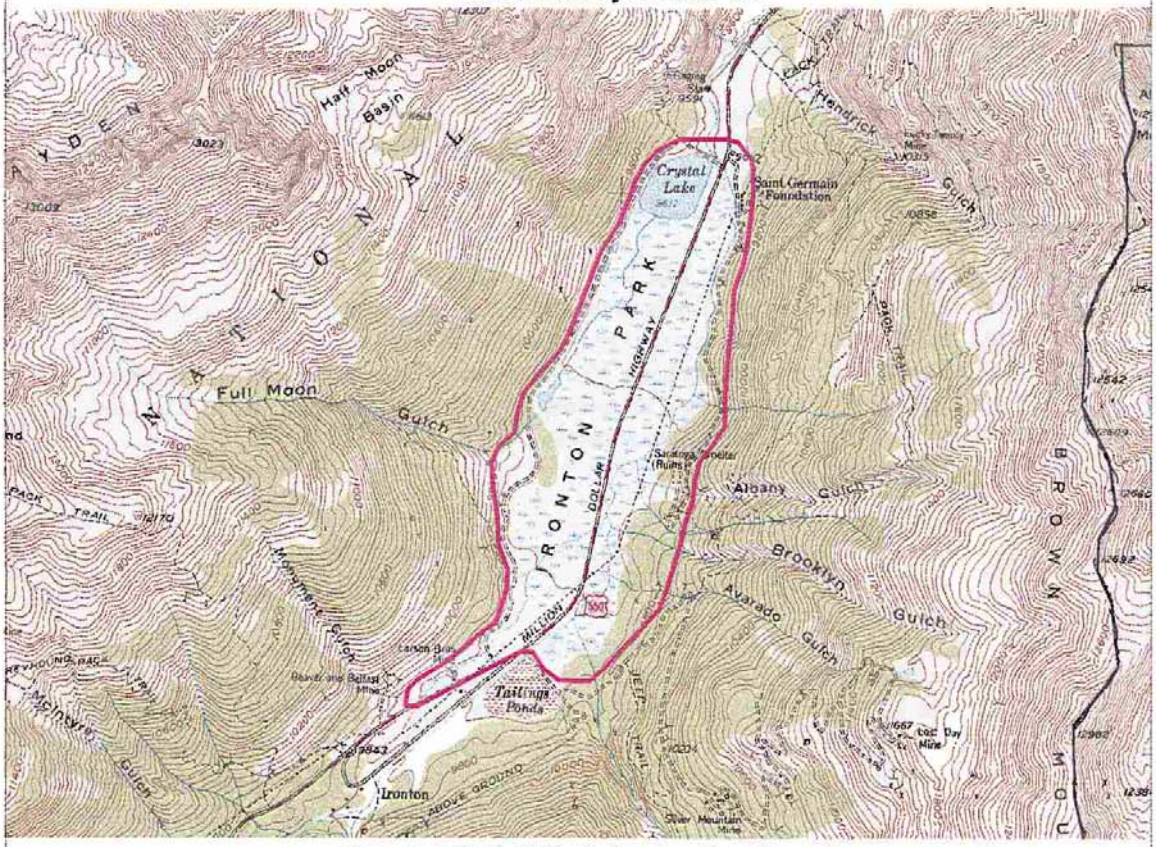
Texture	Thick peat (>100 cm), strong sulfur smell, with small clay lens. pH 6 in wetland water
Color	Black
Cobble Size	N/A
Percent Mottling	N/A

Figure 45. Wetland communities at the Ironton Park PCA

Ironton Park

Potential Conservation Area

Biodiversity Rank: B3



Ironton U.S.G.S. 7.5 min. Quadrangle

ELEMENT OCCURRENCE:

Betula occidentalis/mesic forb-mesic graminoid

Study Area Locator Map

N

0 0.1 0.2 0.3 0.4 0.5 Miles

Figure 46. Map of Ironton Park PCA

Nate Creek Potential Conservation Area

Biodiversity Rank: B3 (High significance)
The Nate Creek PCA contains a good example of a montane riparian forest, and a subspecies of native Colorado River cutthroat trout vulnerable throughout their ranges.

Protection Urgency Rank: P3
The upper part of this PCA is within the Uncompahgre National Forest, and has no other special designation. The lower half is on private land. Any additional water diversions upstream could impact the riparian community.

Management Urgency Rank: M3
Sediments from the road, especially at the creek crossing, may affect the quality of the lower riparian area. Cattle along the Owl Creek Road were observed eating a rare and imperiled species of wild hollyhocks. The long-term effects of grazing on the population are not known, but it is reasonable to assume that effects are detrimental to the plants, and they should be protected from grazing pressure.

Location: Ouray County
U.S.G.S. 7.5 min. quadrangles: Dallas, Courthouse Mountain
Legal Description: T45N R7W S 1-3, 12; T46N R7W S 32-36

General Description: Nate Creek is a tributary of Cow Creek, draining a portion of the west side of Cimarron Ridge. The 545 acre PCA ranges in elevation from 7,440 to 9,400 ft. (2,270 to 2,870 m). The Owl Creek Road parallels the creek, but does not seem to have much negative impact on the riparian zone below. The narrow canyon supports a diverse riparian community dominated by narrowleaf cottonwood (*Populus angustifolia*) and blue spruce (*Picea pungens*). Regeneration of cottonwoods appears to be good. Thinleaf alder (*Alnus incana*) and red-osier dogwood (*Cornus sericea*) line the stream bank. Other riparian species present include coyote willow (*Salix exigua*), Rocky Mountain willow (*Salix monticola*), box elder (*Acer negundo*), and Rocky Mountain maple (*Acer glabrum*). Red top (*Agrostis stolonifera*), Canada wild rye (*Elymus elymoides*), and horsetails (*Equisetum arvense*) grow in wetlands with standing water. Although there are some cattle trails and clearings that have weedy exotic species, the majority of the area is in good condition. Exotic species noted include yellow sweet clover (*Melilotus officinal*), timothy (*Phleum pretense*), hound's tongue (*Cynoglossum officinale*), Kentucky bluegrass (*Poa pratensis*), and Canada thistle (*Cirsium arvense*). Downstream from the PCA there are several water diversions, and nearly all water is removed from the creek before it reaches Cow Creek.

As one travels upstream along the creek, aspen (*Populus tremuloides*) and snowberry (*Symphoricarpos oreophilus*) become more abundant. Major understory species here include Oregon grape (*Mahonia rapines*) elk sedge (*Carex geyeri*) and common juniper (*Juniperus communis*). There was abundant bear sign in the upper canyon. At the higher

elevations, uplands have Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*) and aspen. Although there is some bank erosion and minor grazing impacts, the stream was determined by the Forest Service to be in proper functioning condition. The Forest Service identified by sight native Colorado River cutthroat trout in the upper reaches of Nate Creek during 1998. Research has not yet been completed to ascertain the genetic purity of the population.

Along the Owl Creek Road, above Nate Creek, is the largest population of wild hollyhock (*Iliamna grandiflora*) (G3/S1) known in the Uncompahgre River Basin, and perhaps the largest in Colorado. Over one hundred healthy clumps of these showy plants grow along the roadside, on a steep north facing slope in moist spruce, fir and aspen forest. The plants appear to benefit from the increased light and moisture from the road, as few plants were found away from disturbed areas. We noted that cattle had grazed the tops of several plants. The long-term effects of grazing are not known.

Biodiversity Rank Justification: The Nate Creek PCA contains a good example of a montane riparian forest vulnerable throughout its range. Elements occurring in the Nate Creek PCA that are not specifically tied to the wetland and riparian habitat are profiled in the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999).

Natural Heritage elements associated with wetlands at the Nate Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia-Picea pungens/Alnus incana	**Montane riparian forest**	**G3**	**S3**			**B**
Oncorhynchus clarki pleuriticus	Colorado River cutthroat trout	G5T3	S3	FS	SC	N/A

*EO = Element Occurrence

Boundary Justification: The boundary is drawn to include both the riparian vegetation of Nate Creek and the site of the wild hollyhock along the Owl Creek Road.

Protection Rank Justification: The upper part of this PCA is within the Uncompahgre National Forest, and has no other special designation. The lower half is on private land. Any additional water diversions upstream could impact the riparian community

Management Rank Justification: Sediments from the road, especially at the creek crossing, may affect the quality of the lower riparian area. Cattle along the Owl Creek Road were observed eating a rare and imperiled species of wild hollyhocks. The long-term effects of grazing on the population are not known, but it is reasonable to assume that effects are detrimental to the plants, and they should be protected from grazing pressure.

Wetland Function and Value Assessment for the Nate Creek PCA.

Proposed HGM Class: Riverine. Subclass: R3 Middle Elevation Perennial, with seasonal flooding.

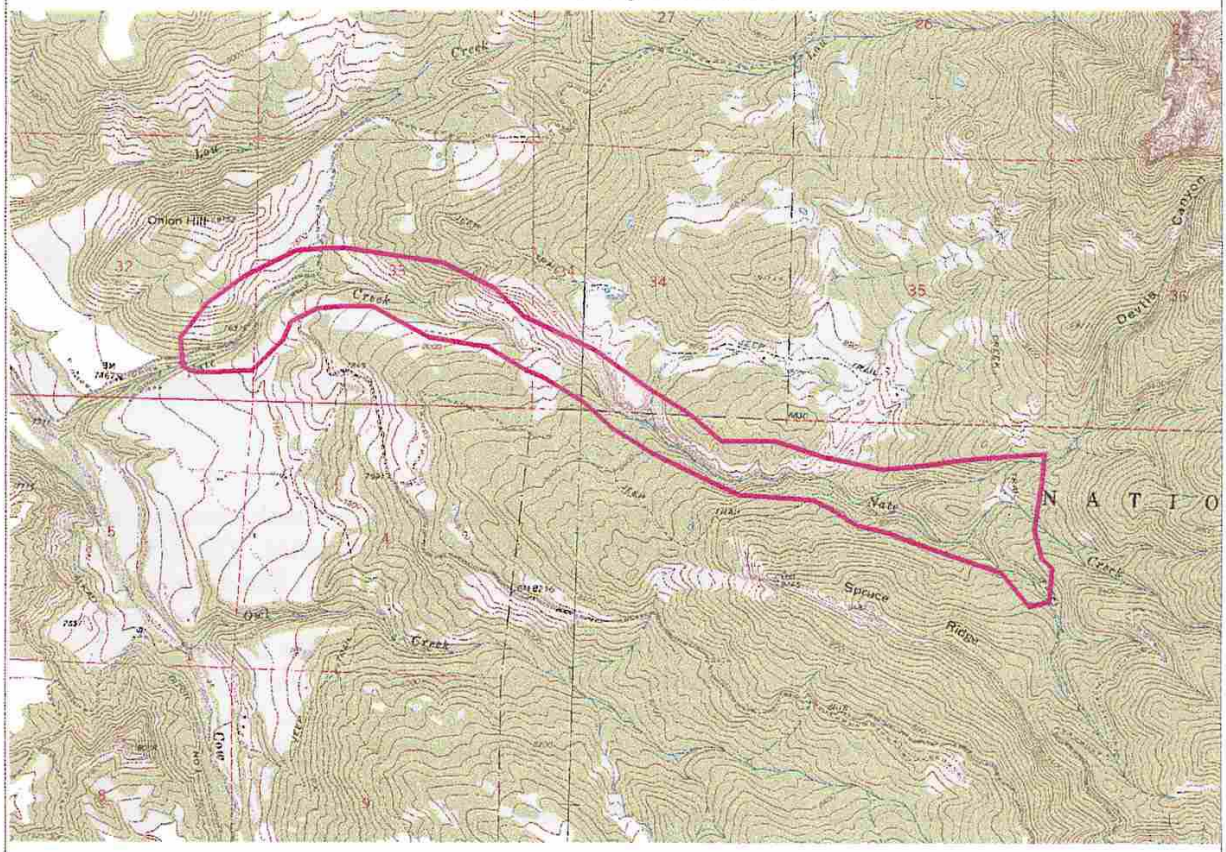
Cowardin System: Plaustrine. Subsystem: Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment Was Performed at the Nate Creek PCA.

Nate Creek

Potential Conservation Area

Biodiversity Rank: B3



Courthouse Mountain and Dallas U.S.G.S. 7.5 min. Quadrangles

ELEMENT OCCURRENCE:

Populus angustifolia-Picea pungens/
Alnus incana ssp. tenuifolia

Study Area Locator Map

N

0 0.3 0.6 0.9 1.2 1.5 Miles

Figure 47. Map of Nate Creek PCA

Red Creek Potential Conservation Area

Biodiversity Rank: B3 (High significance)
The Red Creek PCA contains excellent examples of two montane riparian forests and a riparian shrubland considered vulnerable throughout their range.

Protection Urgency Rank: P5
This PCA is protected as part of the Big Blue Wilderness, and is remote, with no roads or trails.

Management Urgency Rank: M5
Present management is adequate. Although cattle are not fenced out, they apparently do not get into the canyon.

Location: Ouray County
U.S.G.S. 7.5 min. quadrangles: Courthouse Mountain, Dallas and Wetterhorn Peak
Legal Description: T45N R7W S 25-27, 36

General description: The Red Creek drainage, a tributary to Cow Creek, contains small relict populations of at least three significant riparian plant communities. The 203 acre PCA ranges in elevation from 8,200 to 10,000 ft. (2,500 to 3,050 m). The canyon is narrow and twisted with red sandstone cliffs on the south facing walls, and dense forest on the north slopes. The PCA is within the Big Blue Wilderness of the Uncompahgre National Forest. The narrow stream floods frequently in the spring, and carries heavy debris loads. The flood plain is surprisingly wide for the stream width. Disturbance in the PCA is natural, caused by slipping of the adjacent steep cliffs of sandstone, rhyolite and conglomerates. Much of the riparian vegetation is removed during flood events, and consists of small patches, but they are healthy and reproducing. There are no trails in the PCA, and there is no evident human disturbance. Common trees of the area are narrowleaf cottonwood, blue spruce, white fir and subalpine fir. Thinleaf alder, twinberry honeysuckle and red-osier dogwood grow by the stream. Some areas have a rich cover of mosses and liverworts. There are almost no exotic species.

Biodiversity Rank Justification: The Red Creek PCA contains excellent examples of two montane riparian forests and a riparian shrubland considered vulnerable throughout their range.
Natural Heritage elements associated with wetlands at the Red Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus angustifolia*/*Alnus incana	**Montane riparian forests**	**G3**	**S3**			**A**
Alnus incana/mesic forb	Thinleaf alder/mesic forb riparian shrublands	G3G4Q	S3			B
Abies lasiocarpa-Picea engelmannii/*Alnus incana*	Montane riparian forests	G5	S5			A

*EO = Element Occurrence

Boundary Justification: The boundary is drawn to include the riparian communities and fluvial processes along Red Creek.

Protection Rank Justification: This PCA is protected as part of the Big Blue Wilderness, and is remote, with no roads or trails.

Management Rank Justification: Present management is adequate. Although cattle are not fenced out, they apparently do not get into the canyon.

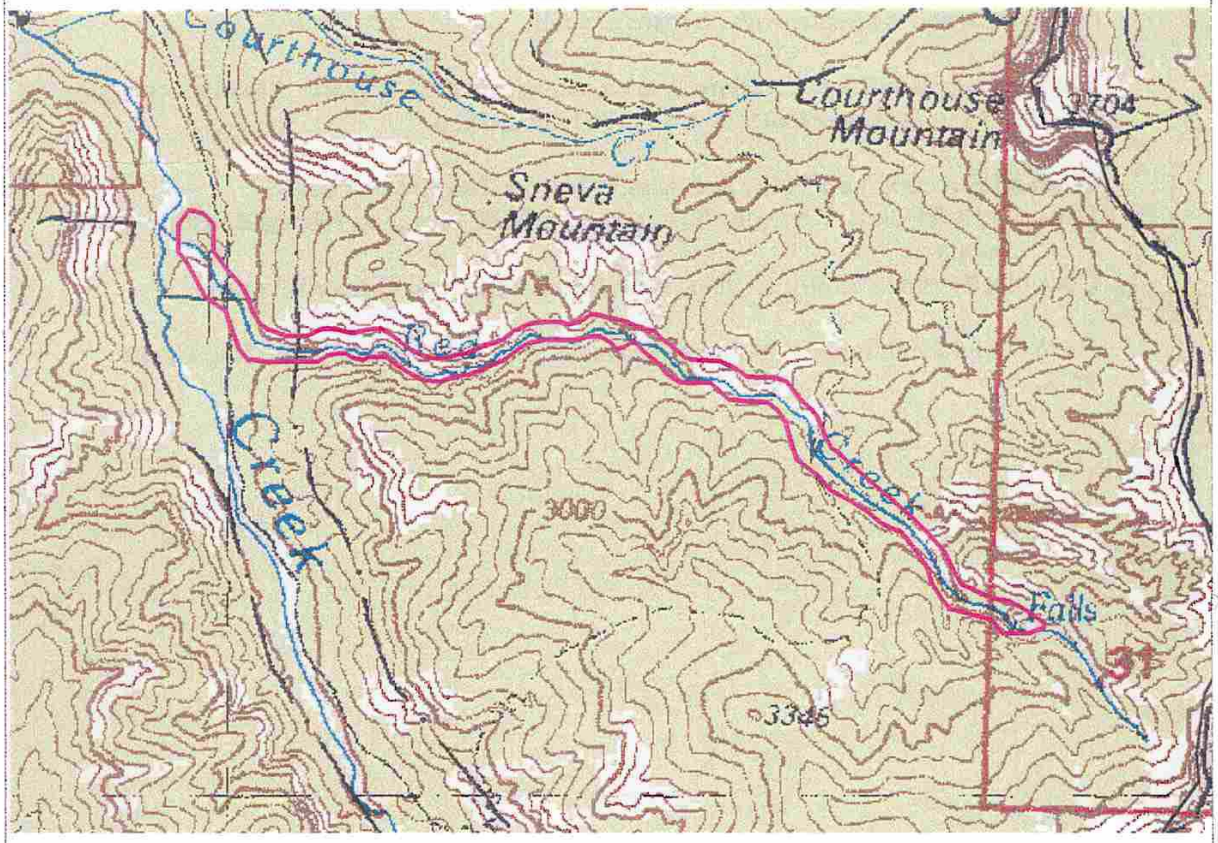
Wetland Function and Value Assessment for the Red Creek PCA.
Proposed HGM Class: Riverine. Subclass: R3 Middle Elevation Perennial, with seasonal flooding.
Cowardin System: Palustrine. Subsystem: Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment Was Performed for the Red Creek PCA.

Red Creek

Potential Conservation Area

Biodiversity Rank: B3



Courthouse Mountain, Dallas and Wetterhorn Peak U.S.G.S. 7.5 min. Quadrangles

ELEMENT OCCURRENCE:

Abies lasiocarpa-Picea engelmannii/ Alnus incana ssp. tenuifolia

Alnus incana ssp. tenuifolia/mesic forb

Populus angustifolia/Alnus incana ssp. tenuifolia

Study Area Locator Map

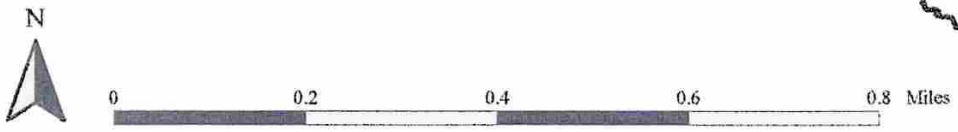


Figure 48. Map of Red Creek PCA

West Dallas Creek Potential Conservation Area

Biodiversity Rank: B3 (High significance)
The West Dallas Creek PCA supports three good examples of communities of concern: a rocky mountain willow montane riparian willow carr considered to be vulnerable throughout its range in the state of Colorado, a beaked sedge montane perched wetland considered vulnerable both globally and within its range in the state of Colorado, and a globally secure montane riparian forest. It also has an example of a more common montane riparian forest community in good condition.

Protection Urgency Rank: P4
The PCA is mostly within the boundaries of the Uncompahgre National Forest, but does include some private land.

Management Urgency Rank: M3
Management actions need to be taken within the next five years in order to maintain the current quality of the element occurrences and hydrologic function. Cattle grazing in the immediate area is having a negative impact on hydrologic function and community viability. Actions could include limiting cattle access to the riparian area.

Location: 12 air miles southwest of the town of Ridgway, Colorado. From Ridgway, take Highway 62 south 6 miles to 9 road. Head south for 7 miles to the Dallas foot trail. Follow the trail west for approximately ½ mile, then hike upstream on the West Fork of Dallas Creek ¼ mile to the site.

U.S.G.S. 7.5 min. quadrangle: Mount Sneffels, Sams
Legal Description: T44N R9W S 20, 21

General Description: The 29 acre West Dallas Creek PCA encompasses a 20 acre wetland complex found at an elevation of 9,520 ft. (2,902 m). The wetland is located in a north facing hillside depression at the convergence of two unnamed tributaries of the West Fork of Dallas Creek. The PCA encompasses three shallow depressional wetlands created by past beaver activity, a slope wetland (*Carex utriculata*-perched wetland) with several springs, and a montane riparian willow carr (*Salix monticola/*mesic forb). Elk heavily browse the willows. A Spruce fir-Engelman spruce/ bluebell (*Abies lasiocarpa-Picea engelmannii/Mertensia ciliata*) montane riparian forest grows allong the stream bank. Upland vegetation is a spruce-fir forest. There is little evidence of human activity directly on the site, with the nearest 4WD road and foot path passing ¼ mile from the PCA.

The montane riparian forest plant community is a good example of its type, with extensive forb cover and little or no shrubs and graminoids. Major forb species are bittercress, bluebells, triangle-leaf groundsel, willow-herb, and cowbane. There are many log jams in the creek, and rocks and downed wood are covered with mosses. Deeply shaded areas in the spruce and Douglas fir on the hillsides have an understory of mountain lover, one-sided wintergreen, rattlesnake plantain, and picture-leaf wintergreen.

Pictureleaf wintergreen was a species tracked by CNHP until this year, and is now watchlisted. Parts of the creek have been fenced from livestock.
In less good condition are the parts of the PCA near a four-wheel drive road. Open areas such as West Dallas Creek have been heavily grazed by livestock and elk. The Dallas trail goes through the PCA, and provides access for hiking and hunting. Upland vegetation is a spruce-fir forest.

Biodiversity Rank Justification: The West Dallas Creek PCA is relatively undisturbed by humans and supports three CNHP communities of concern. The montane riparian willow carr (*Salix monticola/*mesic forb) is a good occurrence of a community recognized as vulnerable throughout its range and in the state of Colorado. The PCA also supports a good example of a globally vulnerable beaked sedge montane perched wetland (*Carex utriculata*- perched wetland) community. Although the later community contains common vegetation, the fact that it occurs as a slope wetland with several springs makes it a unique wetland in Colorado. This beaked sedge montane perched wetland (*Carex utriculata*- perched wetland) community is considered vulnerable both globally and within its range in the state of Colorado. The meadow component of this wetland site contains some weedy and introduced species including: Canada thistle (*Cirsium arvense*), mullein (*Verbascum thapsus*) and Kentucky bluegrass (*Poa pratensis*).

This mosaic of communities is potential habitat for the boreal toad (*Bufo boreas boreas*). Boreal toads occupy pond margins, willow carrs, wet meadows, and riparian areas between 8,000 and 11,940 ft. (2,440-3,640 m) (Pague et al. 1997)

Natural Heritage elements associated with wetlands at the West Dallas Creek PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
***Salix monticola/* mesic forb**	**montane riparian willow carr**	**G3**	**S3**			**B**
Carex utriculata-perched wetland	beaked sedge perched wetland	G3	S3			B
Abies lasiocarpa-Picea engelmannii/Mertensia ciliata	montane riparian forests	G5	S5			B

*EO=Element Occurrence

Boundary Justification: The boundary is drawn to encompass the elements and provide a buffer from land use impacts (e.g., trail development, logging and grazing) of at least 1,000 ft. The boundary includes some riparian area upstream to preserve hydrologic function.
Protection Rank Justification: The PCA is mostly within the boundaries of the Uncompahgre National Forest, but does include some private land.
Management Rank Justification: The Forest Service management plan is unknown. Cattle grazing in the area are having a negative impact on hydrologic function and community viability. The riparian area immediately downstream has been over used by cattle, altering vegetation and channel morphology. Actions could include limiting cattle access to the riparian area.

Wetland Function and Value Assessment for the West Dallas Creek PCA:
Proposed HGM Class: Slope. Subclass: S1. Class: Depressional. Subclass: D1 with permanent saturation from springs.
Cowardin System: Palustrine. Subsystem: Emergent and Scrub-Shrub Wetland.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the West Dallas Creek PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	High	The large wetland size (20 acres) with moderate forested or scrub-shrub vegetative cover yields a high capability to detain moving water from in-channel or overbank flow, regardless of an unrestricted outlet.
Sediment/Shoreline Stabilization	High	High vegetative cover along a perennial stream results in a high ability to dissipate flow and stabilize sediment, reducing erosion.
Groundwater Discharge/ Recharge	High	Multiple perennial seeps and springs over a permeable substrate yields a high potential for groundwater discharge and recharge.
Dynamic Surface Water Storage	High	A large wetland (20 acres) that frequently floods has a high potential to capture water from precipitation, overland and subsurface flow.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	Moderate	There is evidence of flooding and ponding water and a high percent vegetative cover, but the wetland is not likely to receive an excessive sediment/nutrient load, and is therefore ranked moderate.
Biological Functions		
Habitat Diversity	Very High	The wetland site consists of aquatic bed, emergent wetland, scrub-shrub, and open water habitats.
Listed/Proposed/Candidate T&E Species Habitat	None	None known.
CO Natural Heritage Program Species Habitat	High	The wetland site supports two good examples of communities of concern; a montane riparian willow carr (*Salix monticola*/mesic forb),G3/S3, and a beaked sedge montane perched wetland (*Carex utriculata* -perched wetland), G3/S3.
General Wildlife Habitat	High	Elk, deer, muskrat and various butterflies were observed during the wetland site visit, and many other species are suspected to utilize the area, i.e., aquatic/semi aquatic and non-aquatic birds and possible boreal toads.
General Fish/Aquatic Habitat	None	This wetland does not supply habitat for fish.
Production Export/Food Chain Support	High	A large wetland size (20 acres), very high habitat diversity ranking, presence of an outlet and perennial surface water yields a high potential to produce and export food/nutrients.

Function	Ratings	Comments
Values		
Uniqueness	High	Even though the wetland has some disturbance by grazing cattle, the presence of a fen (a constantly wet vegetative community with >80 cm peat accumulation), increases the uniqueness rating to high.
Recreation/Education Potential	Low	Based on the wetlands remote location there are minimal recreation and educational opportunities.

General Soil Description

Texture	Peaty, hemic to at least 80 cm, then clay
Color	Clay 5Y 4/1
Cobble Size	N/A
Percent Mottling	N/A

Figure 49. Wetland communities at the West Dallas Creek PCA

Figure 50. Wetland communities at the West Dallas Creek PCA

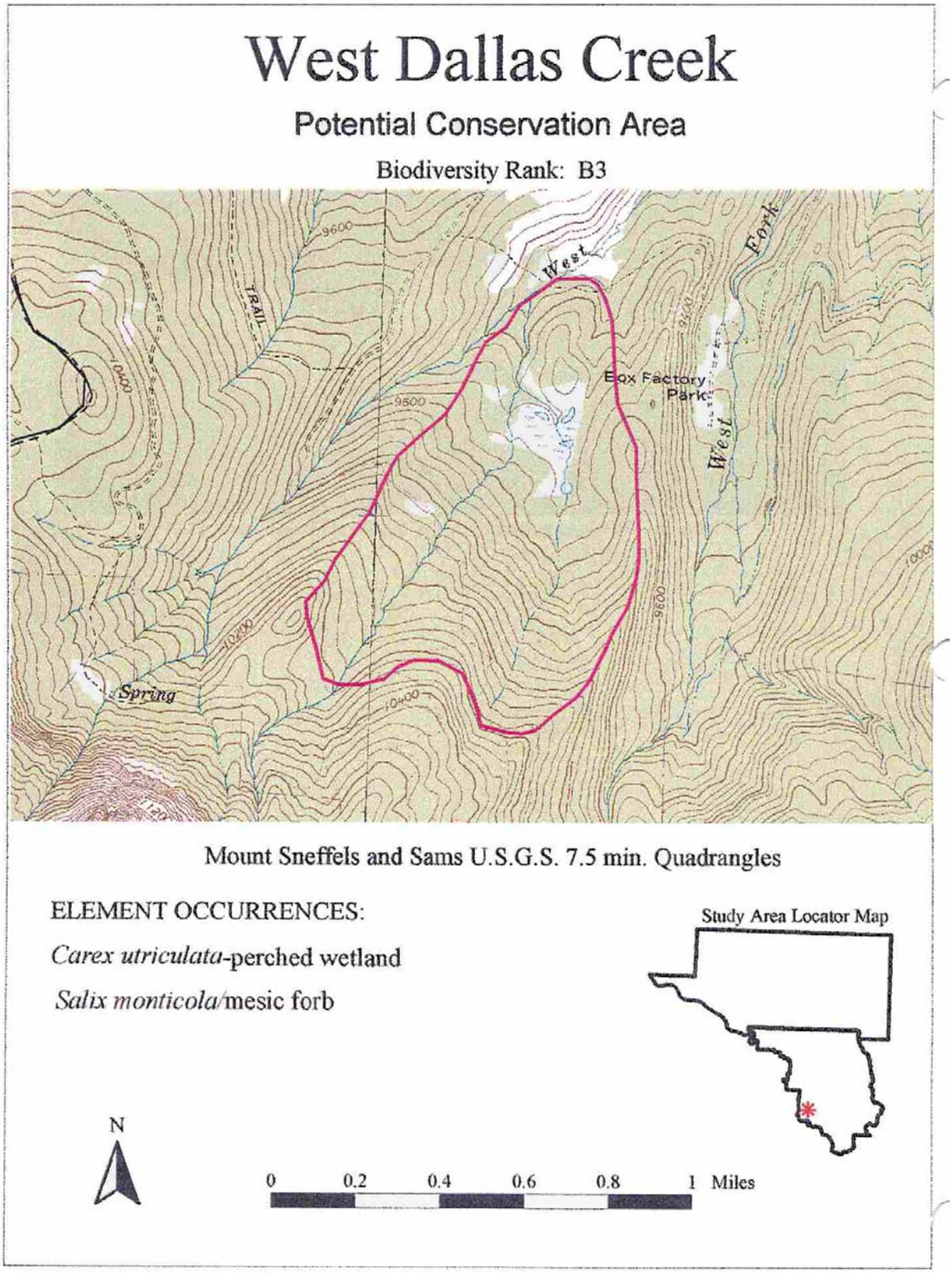


Figure 51. Map of West Dallas Creek PCA

Wildhorse Basin Potential Conservation Area

Biodiversity Rank: B3 (High significance)
The Wildhorse Basin PCA supports an excellent occurrence of a globally vulnerable water sedge-beaked sedge montane perched meadow wetland.

Protection Urgency Rank: P4
The Wildhorse Basin PCA is located on the boundary between the Big Blue Wilderness of the San Juan National Forest and lands under the jurisdiction of the Bureau of Land Management.

Management Urgency Rank: M5
There is no evidence of human impact within the Wildhorse Basin PCA. The PCA is over one mile from the nearest jeep trail and ¼ mile from lightly used foot trails.

Location: Headwaters of Cow Creek. From Ouray, take Highway 550 south approximately 2 miles to the engineer pass 4WD road. Approximately 0.5 miles past engineer pass summit is a sign for the Horsetheif Trail. Park at the sign and follow the trail northeast past American Lake and drop into the Wildhorse Basin and headwaters of Cow Creek.

U.S.G.S. 7.5 min. quadrangle: Wetterhorn Peak
Legal Description: T43N R6W Sections 5, 6

General Description: The 65 acre Wildhorse Basin PCA is located in the alpine headwaters of Cow Creek at an elevation of 11,880 ft. (3,621 m). The wetlands occur on a gentle east facing slope at the foot of Wildhorse Peak. The PCA includes seven closed ponds ranging in size from 10 ft. by 15 ft. (3 m by 5 m) to 30 ft. by 50 ft. (9 m by 15 m). The ponds are interspersed among patches of upland tundra communities and a large spring fed slope wetland, *Carex aquatilis*-*Carex utriculata* (water sedge-beaked sedge). The ponds and wetland areas are supported by snow melt and precipitation. Of the seven ponds, five are perennial and support a two-foot rim of montane wet meadow vegetation. They average less than 2 ft. deep with an unconsolidated bottom. A small stream runs through the PCA supporting a montane willow carr (*Salix planifolia*-*Salix brachycarpa/Caltha leptosepala*) community on its banks.

Biodiversity Rank Justification: The Wildhorse Basin PCA is undisturbed by human impact and supports one large community of concern, a montane wet meadow (*Carex aquatilis*-*Carex utriculata*) perched meadow, approximately 165 ft. (50 m) by 330 ft. (100 m). The montane wet meadow communities are considered rare within the state of Colorado.

Natural Heritage elements associated with wetlands at the Wildhorse Basin PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
***Carex aquatilis- Carex utriculata*-perched wetland**	**montane perched meadow**	**G3**	**S3**			**A**

*EO=Element Occurrence

Boundary Justification: The boundary is drawn to encompass the element occurrences, the seven ponds, the small stream, and the upper basin slopes. The boundary includes a 1,000-ft. buffer from potential land use impacts (e.g., trail development).

Protection Rank Justification: The Wildhorse Basin PCA is located on the boundary between the Big Blue Wilderness of the San Juan National Forest, and lands under the jurisdiction of the Bureau of Land Management at an elevation of 11,880 ft. (3,621 m). Management plans for the BLM are not known, but it is unlikely that any land use with the potential to negatively affect the adjacent wilderness area will be allowed.

Management Rank Justification: There is no evidence of human impact within the Wildhorse Basin PCA. The PCA is over one mile from the nearest jeep trail and ¼ mile from the nearest scarcely used Horsethief pack trail and Ridge Stock Driveway pack trail. Expansion to this trail system should take into account the Wildhorse Basin PCA. As of now, the trails are not well marked and use appears to be minimal.

Figure 52. Wetland community at the Wildhorse Basin PCA

Wetland Function and Value Assessment for the Wildhorse Basin PCA:
Proposed HGM Class: Slope. Subclass: S1. Class Deperssional. Subclass: D1; Class: Riverine. Subclass: R2.
Cowardin System: Palustrine. Subsystem: Emergent and Scrub-Shrub Wetland.

Category II, provides habitat for sensitive plants or animals, functions at a very high level for wildlife/fish habitat, is unique in a given region, or is assigned high ratings for many of the assessed functions and values.

Wetland function and value assessment for the Wildhorse Basin PCA.

Function	Ratings	Comments
Hydrological Functions		
Flood Attenuation and Storage	N/A	This wetland is not flooded via in-channel or overbank flow.
Sediment/Shoreline Stabilization	High	High percent vegetative cover adjacent to seasonal/ permanent water yields a high ability to dissipate flow, stabilize sediment, reducing erosion.
Groundwater Discharge/ Recharge	High	Multiple seeps at the basins toe slopes supplying an almost permanent source of water gives a high rating for groundwater discharge.
Dynamic Surface Water Storage	High	The large wetland size (100 acres) with frequent flooding gives a high potential to capture water from precipitation, overland or subsurface flow.
Biogeochemical Functions		
Sediment/Nutrient/ Toxicant Removal	Moderate	There is evidence of flooding and ponding water and a high percent vegetative cover, but the wetland is not likely to receive an excessive sediment/nutrient load, is therefore ranked moderate.
Biological Functions		
Habitat Diversity	Very High	The wetland site consists of emergent wetland, scrub-shrub wetland and unconsolidated bottom open water habitats.
Listed/Proposed/Candidate T&E Species Habitat	None	None known.
CO Natural Heritage Program Species Habitat	High	The wetland site supports an excellent occurrence of a montane perched wetland (*Carex aquatilis*-*Carex utriculata*-perched wetland), G3/S3.
General Wildlife Habitat	High	Sign of elk, deer, pika and marmots were observed during the wetland site visit with various semi-aquatic and aquatic birds suspected to utilize the area.
General Fish/Aquatic Habitat	N/A	This wetland does not supply habitat for fish.
Production Export/Food Chain Support	High	The large wetland size (100 acres), high habitat diversity rating, presence of an outlet, and perennial surface water yield a high potential to produce and export food/nutrients.
Values		
Uniqueness	Moderate	In the alpine zone, undisturbed wetlands of this sort are relatively common resulting in a moderate uniqueness rating.
Recreation/Education Potential	Low	The wetlands remote location prohibits opportunities for recreational and educational projects.

General Soil Description

Texture	Peaty to 50 cm
Color	Black
Cobble Size	N/A
Percent Mottling	N/A

Figure 53. Overview of the Wildhorse Basin PCA

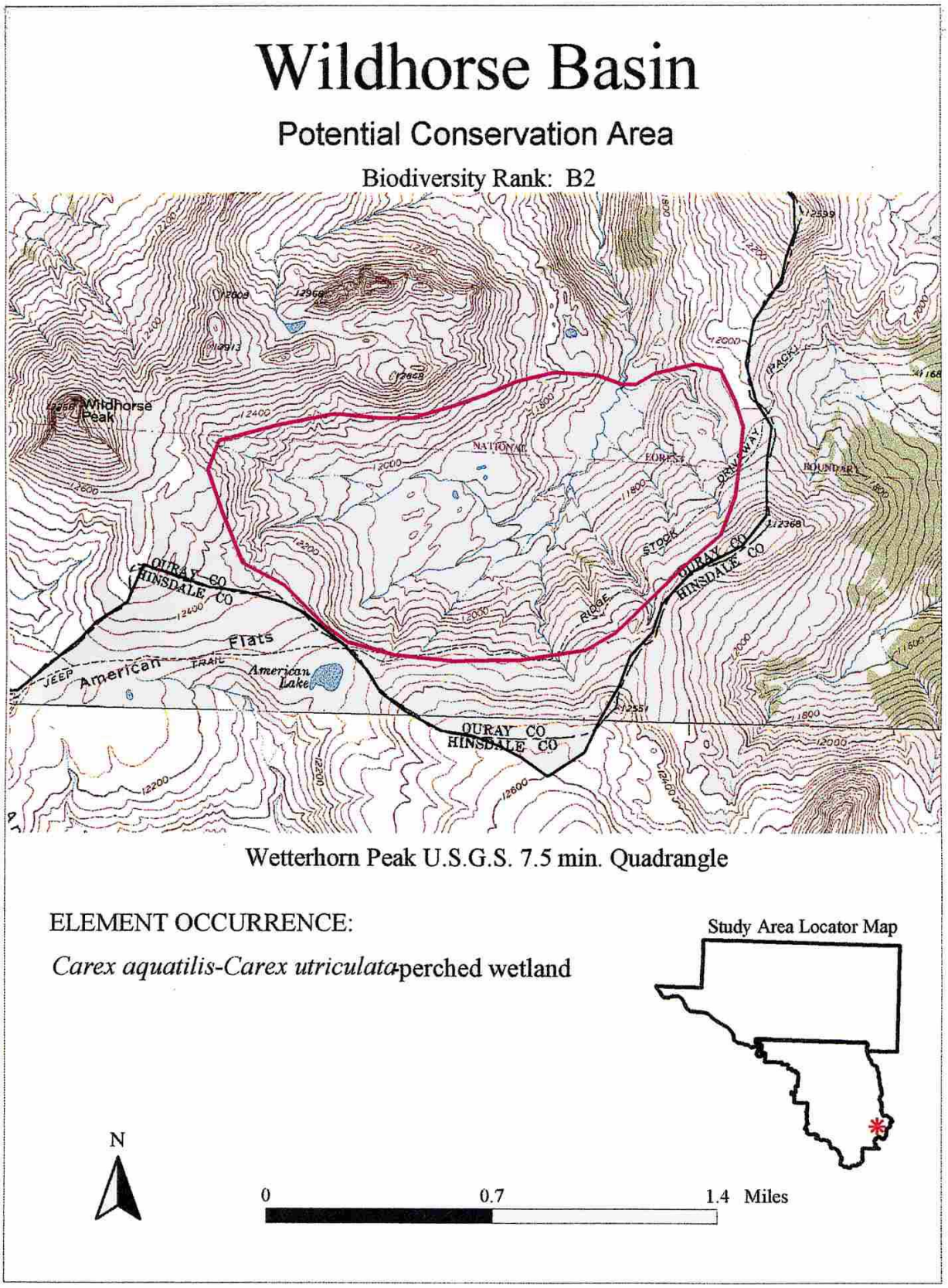


Figure 54. Map of Wildhorse Basin PCA

Green Mountain Potential Conservation Area

Biodiversity Rank: B5 (General biodiversity significance)
The Green Mountain PCA contains good examples of a montane riparian forest and an aspen wetland forest, both considered to be fairly common globally, and vulnerable in the state of Colorado.

Protection Urgency Rank: P4
This area is within the boundaries of the Uncompahgre National Forest.

Management Urgency Rank: M3
Weeds growing along the abandoned logging road need to be controlled.

Location: Ouray County
U.S.G.S. 7.5 min. quadrangle: Courthouse Mountain
Legal Description: T45N R7W S 11-14

General Description: The 859 acre Green Mountain PCA encompasses a section of Owl Creek and the eastern slopes of Green Mountain, in the Uncompahgre National Forest. Elevations range from 8,800 to 9,800 ft. (2,680 to 3,000 m).

The riparian zone along the creek is about 50 ft. (17 m) wide in the area surveyed, and has large scattered subalpine fir (*Abies lasiocarpa*), Douglas fir (*Pseudotsuga menziesii*), *aspen* (*Populus tremuloides*), and blue spruce (*Picea pungens*) trees. There is a dense cover of thinleaf alder (*Alnus incana*), Rocky Mountain willow (Salix monticola), Drummond willow (*Salix drummondiana*), and twinberry honeysuckle (*Lonicera involucrata*) along the stream banks. The vegetation and hydrology appeared to be in good condition, except in the immediate area of a road crossing. The road has since been closed to motorized vehicles.

Patches of aspen are scattered throughout the area, with mesic species such as bracken fern (*Pteridium aquilinum*), tall larkspur (*Delphinium occidental*), meadowrue (*Thalictrum fendleri*), and cow parsnip (*Heracleum sphondylium*).

There are some disturbed areas along the former road where weeds such as Canada thistle are growing. Farther south, there is heavy impact from cattle grazing and logging. However, most disturbance in the PCA is natural, from landslides.

Although not documented from this location, the PCA contains potential boreal owl habitat.

Biodiversity Rank Justification: The Green Mountain PCA contains good examples of a montane riparian forest and an aspen wetland forest.

Natural Heritage elements at the Green Mountain PCA.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	EO* Rank
Populus tremuloides/ Pteridium aquilinum	**Aspen wetland forests**	**G4**	**S3S4**			**B**
Abies lasiocarpa-Picea engelmannii/Alnus incana	Montane riparian forests	G5	S5			B

*EO = Element Occurrence

Boundary Justification: The boundary encompasses three element occurrences on the east side of Green Mountain, and includes a network of converging tributaries and their upland watershed.

Protection Rank Justification: This area is within the boundaries of the Uncompahgre National Forest.

Management Rank Justification: Weeds growing along the abandoned logging road need to be controlled.

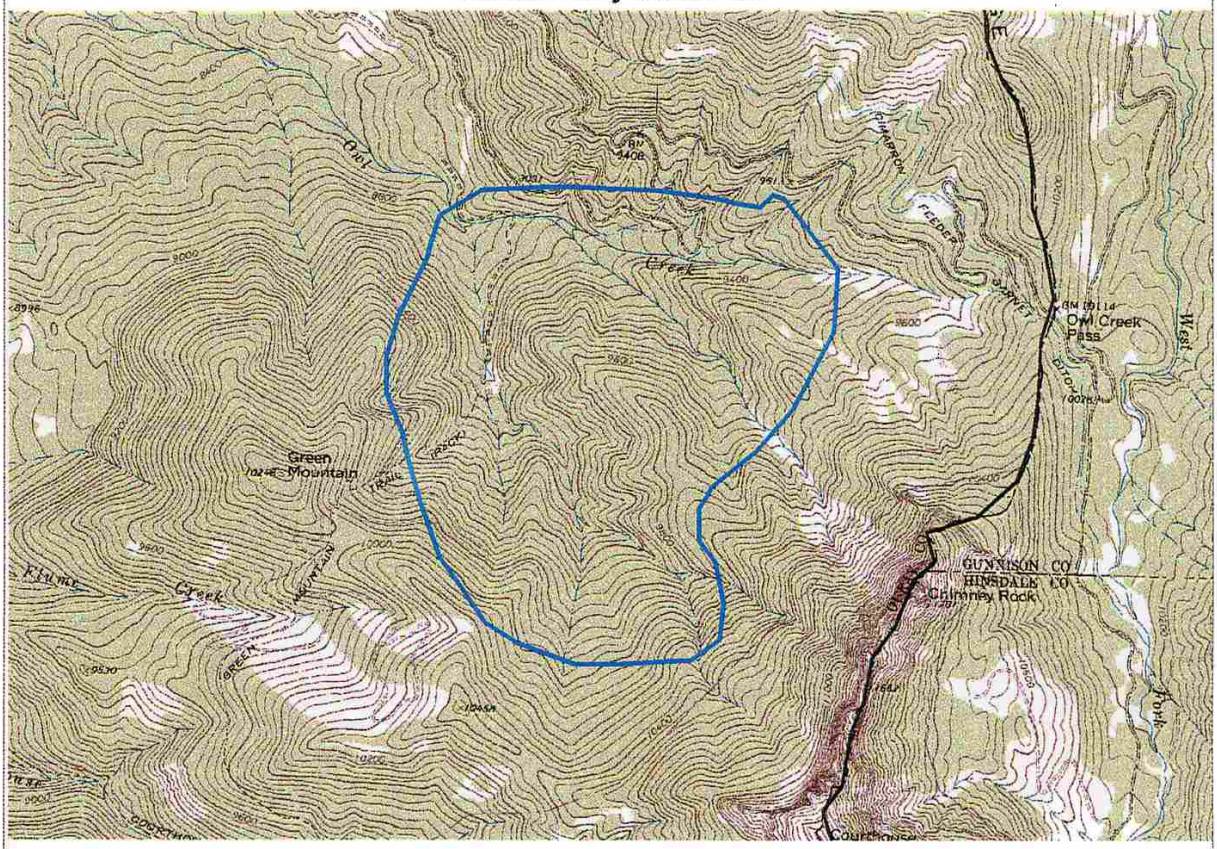
Wetland Function and Value Assessment for the Green Mountain PCA:
Proposed HGM Class: Riverine. Subclass: R3 Middle Elevation Perennial, with seasonal flooding.
Cowardin wetland System: Palustrine. Subsystem: Scrub-Shrub and Forested Wetland.

No Wetland Function and Value Assessment Was Performed at the Green Mountain PCA.

Green Mountain

Potential Conservation Area

Biodiversity Rank: B5



Courthouse Mountain U.S.G.S. 7.5 min. Quadrangle

ELEMENT OCCURRENCE:

Abies lasiocarpa-Picea engelmannii/ Alnus incana ssp. tenuifolia

Populus tremuloides/Pteridium aquilimun

Study Area Locator Map

N

0 0.2 0.4 Miles

Figure 55. Map of Green Mountain PCA

Miller Mesa Wetland Site of Local Significance

Location: Ouray County
U.S.G.S. 7.5 min. quadrangle: Mount Sneffels
Legal Description: T45N R8W S 30-33; T44n R8W S 5

General Description: The 3 acre Miller Mesa Wetland Site of Local Significance emergent wetland was documented at West Lake, at the Top of the Pines Girl Scout camp at an elevation of 8,580 ft. (2,615 m). The seasonally dry lake is supplied with water by spring snowmelt, and has no outlet. It has an outer ring of spike rush (*Eleocharis palustris*), with narrowleaf burreed (*Sparganium emersum*) in the center, and small patches of American mannagrass (*Glyceria grandis*) and baltic rush (*Juncus balticus*). Although there was no standing water in September, soils were still damp. Part of the Girl Scout property, not included in the site, has been invaded by leafy spurge. Treatment has begun on an adjacent property. This is potentially a serious threat to the entire area. The Ponderosa pine (*Pinus ponderosa*) forest on Miller Mesa, like that on the Uncompahgre Plateau, is second growth, having been logged in the 1950's. Although most trees are about forty years old, there are a few large older trees. There are scattered Rocky Mountain junipers (*Juniperus scopulorum*) mixed with the pines. The area east of County Road 5 has been identified by the Colorado Division of Wildlife as a critical elk calving area.

Protection Considerations: The property west of County Road 5 was purchased from the BLM with some deed restrictions, and has been used as a Girl Scout Camp for many years. The Girl Scouts of America have decided to give up the camp, and sell the property. Future owners must allow for public use; however, there is no special protection in place for the natural resources of the area. The portion of the site east of County road 5 is privately owned, with about half of the property under a conservation easement with the Rocky Mountain Elk Foundation. However, there is a threat of county road development through the property to provide access for private lands to the east.

Management Considerations: Present management of both properties within the site is adequate. However, owners should be alert for the possible invasion of leafy spurge from adjacent infested areas.

Wetland Function and Value Assessment for the Miller Mesa Site:
Proposed HGM Class: Depressional. Subclass: D3 with seasonal flooding.
Cowardin System: Palustrine. Subsystem: Emergent.

No Wetland Function and Value Assessment Was Performed at the Miller Mesa Site.

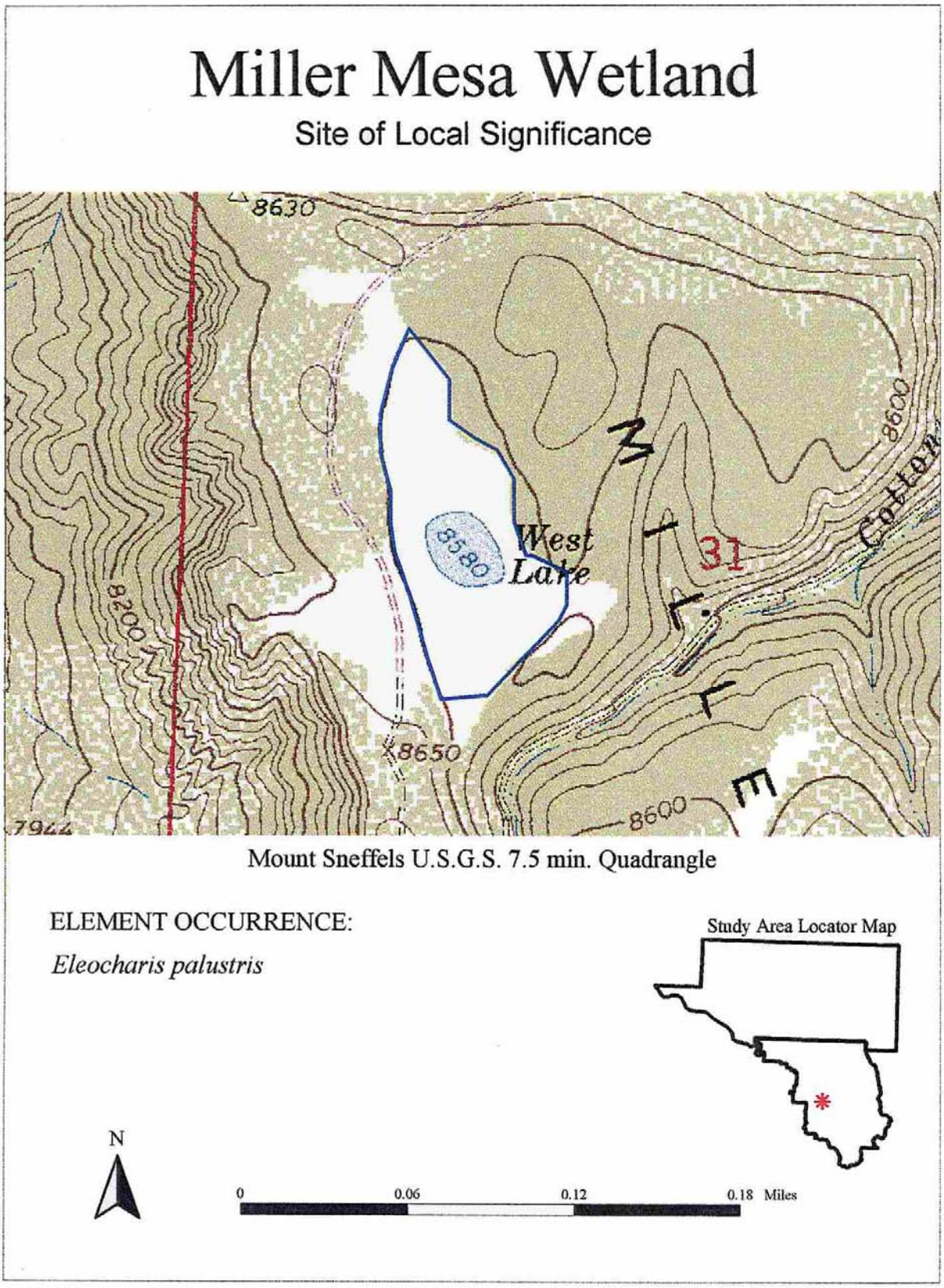


Figure 56. Map of Miller Mesa PCA

APPENDIX A: SIGNIFICANT KNOWN AND POTENTIAL WETLAND ELEMENTS IN THE UNCOMPAHGRE RIVER BASIN

The Colorado Natural Heritage Program has records of the following wetland and riparian elements for the wetlands in eastern Montrose and Ouray counties. This list *does not* necessarily represent *all* rare or imperiled plants, animals, and plant communities, but it is a complete list of known occurrences.

Rare or Imperiled Wetland Plants in Eastern Montrose and Ouray Counties Wetlands

Wetlands in eastern Montrose and Ouray counties provide habitat for one known rare or imperiled plant (Table 6).

Canyon Bog Orchid (*Platanthera sparsiflora* var. *ensifolia*) G4G5T3 S2
The Canyon bog orchid grows in moist or wet soil in mountain meadows, marshes, swamps, bogs, open or dense forests, on stream banks and open seepage, frequently about springs. It has a wide range, from Oregon to Mexico, but good habitat is limited. The genus is also classified by some botanists as *Habenaria* or *Limnorchis*. The orchid's survival depends on a reliable year-round supply of moisture. The combination of grazing and trampling by domestic livestock in the mucky areas where the orchid grows will ordinarily eradicate the plant (Colorado Natural Heritage Program 1999). We found it abundant along a small tributary of Escalante Creek below a hanging garden. It also was found along small backwaters and irrigation ditches in the Uncompahgre River at Eldredge PCA, and in a small wetland next to Pleasant Valley Creek in the Pleasant Valley PCA.

Table 6. Rare or imperiled plants associated with eastern Montrose and Ouray counties' wetlands.

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	Federal Sensitive
Platanthera sparsiflora	canyon bog-orchid	G4G5T3	S2		

Rare or Imperiled Amphibians Associated with Eastern Montrose and Ouray Counties Wetlands

One amphibian of concern is found in eastern Montrose and Ouray counties (Table 7). There are five occurrences for the northern leopared frog in the Uncompahgre River Basin. Northern leopard frogs were found to be common in irrigation induced wetlands, canals, and ditches at lower elevations. Examples of northern leopard frog occurrences are found in the Uncompahgre River Macrosite and Roubideau Creek PCA, and Sazama and Jade Road Sites of Local Significance in this report, and in the South Canal PCA described in the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999).

Northern leopard frog (*Rana pipiens*) G5 S3
The decline of frogs throughout the world in recent years has been of great concern to scientists. The northern leopard frog has disappeared in some parts of Colorado. The exact cause of the declines is unknown and needs further investigation (Hammerson 1982). Part of the statewide decline may be due to predation by the increasingly abundant bullfrog (*Rana catesbiana*), which is native to the eastern U. S., but introduced in Colorado.

The northern leopard frog inhabits springs, slow moving streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes, usually in permanent, clear water with rooted aquatic vegetation. In summer, the frog commonly occupies wet meadows and fields. The species appears to be faring better in eastern Montrose County than in other parts of the state. We documented five populations of northern leopard frogs in eastern Montrose County, in varied habitats, from wetlands along the Uncompahgre River to the banks of small ponds and irrigation ditches in the valleys and on the Uncompahgre Plateau. They inhabited both natural and irrigation-created wetlands.

Table 7. Rare or imperiled amphibian associated with eastern Montrose and Ouray counties' wetlands.

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive
Rana pipiens	northern leopard frog	G5	S3		SC	FS

Rare or Imperiled Fish Associated with Eastern Montrose and Ouray Counties Wetlands

There is one species of rare or imperiled fish associated with Montrose and Ouray counties wetlands (Table 8). There are a total of 4 occurrences for the Colorado River cutthroad trout in the Uncompahgre River Basin. The trout are represented in the East Fork Spring Creek and Nate Creek PCAs in this report, and Pryor Creek and Lou Creek PCAs which are decribed in the companion volume to this repot, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999).

Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) G5T3 S3 SC FS
The Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) is a global and state vulnerable subspecies (Pague et al. 1997). This subspecies is the only trout native to the upper Colorado River basin. Its native range extends southward to the Escalante River on the west and San Juan drainage on the east sides of the basin, including the Green, Yampa, Gunnison, Dolores, San Juan rivers and their tributaries (CDOW 1986; CDOW 1987; Proebstel 1994; Young et al. 1996). Its current distribution includes remnant populations in Colorado, Wyoming, and Utah. The historical habitat included most clearwater streams and rivers of western Colorado (Behnke and Benson 1980). The trout remains only in smaller order streams and a few high elevation lakes of the mountainous country. The Colorado River cutthroat trout is heavily managed and studied. Presently there are 42 populations in Colorado judged to be genetically pure ("A category")

(Proebstel 1994). However, the primary reasons for conservation concern at the global and state levels are long term trend prognoses and threats. Populations continue to decline in many streams (Young et al. 1996). Western Colorado's native trout species is seldom found genetically pure, due to hybridization with introduced Rainbow trout (*Oncorhynchus mykiss*). The populations identified in the Uncompahgre River Basin have yet to be tested for genetic purity. Competition with introduced Brook trout (*Salmo fontinalis*) has been very detrimental and has lead to local extinctions of native populations of cutthroat trout. Competition with non-native trout species and exotic fish diseases also poses a threat.

The wetlands in the floodplain of the Uncompahgre River and its tributaries play an important role in sustaining the populations of these fish. Wetlands provide organic input as food, shelter from heat and predators, temperature regulation, and breeding habitat for some species. The presence of these fish is one reason that wetlands along the length of this major river and its tributaries should not be destroyed.

Table 8. Rare or imperiled fish associated with eastern Montrose and Ouray counties' wetlands.

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Fed Sensitive
Oncorhynchus clarki pleuriticus	Colorado River cutthroat trout	G5T3	S3		SC	FS

Rare or Imperiled Birds Associated with Eastern Montrose and Ouray Counties Wetlands

There are 10 rare or imperiled birds that are known to be associated with eastern Montrose and Ouray counties' wetlands (Table 9). The majority of the birds utilize wetlands for foraging and nesting, however the following species nest and forage in the drier lands adjacent to wetlands: northern goshawk, golden eagle, and grey vireo.

Note that for most migratory birds, CNHP documents only breeding locations; migratory birds are otherwise too unpredictable in their locations. However, the CNHP does track predictable locations of migratory birds such as winter roosts of bald eagles and staging areas for greater sandhill cranes. Despite the focus on predictable locations, it should be clearly recognized that many bird species depend heavily on wetlands if only for nourishment and rest during their long migrations.

Table 9. Rare or imperiled birds associated with eastern Montrose and Ouray counties' wetlands.

Scientific Name	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Status
Accipiter gentilis	northern goshawk	G5	S3B SZN			FS
Amphispiza bilineata	black-throated sparrow	G5	S3B,SZN			
Aquila chrysaetos (watch)	golden eagle	G5	S3S4B, SZN			
Ardea herodias	great blue heron	G5	S3B, SZN			
Circus cyaneus	northern harrier	G5	S3B,SZN			
Cistothorus palustris	marsh wren	G5	S3B,SZN			
Contopus borealis	olive-sided flycatcher	G5	S3S4B			FS
Cypseloides niger	black swift	G4	S3B			FS
Haliaeetus leucocephalus	bald eagle	G4	S1B,S3N	LT	T	
Vireo vicinior	grey vireo	G4	S2B, SZN			

Northern goshawk (*Accipiter gentilis*) G5 S3B, SZN
The northern goshawk is secure globally, there are 62 nest sites reported from Colorado's national forests (Colorado Natural Heritage Program 1999). This species apparently responds negatively to some forms of forest fragmentation (Reynolds 1983), but there are few data on population trends. The northern goshawk is considered vulnerable and is a U.S. Forest Service species of special concern. An active nest was found within one mile of the Beaver Dams Creek PCA.

Black-throated sparrow (*Amphispiza bilineata*) G5 S3B, SZN
The Black-throated Sparrow is an uncommon local summer resident in Colorado. Its breeding habitat is open pinyon-juniper woodlands and semidesert shrublands (Andrews and Righter 1992). This sparrow has physiologically adapted to conserve and utilize water absorbed from its food, which allows it to persist quite well in arid environments. The Black-throated Sparrow is represented in the Rim Road PCA, which is profiled in the companion volume to this repot, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999).

Golden eagle (*Aquila chrysaetos*) G5 S3S4B, SZN
Although the golden eagle has been deemed secure enough to be put on CNHP's "watch list", the presence of this raptor is certainly of local interest. It was observed near Olathe, near Ouray, and on the Uncompahgre Plateau. No PCAs have been created for it, but one location does fall within the Uncompahgre River Macrosite.

Great blue heron (*Ardea herodias*) G5 S3B, SZN
The wide ranging great blue heron is found in colonies scattered throughout Colorado. Some winter here, while most others return from more southern habitats to our area in mid-February to March and leave again in October (Andrews and Righter 1992). They prefer freshwater and brackish marshes along lakes, rivers, fields and meadows. They nest high in trees, or less commonly in bushes, on the ground, rock ledges, or cliffs. The birds eat fish, crustaceans, amphibians and reptiles, mice and shrews, and other animals.

Most foraging is done while standing in the water. In our area, undisturbed cottonwood stands are essential for nesting. Colonies are utilized year after year, as long as there is no disturbance; however, the supporting cottonwoods generally die after some years, causing the colonies to relocate. A relatively small rookery was found along the Cimarron River, and is represented in the PCA of that name. Great blue herons were also observed at the Cimarron State Wildlife Area PCA and Jade Road Site of Local Significance in the late summer, so breeding status was not able to be determined.

Northern harrier (*Circus cyaneus*) G5 S3B, SZN
The northern harrier, formerly known as the marsh hawk, is a large raptor recognizable by its white rump and low, wavering flight patterns. It builds its nest on the ground in sparsely shrubby open ground or marshes. It hunts for small mammals and sometimes birds while flying low over the ground, occasionally hovering. Northern harriers were observed in five locations in the Uncompahgre River Basin, and are represented in the Rim Road, Doug Creek and Dry Cedar Creek PCAs which are profiled in the companion volume to this report, Uncompahgre River Basin Natural Heritage Assessment Vol. I (Lyon et al. 1999). Northern harriers were also observed at the Jade Road Site of Local Significance, and Cimarron State Wildlife Area Site of Local Significance, but breeding status could not be determined in August when the observations were made.

Marsh wren (*Cistothorus palustris*) G5 S3B, SZN
A small, brown wren with white line over its eye and white stripes on its back, the marsh wren is found throughout the western United States in cattail and bulrush marshes where it nests colonially. Marsh wrens were commonly observed at the Jade Road site of local significance, and Cimarron State Wildlife Area Site of Local Significance, but no EORs were created for the observations because breeding status could not be determined in August. However, it is very likely that they do breed there, as the cattail marshes provide excellent habitat.

Olive-sided flycatcher (*Contopus borealis*) G5 S3S4B
The olivesided flycatcher is an insect-eating bird that can be found in forests and woodlands, especially those recently burned. It often uses dead snags as a singing or hunting perch. It can be distinguished from other similar species by its distinctive "quick-three-beers" song. This species was found quite common throughout the Uncompahgre River Basin, although no PCAs were created for it.

Black swift (*Cypseloides niger*) G4 S3B
The black swift is an uncommon breeder in the mountainous regions of Colorado (Andrews and Righter 1992). This bird is a colonial nester and has a rather unique nesting biology. It has six nesting characteristics described by Knorr (1993) as: water, high relief (almost invariably), inaccessibility, darkness, unobstructed flyways, and niches in rock for nests. In the Uncompahgre River Basin, waterfalls provide these conditions for nesting black swifts. One of the most recognized colonies of this bird in Colorado is in Box Canyon Falls in Ouray. Another colony was discovered at a waterfall on Oben Creek in Ouray County. The black swift is represented by PCAs Cow Creek-Oben Creek and Uncompahgre River Macrosite.

Bald eagle (*Haliaeetus leucocephalus*) G4 S1B, S3N
The bald eagle is a frequent winter visitor to the Grand Valley, but breeding pairs are unknown. However, its breeding range is expanding, possibly due to tree planting and erosion control (Ehrlich et al.1988). Widespread national efforts to protect and restore breeding populations have been generally successful (Wheye 1992). The species has made a comeback from its previously endangered status, and is now federally listed as threatened in the U. S. (USFWS, Federal Register, 12 July 1995). The bald eagle roosts in conifers or deciduous trees, such as the large cottonwoods along the Colorado River. It prefers accessible trees near water and away from human activity. The eagle feeds opportunistically on fishes, injured waterfowl and seabirds, various mammals, and carrion (Terres 1980). Bald eagles commonly roost and feed in the mature cottonwood trees all along the Lower Uncompahgre River during their winter migrations.

Gray vireo (*Vireo vicinior*) G4 S2B, SZN
This small, gray-backed bird breeds in arid mountains from southern California to southwestern Colorado. It prefers dry, open pinyon-juniper woodlands at lower elevations (Andrews and Righter 1992). Gray vireos were found near the confluence of Dallas Creek and the Uncompahgre River and at Happy Canyon. They are represented in the Dallas Creek Confluence site, within the Uncompahgre River Macrosite. The site offered a diverse vertical niche space within a healthy community of pinyon, juniper and sagebrush above the reservoir. Singing males during the breeding season were considered evidence of nesting in the area.

Wetland and Riparian Plant Associations in the Uncompahgre River Basin (eastern Montrose and Ouray counties)

Information in BCD (Colorado Natural Heritage Program 1999) was used to develop a preliminary list of wetland plant communities in the Uncompahgre River Basin. This list was further developed with information gathered during the field efforts from this study. Since this study was intended to identify the wetland sites of highest conservation value, and did not encompass wetland classification, Colorado Natural Heritage Program does not presume the following list of plant communities to be a complete list of Uncompahgre River Basin plant communities. Nonetheless, Colorado Natural Heritage Program believes the list to be a good representation of the major wetland and riparian plant communities present in the Uncompahgre River Basin.

There are 32 wetland and riparian plant communities that have been documented in the study area which includes all of Ouray and the eastern half of Montrose counties (Table 10). The plant communities are presented, in the context of both The Nature Conservancy hierarchical classification (Anderson et al. 1998) and the U.S. Fish and Wildlife Service's wetland classification (Cowardin et al. 1979). The Fish and Wildlife Service classification units (palustrine system and forested, scrub-shrub, emergent, and aquatic bed classes) will be useful for anyone familiar with the National Wetlands

Inventory maps that use this classification. Detailed description for each of these communities begins on page 182.

For each plant association, a description is provided of its distribution in the state and region, vegetation composition, soils, wetland description, and environmental conditions where it is found (i.e., geomorphologic setting, hydrology, etc.). Plant association descriptions also include notes on successional status and management as well as a list of other wetland plant species with which it may be found. The majority of the plant association descriptions are derived from the riparian plant association and vegetation classification project (Osborn et al. 1999).

Table 10. Riparian and wetland plant communities in the Uncompahgre River Basin.

Scientific Name	Common Name	Global Rank	State Rank
Palustrine Forested Wetland			
Abies lasiocarpa-Picea engelmannii/Alnus incana	montane riparian forest	G5	S5
Abies lasiocarpa-Picea engelmannii/Mertensia ciliata	montane riparian forests	G5	S5
Abies lasiocarpa-Picea engelmannii/Salix drummondiana	montane riparian forests	G5	S4
Picea pungens/Cornus sericea	montane riparian forests	G4	S2
Populus angustifolia/Alnus incana	montane riparian forests	G3?	S3
Populus angustifolia/Cornus sericea	cottonwood riparian forests	G4	S3
Populus angustifolia/Crataegus rivularis	montane riparian forests	G2?	S2?
Populus angustifolia/Juniperus scopulorum	montane riparian forests	G2G3	S2
Populus angustifolia/Rhus trilobata	narrowleaf cottonwood/skunkbrush riparian forests	G3	S3
Populus angustifolia/Salix exigua	narrowleaf cottonwood riparian forests	G4	S4
Populus angustifolia/Salix ligulifolia-Shepherdia argentea	narrowleaf cottonwood riparian forests	G1	S1
Populus angustifolia-Picea pungens/Alnus incana	montane riparian forests	G3	S3
Populus tremuloides/Acer glabrum	montane riparian forests	G2	S1S2
Populus tremuloides/Pteridium aquilinum	aspen wetland forests	G4	S3S4
Pseudotsuga menziesii/Cornus sericea	lower montane riparian forests	G4	S2
Palustrine Scrub-Shrub Communities Broad-leaved Deciduous			
Alnus incana/mesic forb	thinleaf alder/mesic forb riparian shrubland	G3G4Q	S3
*Betula glandulosa/*mesic forb-mesic graminoids	subalpine riparian shrubland	G3G4	S3
Betula occidentalis/mesic forb	foothills riparian shrublands	G3	S2
Salix drummondiana/Calamagrostis canadensis	lower montane willow carr	G3	S3
Salix exigua/bare ground	coyote willow/barren soil	G5	S5
Salix exigua/mesic graminoid	coyote willow/mesic graminoid	G5	S5
*Salix monticola /*mesic forb	montane riparian willow carr	G3	S3
Palustrine Emergent Communities Persistent			
Carex aquatilis- Carex utriculata-perched wetland	montane perched meadow	G3	S3
Carex utriculata-perched wetland	beaked sedge perched wetland	G3	S3
Distichlis spicata	salt meadows	G5	S3
Eleocharis palustris	emergent wetlands	G5	S4
Eleocharis rostellata	emergent wetland	G2G3	S2S3
Phragmites australis	marshes	G4	S3
Spartina gracilis	salt meadows	G4?	S2
Typha latifolia	narrow-leaf cattail marsh	G5	S3

Palustrine Aquatic Bed Communities Rooted Vascular			
Polygonum amphibium	montane wet meadows	G5	S3
Potamogeton foliosus	montane floating/ submergent palustrine wetlands	G5	S3

PALUSTRINE FORESTED WETLAND

Subalpine fir-Engelmann spruce/thinleaf alder (*Abies lasiocarpa-Picea engelmannii /Alnus incana ssp. tenuifolia*) plant association

Colorado Natural Heritage Program Rank: G5/S5

General Description and Comments: The *Abies lasiocarpa-Picea engelmannii/Alnus incana* (subalpine fir-Engelmann spruce/thinleaf alder) plant association occurs on heavily forested stream reaches where *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests also occur on adjacent hillslopes. Tall *Alnus incana* (thinleaf alder) grows in a thick band along the edge of the stream. At higher elevations, *Salix drummondiana* (Drummond willow) becomes a co-dominant of *Alnus incana* (thinleaf alder, beginning the gradient into the *Abies lasiocarpa-Picea engelmannii/Salix drummondiana* (subalpine fir-Engelmann spruce/Drummond willow) plant association.

Classification Problems: The *Abies lasiocarpa-Picea engelmannii/Alnus incana* ssp. *tenuifolia-Salix drummondiana* plant association has been split into two closely related plant associations: the *Abies lasiocarpa-Picea engelmannii/Alnus incana* plant association, which occurs at lower elevations and has *Alnus incana* in the understory; and the *Abies lasiocarpa-Picea engelmannii/Salix drummondiana* plant association, which occurs at higher elevations and has very little to no *Alnus incana* in the understory (Kittel et al. 1996). Stands with both *Alnus incana* and *Salix drummondiana* appear to be transitional between these two plant associations.

Related Types/Synonyms: The following three community names are synonymous with the Colorado *Abies lasiocarpa-Picea engelmannii/Alnus incana* plant association: 1) *Abies lasiocarpa/Alnus incana-Salix drummondiana* (Kittel and Lederer 1993), 2) *Picea engelmannii-Abies lasiocarpa/Alnus incana*, (Kittel *et al*. 1994, Kittel *et al*. 1995), and 3) *Abies lasiocarpa-Picea engelmannii/Alnus incana* spp. *tenuifolia-Lonicera involucrata-Salix drummondiana* (Baker 1989, Kettler and McMullen 1996, Richard *et al*. 1996).

Closely related communities include the *Abies lasiocarpa/Alnus incana-Cornus sericea* (subalpine fir/thinleaf alder-red-osier dogwood) plant association (Kettler and McMullen 1996), the conifer/*Cornus sericea* (conifer/red-osier dogwood) community type (Padgett *et al*. 1989, Manning and Padgett 1995), and the *Picea/ Cornus stolonifera* (spruce/red-osier dogwood) community type (Youngblood *et al*. 1985). These communities have significant cover of *Cornus sericea* (red-osier dogwood) and very little *Alnus incana*

(thinleaf alder) and are considered phases of the *Abies lasiocarpa-Picea engelmannii/Alnus incana* association.

Regional Distribution: This plant association occurs in Nevada (Manning and Padgett 1995), Utah (Padgett *et. al*. 1989), eastern Idaho, western Wyoming (Youngblood *et al*. 1985), and Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs in the Yampa, San Miguel/Dolores (Kittel and Lederer 1993), Gunnison (Kittel *et al*. 1995), Colorado (Kittel *et al* 1994), and South Platte River Basins (Kittel et al. 1996), the San Juan and Routt National Forests (Richard *et al*. 1996, Kettler and McMullen 1996), and Rocky Mountain National Park (Baker 1989). Examples of this community type can be found in the Cow Creek-Oben Creek, Red Creek, and Green Mountain PCAs.

Elevation Range: 7,200-10,300 ft (2,200-3,100 m).

Site Geomorphology: This plant association generally occurs in narrow, 150-800 ft (40-250 m), V-shaped valleys on stream benches and banks. It usually occurs within 15-20 ft (5-6 m) of the channel edge and is rarely more than 2 ft (0.5 m) above the stream bank. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Stream channels are narrow and steep (Rosgen's Channel Type: A2, A3, A4), moderately wide with a moderate gradient (Rosgen's Channel Type: B1-B6) or wide and very sinuous (C2, C3, C4).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Soils: Soils are shallow, dark-colored, loamy sands, silty loams, and sandy clay loams. There is generally high organic matter in the top 50 in (20 cm) and mottles at 100 in (40 cm), becoming skeletal at 150 in (60 cm).

Vegetation: *Picea engelmannii* (Engelmann spruce) dominates the upper canopy with 0-80% cover. *Abies lasiocarpa* (subalpine fir) is usually present with 0-80% cover. Other tree species occasionally present are 0-15% cover of *Populus angustifolia* (narrowleaf cottonwood), 0-20% cover each of *Picea pungens* (Colorado blue spruce) and *Pinus contorta* (lodgepole pine), and 0-1% cover of *Populus tremuloides* (aspen). *Abies concolor* (white fir) is present with 0-15% cover in stands in the southwestern part of the state.

An open to dense mid-canopy of *Alnus incana* ssp. *tenuifolia* (thinleaf alder) is always present with 5-90% cover. *Salix drummondiana* (Drummond willow) can occur with 0-20% cover as a narrow band bordering the stream channel. In one stand in the Routt National Forest, *Cornus sericea* (red-osier dogwood) was present with 55% cover.

The herbaceous undergrowth is usually rich in forb species having an overall cover of 20-70%. Characteristic forb species include *Mertensia ciliata* (mountain bluebell),

Mertensia fransiscana (flagstaff bluebell), *Cardamine cordifolia* (heartleaf bittercress), *Heracleum lanatum* (cow parsnip), *Geum macrophyllum* (large-leaved avens), *Saxifraga odontoloma* (brook saxifrage), and *Geranium richardsonii* (Richardson geranium). Graminoid cover is minimal in western slope stands. In the South Platte River Basin, overall graminoid cover can be as high as 50% and includes 0-25% cover of *Calamagrostis canadensis* (bluejoint reedgrass), 5-10% cover of *Carex disperma* (softleaf sedge), and 0-15% cover of *Glyceria* spp. (mannagrass). One plot had 43% cover of *Equisetum arvense* (field horsetail).

Successional and Ecological Processes: Many first- and second-order streams run through subalpine spruce-fir forests providing habitats for obligate riparian shrubs, forbs, and grasses, forming the numerous riparian *Abies lasiocarpa-Picea engelmannii* plant associations. Although *Abies lasiocarpa* and *Picea engelmannii* are not obligate riparian species, the two species strongly influence forested subalpine riparian ecosystems.

The successional process of the spruce-fir forest is complex. Some ecologists suggest that *Abies lasiocarpa* and *Picea engelmannii* are in equilibrium and form a stable climax community. Others suggest that the two species coexist in nonequilibrium and that given enough time, either *Abies lasiocarpa* or *Picea engelmannii* will dominate the overstory (Aplet *et al*. 1988). The literature reviewed here suggests that the spruce-fir forest will never become a single-species dominated "climax" forest, but rather is a perpetually changing mosaic of patches that are of different ages and composition. The successional dynamics of the forest is a complex interaction of local site physical characteristics, the life history traits of spruce and fir, and the confounding effects of fire, windthrow and insect outbreak acting at both large (entire stand) and small (individual trees) scales. These interacting affects are outlined below.

Abies lasiocarpa has greater reproductive success in the shaded forest than *Picea engelmannii* (Peet 1981) and lives for approximately three hundred years. *Picea engelmannii* has a lower rate of establishment, but commonly lives longer than five hundred years (Aplet et al. 1988). In Colorado, all age classes of both species are generally found within the riparian zone.

The fire frequency of *Abies lasiocarpa* and *Picea engelmannii* in moist areas is lower than on the dry upland sites (Peet 1981), but the trees in riparian areas do burn. Following a crown fire, both *Abies lasiocarpa* and *Picea engelmannii* colonize the burned area. *Picea engelmannii* establishment is greater for the first several decades, but as the ground becomes shaded, *Abies lasiocarpa* seedlings increase in abundance (Veblen *et al*. 1991). As the stand matures, the faster-growing *Picea engelmannii* overtops *Abies lasiocarpa* in mesic sites. Eventually, the shorter-lived *Abies lasiocarpa* begin to die, leaving small gaps in the canopy in which a new generation of mainly *Abies lasiocarpa* seedlings establish (Peet 1981).

Windthrow and insect attack also affect the composition and age structure of *Abies lasiocarpa* and *Picea engelmannii* stands. Fallen trees, downed by wind or left as logging debris, act as hosts to the endemic spruce beetle (*Dendroctonus rufipennis*), the

most damaging insect to *Picea engelmannii*. During periodic rises in its population, however, the beetle infests large areas of live trees, selectively attacking and killing individuals with diameters greater than 4 in (10 cm) (Veblen et al. 1991). The dead trees remain standing for years. Instead of being replaced by new seedlings, young *Abies lasiocarpa* and *Picea engelmannii* saplings are "released" from competition and grow to fill in the canopy (Veblen et al. 1991).

The *Abies lasiocarpa-Picea engelmannii/Alnus incana* ssp. *tenuifolia* plant association appears to be a late-seral, or at least a long-lived riparian community that may also represent a successional change from a deciduous-dominated overstory to a conifer-dominated overstory (Padgett et al. 1989) at lower elevations. This successional shift may be attributed to a lack of fire in the association (Manning and Padgett 1995).

Adjacent Riparian Vegetation: This plant association generally is the only riparian association along a stream reach. Adjacent riparian associations can include *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests or *Populus angustifolia-Picea pungens* (narrowleaf cottonwood-Colorado blue spruce) forests along wider flood plains. Adjacent shrub-dominated associations include *Alnus incana* (thinleaf alder), *Salix boothii* (Booth willow), *Salix geyeriana* (Geyer willow), or *Salix planifolia* (planeleaf willow) shrublands. *Calamagrostis canadensis* (bluejoint reedgrass) and *Carex aquatilis* (aquatic sedge) meadows can also occur in adjacent riparian areas.

Adjacent upland vegetation: *Picea engelmannii* (Engelmann spruce)*, Abies lasiocarpa* (subalpine fir)*, Picea pungens* (Colorado blue spruce)*,* and *Populus tremuloides* (aspen) forests occur on adjacent hillsides, usually intergrading with the riparian canopy.

Management: The dense shrub layer of the *Abies lasiocarpa-Picea engelmannii/Alnus incana* (subalpine fir-Engelmann spruce/thinleaf alder) plant association may limit livestock access (Manning and Padgett 1995). *Alnus incana* is not particularly palatable to livestock, but can be damaged as animals search for more palatable forb species (Hansen et al. 1995).
Alnus incana is an excellent stream bank stabilizer due to its rhizomatous roots. Young stands can re-sprout after flood damage or fire and can tolerate a short duration of standing water. *Cornus sericea* (red-osier dogwood) could also be considered for stabilization projects since it quickly establishes from seed or transplanted seedlings along stream edges (Hansen et al. 1995).
This plant association is sensitive to timber harvesting activities due to high soil moisture content. Timber productivity is fairly low. Management usually considers *Picea engelmannii* the most productive species. However, consideration must be given to the uneven-aged structure and the inability of *Picea* to regenerate without providing protection for seedling survival. Small clearcuts, shelterwood, or group or individual tree selection methods should be designed to prevent seedling mortality from frost, desiccation from winter winds, sunscald, and soil movement (Youngblood and Mauk 1985). This type is poorly suited for roads, trails, or other developments. Protection of water resources is a major consideration for any management activity (The Nature Conservancy 1992).

Subalpine fir-Engelmann spruce/mountain bluebells (*Abies lasiocarpa-Picea engelmannii/Mertensia ciliata*) plant association

Colorado Natural Heritage Program Rank: G5/S5

General Description and Comments: The *Abies lasiocarpa-Picea engelmannii/ Mertensia ciliata* (subalpine fir-Engelmann spruce/mountain bluebells) plant association is a heavily shaded forest with no shrubs and a thick line of wildflowers lining the stream edge. It is a common community in the subalpine zone along first- and second-order streams. *Mertensia ciliata* in nearly always present but can sometimes be absent. Other forbs consistently present include *Cardamine cordifolia* (heartleaf bittercress), *Micranthes odontoloma* (brook saxifrage) and *Senecio triangularis* (arrowleaf groundsel). *Salix drummondiana* (Drummond willow), *Lonicera involucrata* (honeysuckle), and *Ribes* (currant) species can be present, but with less than 10% cover. At high elevations, *Vaccinium myrtillus* (Rocky Mountain whortleberry), typically an upland species, can intergrade with this riparian plant association on the stream banks.

Related Types/Synonyms: This association has been reported under many names. The following five communities are considered synonymous with the Colorado *Abies lasiocarpa-Picea engelmannii/Mertensia ciliata* plant association: 1) the *Picea engelmannii-Abies lasiocarpa/Cardamine cordifolia-Mertensia ciliata-Senecio triangularis* plant association (Baker 1989), 2) the *Abies lasiocarpa/ Mertensia ciliata*) plant association (Kettler and McMullen 1996, Kittel *et al*. 1994, Kittel *et al*. 1995, Richard *et al*. 1996), 3) the *Picea engelmannii-Abies lasiocarpa/Mertensia ciliata*) plant association (Kittel and Lederer 1993), 4) the *Abies lasiocarpa-Picea engelmannii/ Mertensia ciliata* plant association (Johnston 1987), and 5) the conifer/ *Aconitum columbianum* (monkshood) community type (Padgett et al. 1989).

There are two closely related communities: 1) the *Picea engelmannii-Abies lasiocarpa/ Senecio triangularis* (Engelmann spruce-subalpine fir/arrowleaf groundsel) plant association (Hess 1981, Komarkova 1986), which occurs on steep, wet hillsides, rather than in valley bottoms and 2) the *Picea*/*Galium triflorum* (spruce/fragrant bedstraw) community type (Youngblood et al. 1985), which has *Picea pungens* (blue spruce) as the dominate overstory, rather than *Abies lasiocarpa* and *Picea engelmannii*.

Regional Distribution: This association occurs in Montana, Utah (Padgett *et al*. 1989), New Mexico (Johnston 1987), and Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This is a common plant association throughout the southern Rocky Mountains of Colorado (Alexander 1981, Baker 1984, Boyce 1977, DeVelice et al. 1986, Steen and Dix 1974, Dix and Richards 1976, Johnston 1987, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel *et al*. 1994, Kittel *et* al. 1995, Peet 1981, as cited in Baker 1989, Richard *et* al. 1996, Steen and Powell 1985, as cited in Johnston 1987). Examples of this community type can be found in the Cow Creek-Oben Creek and West Dallas PCA.

Elevation Range: 8,200-11,500 ft (2,500-3,500 m).

Site Geomorphology: This plant association occurs in narrow to wide valleys, 35-350 ft (10-100 m) wide, and is limited to the immediate stream channel edge and overflow areas. It usually establishes within 15 ft (5 m) of the channel and within 2 ft (0.5 m) of channel bankfull height. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Typically this association occurs along steep (2-15% gradient), narrow streams (Rosgen's Channel Type: A2-A6), but can also be found along moderate gradient stretches (Rosgen's Channel Type: B2-B6).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Soils: Soils range from a thin layer of skeletal sandy loams to somewhat deep, mottled loamy sands over colluvial boulders. Total soil depth is never more than 7 ft (2 m), and is typically less than 3 ft (1 m). Consistent to all profiles is a deep, dark brown color and high organic content. Some of the soils from the Colorado River Basin classify as fragmental to fine clayey Cryorthents, Cryaquepts, Cryofluvents, Cryoborolls.

Vegetation: *Picea engelmannii* (Engelmann spruce) and/or *Abies lasiocarpa* (subalpine fir) provide a dense overstory of 20-100% cover immediately bordering and usually overhanging the stream. There is generally very little shrub cover, but occasionally, at high elevations, *Vaccinium myrtillus* (Rocky Mountain whortleberry) intergrades from the uplands into the riparian area with 0-50% cover. *Salix drummondiana* (Drummond willow), *Lonicera involucrata* (honeysuckle), and *Ribes* (currant) species can be present, but with less than 10% cover. The forb layer is dense and rich with 20-80% cover. Forb species nearly always present, but with widely varying abundance, include 0-50% cover of *Cardamine cordifolia* (bittercress), 0-40% cover of *Mertensia ciliata* (mountain bluebells), and 0-20% cover each of *Oxypolis fendleri* (cowbane), *Senecio triangularis* (arrowleaf groundsel) and *Micranthes odontoloma* (brook saxifrage).

Successional and Ecological Processes: Many first- and second-order streams run through subalpine spruce-fir forests providing habitats for obligate riparian shrubs, forbs, and grasses, forming the numerous riparian *Abies lasiocarpa-Picea engelmannii* plant associations. Although *Abies lasiocarpa* and *Picea engelmannii* are not obligate riparian species, the two species strongly influence forested subalpine riparian ecosystems.

The successional process of the spruce-fir forest is complex. Some ecologists suggest that *Abies lasiocarpa* and *Picea engelmannii* are in equilibrium and form a stable climax community. Others suggest that the two species coexist in nonequilibrium and that given enough time, either *Abies lasiocarpa* or *Picea engelmannii* will dominate the overstory (Aplet *et al*. 1988). The literature reviewed here suggests that the spruce-fir forest will never become a single-species dominated "climax" forest, but rather is a perpetually changing mosaic of patches that are of different ages and composition. The successional dynamics of the forest is a complex interaction of local site physical characteristics, the

life history traits of spruce and fir, and the confounding effects of fire, windthrow and insect outbreak acting at both large (entire stand) and small (individual trees) scales. These interacting affects are outlined below.

Abies lasiocarpa has greater reproductive success in the shaded forest than *Picea engelmannii* (Peet 1981) and lives for approximately three hundred years. *Picea engelmannii* has a lower rate of establishment, but commonly lives longer than five hundred years (Aplet *et al*. 1988). In Colorado, all age classes of both species are generally found within the riparian zone.

The fire frequency of *Abies lasiocarpa* and *Picea engelmannii* in moist areas is lower than on the dry upland sites (Peet 1981), but the trees in riparian areas do burn. Following a crown fire, both *Abies lasiocarpa* and *Picea engelmannii* colonize the burned area. *Picea engelmannii* establishment is greater for the first several decades, but as the ground becomes shaded, *Abies lasiocarpa* seedlings increase in abundance (Veblen *et al*. 1991). As the stand matures, the faster-growing *Picea engelmannii* overtops *Abies lasiocarpa* in mesic sites. Eventually, the shorter-lived *Abies lasiocarpa* begin to die, leaving small gaps in the canopy in which a new generation of mainly *Abies lasiocarpa* seedlings establish (Peet 1981).

Windthrow and insect attack also affect the composition and age structure of *Abies lasiocarpa* and *Picea engelmannii* stands. Fallen trees, downed by wind or left as logging debris, act as hosts to the endemic spruce beetle (*Dendroctonus rufipennis*), the most damaging insect to *Picea engelmannii*. During periodic rises in its population, however, the beetle infests large areas of live trees, selectively attacking and killing individuals with diameters greater than 4 in (10 cm) (Veblen *et al*. 1991). The dead trees remain standing for years. Instead of being replaced by new seedlings, young *Abies lasiocarpa* and *Picea engelmannii* saplings are "released" from competition and grow to fill in the canopy (Veblen *et al*. 1991).

Adjacent Riparian Vegetation: This plant association commonly dominates the entire stream reach and is rarely part of a mosaic. However, adjacent riparian vegetation can include *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests and *Alnus incana* (thinleaf alder) shrublands. Along steep, narrow streams adjacent to broader valleys, *Salix geyeriana* (Geyer willow) *Salix planifolia* (planeleaf willow) shrublands occur in adjacent riparian areas.

Adjacent upland vegetation: The upland vegetation is *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) and *Populus tremuloides* (aspen) forests.

Management: Forage value of this plant association is minimal due to the limited understory. Soils may be easily compacted by livestock grazing along the wet, mossy stream banks (Hansen et al. 1995).

Timber productivity is fairly low. Management usually considers *Picea engelmannii* the most productive species. However, consideration must be given to the uneven-aged

structure and the inability of *Picea* to regenerate without providing protection for seedling survival. Small clearcuts, shelterwood, or group or individual tree selection methods should be designed to prevent seedling mortality from frost, desiccation from winter winds, sunscald, and soil movement (Youngblood and Mauk 1985).

Subalpine fir-Engelmann spruce/Drummond willow (*Abies lasiocarpa-Picea engelmannii/Salix drummondiana*) plant association

Colorado Natural Heritage Program Rank: G5/S4

General Description and Comments: The *Abies lasiocarpa-Picea engelmannii/Salix drummondiana* (subalpine fir-Engelmann spruce/Drummond willow) plant association is a heavily forested type found along steep, narrow first-order streams above 9,000 ft (2,700 m) where *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests also occur on adjacent hillslopes. Tall *Salix drummondiana* (Drummond willow) grows in a thick band along the edge of the stream. *Alnus incana* (thinleaf alder) can become a co-dominant of *Salix drummondiana* (Drummond willow) at mid-elevations. *Picea pungens* is occasionally present at the stream edge and represents a variation of this type.

Classification Problems: The *Abies lasiocarpa-Picea engelmannii/Alnus incana* ssp. *tenuifolia-Salix drummondiana* has been split into two closely related plant associations: the *Abies lasiocarpa-Picea engelmannii/Alnus incana* plant association, which occurs at lower elevations and has *Alnus incana* in the understory; and the *Abies lasiocarpa-Picea engelmannii/Salix drummondiana* plant association, which occurs at higher elevations and has very little to no *Alnus incana* in the understory (Kittel et al. 1996). Stands with both *Alnus incana* and *Salix drummondiana* appear to be transitional between these two plant associations.

Related Types/Synonyms: The *Abies lasiocarpa/Salix drummondiana* plant association (Kittel *et al*. 1996, Kittel *et al*. 1995, Richard *et al*. 1996), the *Abies lasiocarpa-Picea engelmannii/Alnus incana* ssp. *tenuifolia-Lonicera involucrata-Salix drummondiana* plant association (Baker 1989), and the *Abies lasiocarpa/Alnus incana* ssp. *tenuifolia-Salix* plant association (Bourgeron and Engelking 1994) are considered synonymous with the Colorado *Abies lasiocarpa-Picea engelmannii/Salix drummondiana* plant association. Closely related communities include the Picea*/Cornus stolonifera* (spruce/red-osier dogwood) community type (Youngblood et al. 1985) which has similar overstory species, but has a dense shrub layer of *Alnus incana* and with only occasional *Salix drummondiana,* the *Picea/Cornus stolonifera* and *Picea/Equisetum arvense* (spruce/field horsetail) habitat types (Hansen et al. 1995) which can have abundant *Salix drummondiana* and *Alnus incana*, but also a more diverse tree species component.

Regional Distribution: This association occurs in Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs in the San Juan Mountains (Richard et al. 1996), and the Colorado, Gunnison, Arkansas, and South Platte River Basins (Kittel et al. 1994, Kittel *et al*. 1995, Kittel *et al*. 1996). Examples of this community type can be found in the Middle Fork of Spring Creek PCA.

Elevation Range: 8,400-10,900 ft (2,600-3,300 m).

Site Geomorphology: Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). This plant association is commonly found on steep (2-25% gradient), narrow (<10 m), first-order streams in moderate to deep V-shaped valleys (Rosgen's Channel Type: A2, A3, A4, A5). The thick shrub canopy is restricted to a narrow band along the rocky stream bank. It can also occur in wider valleys along moderate gradient reaches with channel bottoms that range from bedrock to gravel (Rosgen's Channel Type: B1, B2, B3, and B4). One site in the Gunnison River Basin occurs along a braided stream channel (Rosgen's Channel Type: D2).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Soil: Soils are typically shallow (<1 m) sandy loams to sandy clay loams packed between large angular boulders and cobbles with a thin layer of partially decomposed organic matter under the litter layer.

Vegetation: This plant association has a dense canopy of 20-90% cover of *Abies lasiocarpa* (subalpine fir) and *Picea engelmannii* (Engelmann spruce). *Picea pungens* (Colorado blue spruce) is occasionally present with 0-10% cover in lower elevation, wet stands, and *Pinus contorta* is present with 0-20% cover in early-seral stands. A narrow but dense strip of shrubs consists of 1-90% cover of *Salix drummondiana* (Drummond willow), 0-40% cover of *Salix monticola* (mountain willow), 0-30% cover each of *Salix brachycarpa* (barrenground willow) and *Salix planifolia* (planeleaf willow), and 0-20% cover of *Lonicera involucrata* (honeysuckle). *Alnus incana* (thinleaf alder) and *Cornus sericea* (red-osier dogwood) may be present in small amounts with 0-10% cover. The dense herbaceous undergrowth is characterized by 0-30% cover each of *Heracleum lanatum* (cow parsnip) and *Mertensia ciliata* (mountain bluebells), 0-20% cover each of *Micranthes odontoloma* (brook saxifrage) and *Cardamine cordifolia* (bittercress), and 0-10% cover each of *Mertensia fransiscana* (bluebells), *Senecio triangularis* (arrowleaf groundsel), and *Geranium richardsonii* (Richardson geranium). Graminoid cover is minor, but can include 0-30% cover of *Calamagrostis canadensis* (bluejoint reedgrass) and 0-5% cover of *Carex aquatilis* (water sedge).

Successional and Ecological Processes: Many first- and second-order streams run through subalpine spruce-fir forests providing habitats for obligate riparian shrubs, forbs, and grasses, forming the numerous riparian *Abies lasiocarpa-Picea engelmannii* plant associations. Although *Abies lasiocarpa* and *Picea engelmannii* are not obligate riparian species, the two species strongly influence forested subalpine riparian ecosystems.

The successional process of the spruce-fir forest is complex. Some ecologists suggest that *Abies lasiocarpa* and *Picea engelmannii* are in equilibrium and form a stable climax community. Others suggest that the two species coexist in nonequilibrium and that given enough time, either *Abies lasiocarpa* or *Picea engelmannii* will dominate the overstory (Aplet *et al*. 1988). The literature reviewed here suggests that the spruce-fir forest will never become a single-species dominated "climax" forest, but rather is a perpetually

changing mosaic of patches that are of different ages and composition. The successional dynamics of the forest is a complex interaction of local site physical characteristics, the life history traits of spruce and fir, and the confounding effects of fire, windthrow and insect outbreak acting at both large (entire stand) and small (individual trees) scales. These interacting affects are outlined below.

Abies lasiocarpa has greater reproductive success in the shaded forest than *Picea engelmannii* (Peet 1981) and lives for approximately three hundred years. *Picea engelmannii* has a lower rate of establishment, but commonly lives longer than five hundred years (Aplet *et al*. 1988). In Colorado, all age classes of both species are generally found within the riparian zone.

The fire frequency of *Abies lasiocarpa* and *Picea engelmannii* in moist areas is lower than on the dry upland sites (Peet 1981), but the trees in riparian areas do burn. Following a crown fire, both *Abies lasiocarpa* and *Picea engelmannii* colonize the burned area. *Picea engelmannii* establishment is greater for the first several decades, but as the ground becomes shaded, *Abies lasiocarpa* seedlings increase in abundance (Veblen *et al*. 1991). As the stand matures, the faster-growing *Picea engelmannii* overtops *Abies lasiocarpa* in mesic sites. Eventually, the shorter-lived *Abies lasiocarpa* begin to die, leaving small gaps in the canopy in which a new generation of mainly *Abies lasiocarpa* seedlings establish (Peet 1981).

Windthrow and insect attack also affect the composition and age structure of *Abies lasiocarpa* and *Picea engelmannii* stands. Fallen trees, downed by wind or left as logging debris, act as hosts to the endemic spruce beetle (*Dendroctonus rufipennis*), the most damaging insect to *Picea engelmannii*. During periodic rises in its population, however, the beetle infests large areas of live trees, selectively attacking and killing individuals with diameters greater than 4 in (10 cm) (Veblen *et al*. 1991). The dead trees remain standing for years. Instead of being replaced by new seedlings, young *Abies lasiocarpa* and *Picea engelmannii* saplings are "released" from competition and grow to fill in the canopy (Veblen *et al*. 1991).

The dense *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) overstory, thick *Salix drummondiana* (Drummond willow) shrub canopy, and thick forb undergrowth of this plant association indicate that it is late seral. High forb cover suggests that with time and further upper canopy closure, this association may shift to an *Abies lasiocarpa/Mertensia ciliata* (subalpine fir/bluebells) plant association. With a more open forest canopy, shrubs such as *Alnus incana* (thinleaf alder) or *Salix drummondiana* may be present. Stands with high cover of both *Salix drummondiana* and *Alnus incana* in the understory may be transitional as *Salix drummondiana* replaces *Alnus incana* at higher elevations.

Adjacent Riparian Vegetation: This plant association does not generally form a mosaic and is often the only riparian association along a stream reach. Adjacent riparian associations can include *Alnus incana* (thinleaf alder) or *Salix drummondiana* (Drummond willow) shrublands or *Populus angustifolia-Picea pungens* (narrowleaf cottonwood-Colorado blue spruce) forests along wider, moderate-gradient reaches.

Adjacent Upland Vegetation: *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests occur on adjacent hillsides, usually intergrading with the riparian canopy. *Populus tremuloides* (aspen) forests are also common and often intermix with the *Abies lasiocarpa-Picea engelmannii* forests. Mesic shrubs such as *Acer glabrum* (mountain maple) and *Symphoricarpos rotundifolius* (snowberry) occur on adjacent toeslopes.

Management: Forage value is high in this plant association when forb growth is abundant. However, grazing during wet periods can churn wet soil and destroy plant cover (Hansen et al. 1995). This association is sensitive to timber harvesting activities due to high soil moisture content. Timber productivity is fairly low and consideration must be given to the uneven-aged structure and the inability of *Picea* to regenerate without providing protection for seedling survival. Small clearcuts, shelterwood, or group or individual tree selection methods should be designed to prevent seedling mortality from frost, desiccation from winter winds, sunscald, and soil movement (Youngblood and Mauk 1985).

This type is poorly suited for roads, trails, or other developments. Protection of water resources is a major consideration for any management activity (The Nature Conservancy 1992).

Colorado blue spruce/red-osier dogwood (*Picea pungens/Cornus sericea*) plant association

Colorado Natural Heritage Program Rank: G4/S2

General Description and Comments: The *Picea pungens/ Cornus sericea* (Colorado blue spruce/red-osier dogwood) plant association is a cool, moist riparian woodland occurring in deep narrow canyons. It was once a more common type and represents slightly more stable habitats than those of the *Picea pungens/Alnus incana* (Colorado blue spruce/thinleaf alder) plant association. The *Picea pungens/Cornus sericea* association is characterized by an open to thick understory of *Cornus sericea*, deeply shaded by *Picea pungens* (Colorado blue spruce).

Related Types/Synonyms: The following two communities are synonymous with the Colorado *Picea pungens/Cornus sericea* plant association: the *Picea pungens/Amelanchier alnifolia-Cornus sericea* (Colorado blue spruce/serviceberry-red-osier dogwood) plant association (Hess and Wasser 1982, Kittel *et al*. 1994, Kittel *et al*. 1995, Komarkova 1986) and the *Picea pungens/Amelanchier alnifolia-Swida sericea* (Colorado blue spruce/serviceberry-red-osier dogwood) plant association (Johnston 1987). *Swida sericea* is a synonym for *Cornus sericea* (Kartesz 1994).

Closely related communities include: the *Picea* spp./*Cornus sericea* community type (Youngblood et al. 1985) and the conifer/*Cornus sericea* type (Padgett et al. 1989), which have conifers other than *Picea pungens* as the dominant overstory species.

Regional Distribution: This plant association occurs in Arizona, northern New Mexico (DeVelice et al. 1985, Bourgeron and Tuhy 1989), western Wyoming (Youngblood et al. 1985), and Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs in the San Miguel/Dolores, Gunnison, Colorado, and White River Basins, and on the Routt and San Juan National Forests (DeVelice et al. 1985, as cited in Johnston 1987, Hess and Wasser 1982, Johnston 1987, Kittel and Lederer 1993, Kittel *et al*. 1994, Kittel *et al*. 1995, Komarkova 1986, and Richard *et al*. 1996). Examples of this community type can be found in the Roubideau Creek PCA.

Elevation Range: 7,000-8,500 ft (2,100-2,600 m).

Site Geomorphology: This plant association occurs on floodplains and benches in narrow valleys, 20-100 ft (7-30 m) wide, with variable stream gradients (1-10%). Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). It occurs along broad, slightly meandering channel reaches (Rosgen's Channel Type: B2, B3, B4) and occasionally along steep and narrow reaches (Rosgen's Channel Type: A3, A6).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Soil: The soils of this plant association are deep, dark-colored clay loams to sandy loams, often with signs of mottling. Coarse fragments range from 0-50% with the percentage increasing with depth. There may be high organic matter in the top layers.

Vegetation: The overstory of this plant association is an open to dense canopy of *Picea pungens* (Colorado blue spruce) with 15-60% cover. *Populus tremuloides* (quaking aspen) is occasionally present with 0-50% cover. *Cornus sericea* (red-osier dogwood) forms an open to dense shrub layer with 5-80% cover. Other shrubs include *Betula occidentalis* (river birch) with 0-30% cover, *Alnus incana* (thinleaf alder) and *Salix drummondiana* (Drummond willow) with 0-20% cover, and *Acer glabrum* (Rocky Mountain maple), *Lonicera involucrata* (honeysuckle), and *Amelanchier utahensis* (Utah serviceberry) with 0-10% cover each. Understory vegetation is sparse with less than 20% cover.

Successional and Ecological Processes: In deep, narrow canyons with swift-moving streams and narrow floodplains and benches, *Picea pungens* (Colorado blue spruce) appears to be a climax riparian species. *Picea pungens* will remain until removed or damaged by a catastrophic flood (Padgett et al. 1989). *Cornus sericea* (red-osier dogwood) is more abundant on level sites where water tables are periodically high (Johnston 1987).

Adjacent Riparian Vegetation: *Populus angustifolia* (narrowleaf cottonwood) and *Picea pungens* (Colorado blue spruce) forests and *Alnus incana* ssp. *tenuifolia* (thinleaf alder), *Cornus sericea* (red-osier dogwood), *Salix monticola* (mountain willow), and *Salix drummondiana* (Drummond willow) shrublands occur in adjacent riparian areas.

Adjacent upland vegetation: At higher elevations, *Pseudotsuga menziesii* (Douglas-fir), *Pinus ponderosa* (ponderosa pine) forests occur on adjacent hill slopes. At lower elevations, *Populus tremuloides* (quaking aspen) and *Pinus edulis-Juniperus osteosperma* (pinyon pine-one-seed juniper) woodlands and *Quercus gambelii* (Gambel oak) and *Artemisia tridentata* (big sagebrush) shrublands occur on adjacent hillslopes.

Management: Due to heavy shading, this plant association provides low forage value for livestock. *Cornus sericea* (red-osier dogwood) is considered to be an "ice cream" plant (e.g., it is readily eaten and is a preferred browse species) for livestock and has moderate to high forage production. In open areas, livestock use can be quite high. Dense stands of *Cornus sericea*, however, may restrict livestock access (Hansen *et al*. 1995). *Cornus sericea* can survive all the but the most severe fires. After fire, new shoots sprout from the surviving rhizomes (Hansen *et al*. 1995).

Cornus sericea is a very effective stream bank stabilizer and should be considered for revegetating degraded sites. The rapid growth following direct seeding or transplanting allows this shrub to quickly establish on stream banks (Hansen *et al*. 1995).

Narrowleaf cottonwood/thinleaf alder (*Populus angustifolia/Alnus incana ssp. tenuifolia*) plant association

Colorado Natural Heritage Program Rank: G3?/S3

General Description and Comments: The *Populus angustifolia/Alnus incana* ssp. *tenuifolia* (narrowleaf cottonwood/thinleaf alder) plant association is characterized by a dense stand of *Alnus incana* lining the stream bank and an open to nearly closed canopy of *Populus angustifolia*. Other shrubs may occur but *Alnus* (thinleaf alder) has at least 10-20% cover and is the most abundant of all other shrubs within the stand. It occurs along narrow, fast-moving stream reaches in montane areas.

Classification Problems: Both *Populus angustifolia* and mixed *Populus angustifolia*-conifer plant associations are in the classification. The criteria for identifying *Populus angustifolia* dominated associations is that *Populus angustifolia* has at least 20% canopy cover. If any conifer species are present, they have a canopy cover total of no more than 10%.

Related Types/Synonyms: The *Populus angustifolia/Alnus incana* (narrowleaf cottonwood/thinleaf alder) community type (Durkin et al.1994) is synonymous with the Colorado *Populus angustifolia/Alnus incana* plant association. The *Populus angustifolia/Alnus incana* type (Walford 1993) is not synonymous with the Colorado association of the same name. Walford's association appears to be more closely aligned with the *Populus angustifolia/Salix exigua* (narrowleaf cottonwood/ coyote willow) plant association as it occurs on coarse alluvial point bars and consists of mostly young trees.

Two closely related communities have *Populus angustifolia* (narrowleaf cottonwood) and *Alnus incana* (thinleaf alder), but a higher abundance of other shrub species (mainly *Cornus sericea*, red-osier dogwood). These community types are the *Populus angustifolia/Cornus sericea* (narrowleaf cottonwood/red-osier dogwood) (Padgett et al. 1989, Hansen et al.1995) and the *Populus angustifolia/Alnus incana-Cornus sericea* (narrowleaf cottonwood/thinleaf alder-red-osier dogwood) plant association (Johnston 1987).

Regional Distribution: This plant association occurs in New Mexico (Durkin et al. 1994) and Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs on the West Slope in the Yampa and Gunnison River Basins and the San Juan National Forest (Kittel et al. 1993, Kittel et al. 1994, Richard *et al*. 1996). It also occurs along the Front Range in the Arkansas and South Platte River Basins (Kittel et al. 1996, Kittel et al. 1997). Examples of this community type can be found in the Red Creek PCA.

Elevation Range: 6,200-8,900 ft (1,900-2,700 m).

Site Geomorphology: This plant association occurs on active floodplains in narrow to broad valleys. It forms a narrow, dense band along stream banks and benches. Some of the stands have signs of recent flooding. Stream gradient and channel width are highly variable. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Some sites occur along steep, narrow reaches with little sinuosity (Rosgen's Channel Type: A2-A4). Other sites occur along low gradient, moderately sinuous, broad channel reaches (Rosgen's Channel Type: B2-B5), low gradient, highly sinuous reaches (Rosgen's Channel Type: C3, C4), or very narrow and highly sinuous stream sections (E5, E6).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Soils: Soils are mostly coarse textured ranging from deep sands to shallow sandy loams. Some profiles show stratification with loams to clay loams alternating with sands. Most profiles become skeletal at an average depth of 12 in (30 cm).

Vegetation: This plant association has an open to dense canopy of up to 80% cover of *Populus angustifolia* (narrowleaf cottonwood). *Abies concolor* (white fir), *Pseudotsuga menziesii* (Douglas-fir), or *Picea pungens* (Colorado blue spruce) may occasionally co-dominate the overstory with <10% cover. The shrub understory is dominated by a dense band of 10-90% cover of *Alnus incana* ssp. *tenuifolia* (thinleaf alder) lining the stream bank. A wide variety of other shrubs may be present including 0-40% cover of *Salix bebbiana* (Bebb willow), *Salix monticola* (mountain willow), *Salix drummondiana* (Drummond willow), *Salix eriocephala* var. *ligulifolia* (strapleaf willow), *Salix lucida* var. *caudata* (whiplash willow), or *Salix exigua* (coyote willow), 0-30% cover of *Cornus sericea* (red-osier dogwood), 0-20% cover of *Rosa woodsii* (wood's rose), 0-15% cover of *Acer glabrum* (Rocky Mountain maple), and 0-10% cover of *Betula occidentalis* (river birch). The herbaceous undergrowth is generally sparse due to the dense overstory.

Successional and Ecological Processes: Cottonwood woodlands grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation is constantly being "re-set"' by flooding disturbance. Cottonwood communities are early, mid- or late-seral, depending on the age class of the trees and the associated species of the stand. Cottonwoods, however, do not reach a climax stage as defined by Daubenmire (1952). Mature cottonwood stands do not regenerate in place, but regenerate by "moving" up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities.

The process of cottonwood regeneration is well documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly deposited moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment during lesser flows. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel.

In this newly elevated position, with an absence of excessive browsing, fire, and agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes stream banks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations and habitats (The Nature Conservancy 1996).

As cottonwoods mature, other tree species may become established. If the landsurface is subject to reworking by the river, the successional processes will start over with erosion and subsequent flooding deposition. If the land surface is not subject to alluvial processes, for example, a high terrace, the cottonwoods will be replaced by upland shrub and/or tree species that may comprise the climatic climax plant association for that area.

Alnus incana ssp. *tenuifolia* (thinleaf alder) is a long-lived, early-seral species. It is one of the first species to establish on fluvial or glacial deposits as well as the spoils of placer mining (Viereck 1970, Van Cleve *et al*. 1971, Chapin *et al*. 1994, Hansen et al. 1989). After establishment, young stands of *Alnus incana* are continually flooded. As stands mature, the stems can slow flood waters and trap sediment. Fine-textured sediments accumulate on top of the coarser alluvial material and the land surface eventually rises above annual flood levels. Flooding is then less frequent and soils begin to develop (Padgett et al. 1989).

Alnus incana is shade-intolerant (Viereck 1970, Chapin *et al*. 1994), and many mature stands in Colorado are restricted to stream bank edges, possibly because these are the only sites where light can penetrate the neighboring overstory canopy. *Alnus incana* has been observed on high-gradient streams and is thought to require well-aerated water (Hansen *et al*. 1988, Padgett et al. 1989).

Alnus incana (thinleaf alder) fixes atmospheric nitrogen through a symbiotic relationship with the bacteria *Frankia* and increases the ecosystem nitrogen supply with the deposition of nitrogen-rich leaf litter (Binkley 1986). The annual input of nitrogen to soils from alder species ranges from 16 to 150 kg/ha annually compared to 1 to 10 kg/ha/yr deposited by atmospheric precipitation alone (Binkley 1986, Bowman and Steltzer *in press*). Nitrogen rich detritus is an important source of nutrients for the aquatic ecosystem as well.

The *Populus angustifolia/Alnus incana* (narrowleaf cottonwood/thinleaf alder) plant association is considered mid-seral. Without flooding the stream banks may become dominated by north-facing upland communities such as *Pseudotsuga menziesii* (Douglas-fir) or *Juniperus* (juniper) species.

Adjacent Riparian Vegetation: In narrow canyons, the *Populus angustifolia/Alnus incana* (narrowleaf cottonwood/thinleaf alder) plant association is often the only community along stream banks. Along wider stream reaches, this association is adjacent to stands of *Pseudotsuga menziesii* (Douglas-fir), *Populus angustifolia* (narrowleaf cottonwood), and *Quercus gambelii* (Gambel oak). Younger *Populus angustifolia* stands often occur on adjacent point bars and fresh alluvial deposits. *Carex utriculata* (beaked

sedge) meadows or *Alnus incana* (thinleaf alder), *Betula occidentalis* (water birch), or *Salix* (willow) shrublands occur on the floodplain.

Adjacent Upland Vegetation: At lower elevations, south-facing slopes have *Pinus edulis*-*Juniperus monosperma* (pinyon pine-one-seed juniper) woodlands. North-facing slopes often have mixed conifer-*Populus tremuloides* (quaking aspen) forests or thick to scattered stands of *Pseudotsuga menziesii* (Douglas-fir) and *Quercus gambelii* (Gambel oak). At higher elevations, *Pseudotsuga menziesii*-mixed conifer forests or barren talus are on adjacent slopes.

Management: Because the regeneration and establishment of new stands of cottonwood is dependent upon flooding events, any alteration to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows and reduce flooding frequency and magnitude. This results in fewer flood events that provide conditions for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association is high and very palatable to livestock. Cattle frequently browse cottonwood seedlings and saplings and the nitrogen-rich Alnus incana (thinleaf alder) leaves. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. If grazed cottonwood dominated riparian areas in Colorado should only be grazed moderately for short periods during the growing season or solely during the winter season (Hansen *et al* 1995).

Alnus incana is an excellent stream bank stabilizer because of its rhizomatous roots. Young stands can re-sprout after flood damage or fire and can tolerate a short duration of standing water (Hansen et al. 1995). In addition, alder provides overbank shading, and nutrient inputs, important for fish and other aquatic critters.

Narrowleaf cottonwood/red-osier dogwood (*Populus angustifolia/Cornus sericea*) plant association

Colorado Natural Heritage Program Rank: G4/S3

General Description and Comments: The *Populus angustifolia/Cornus sericea* (narrowleaf cottonwood/red-osier dogwood) plant association is found along moderate-size rivers in the montane zone. It is highly variable in the number of conifer and shrub species present along the reach. However, it is generally recognized by a clear dominance of *Populus angustifolia* with less than 10% cover of other tree species and a thick understory of *Cornus sericea*.

Classification Problems: Distinguishing *Populus angustifolia* (narrowleaf cottonwood) plant associations from mixed *Populus angustifolia*-conifer plant associations requires that there be at least 20% cover of *Populus angustifolia* and less than 10% cover of conifers along the entire reach.

Related Types/Synonyms: The following six communities are all considered synonymous with the Colorado *Populus angustifolia/Cornus sericea* plant association: 1) the *Populus angustifolia/Cornus sericea--Betula occidentalis* phase, the *Populus angustifolia/Amelanchier alnifolia,* 2) the *Populus angustifolia/Amelanchier utahensis/Smilacina stellata*, 3) the *Populus angustifolia/Amelanchier* species (Johnston 1987, Colorado Natural Heritage Program 1999), 4) the *Populus angustifolia/ Amelanchier alnifolia/Smilacina stellata* (*Crataegus rivularis*-*Cornus sericea* phase) plant association (Hess and Wasser 1982), 5) the *Populus angustifolia/Cornus sericea* community type (Hansen *et al*. 1989, Padgett et al. 1989, Youngblood et al. 1985), and 6) the *Populus/Cornus sericea* community type occurs in Nevada (Manning and Padgett 1995).

Closely related communities include the *Populus angustifolia/Betula occidentalis* (narrowleaf cottonwood/river birch) community type (Padgett et al. 1989), which has more abundant and consistent *Betula occidentalis*, the *Populus angustifolia/Prunus virginiana* (narrowleaf cottonwood/chokecherry) ecological type (Girard et al. 1995) which has a dense herbaceous understory and little, if any, *Cornus sericea* shrub cover, the *Populus angustifolia/Rosa woodsii* (narrowleaf cottonwood/wood's rose) community type (Girard et al. 1995 and Padgett et al. 1989) which may have *Cornus sericea* (red-osier dogwood), and the *Populus angustifolia-Acer negundo*/mixed shrub/mixed graminoid-mixed forb vegetation type in New Mexico (Dick-Peddie 1993).

Regional Distribution: This plant association occurs in Nevada (Manning and Padgett, 1995), Idaho (Youngblood et al. 1985), Utah (Padgett et al. 1989), Wyoming (Johnston 1987), Colorado (Johnston 1987 and Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs throughout the Rocky Mountains of Colorado (Johnston 1987, Hess and Wasser 1982, Jankovsky-Jones 1994,

Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Richard et al. 1996). Examples of this community type can be found in the Roubideau Creek PCA.

Elevation Range: 6,000-8,700 ft (1,800-2,700 m).

Site Geomorphology: The *Populus angustifolia/Cornus sericea* (narrowleaf cottonwood/red-osier dogwood) plant association occurs in narrow to wide valleys, 30-500 ft (10-150 m), having variable gradients (1-16.5%) and moderately steep stream channels (2-5% gradient). This association occurs on narrow benches along narrow stream channels and on large floodplains along broad, meandering rivers. This association usually occurs between 2 to 10 ft (0.5-2 m) above the stream channel. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Stream channels vary widely in slope and width including broad, moderately sinuous, and moderate-gradient reaches (Rosgen's Channel Type: B2-B6), and broad, highly sinuous, low-gradient, reaches (Rosgen's Channel Type: C2, C3, C5). Occasionally, stream channels are steep and narrow (Rosgen's Channel Type: A5).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional to rare flooding.

Wetland Soil: Soils are highly variable and stratified. Soil textures include silty clays, silty clay loams, clay loams, sandy clays, sandy clay loam, and loamy sands. The soils are 1.5-3 ft (0.5-1 m) deep and become skeletal at depth. Soils in the White and Colorado River Basins classify as argic pachic Cryoborolls on terraces, and typic or oxyaquic Cryorthents, typic Craquents, lithic ustic Torriorthents, udic Ustorthents and sandy oxyaquic Cryofluvents on lower floodplains.

Vegetation: This is one of the most diverse cottonwood-dominated riparian plant associations. The upper canopy consists of several species, but *Populus angustifolia* (narrowleaf cottonwood) is always dominant with 20-70% cover. Other trees include 0-30% cover of *Acer negundo* (boxelder), 0-20% cover each of *Juniperus scopulorum* (Rocky Mountain juniper), *Picea pungens* (Colorado blue spruce), and *Pinus ponderosa* (ponderosa pine), 0-10% cover of *Picea engelmannii* (Engelmann spruce), and, if present, less than 5% cover of *Pseudotsuga menziesii* (Douglas-fir).

The shrub layer is dense and diverse with 10-80% cover of *Cornus sericea* (red-osier dogwood), 0-40% cover of *Alnus incana* (thinleaf alder), 0-30% cover each of *Amelanchier utahensis* (Utah serviceberry), *Rosa woodsii* (wood's rose), *Acer glabrum* (Rocky Mountain maple), *Quercus gambelii* (Gambel oak), and *Salix* (willow) species, 0-25% cover of *Crataegus rivularis* (river hawthorn), 0-20% cover of *Lonicera involucrata* (honeysuckle), and 0-10% cover of *Amelanchier alnifolia* (serviceberry). In stands where aspect and shade provide a moist environment, the herbaceous cover can be as much as 50%. Forb species include 0-50% cover of *Maianthemum stellatum* (false Solomon seal), 0-20% cover of *Heracleum lanatum* (cow parsnip), and 0-10% cover each of *Achillea millefolium* var. *alpicola* (milfoil yarrow), and *Osmorhiza depauperata* (blunt-fruit sweet cicely). Graminoid cover is insignificant. Other sites are relatively dry with a sparse

herbaceous undergrowth (<10% cover) and a number of exotic, hay meadow grasses, probably introduced from cattle grazing.

Successional and Ecological Processes: Cottonwood woodlands grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation is constantly being "re-set"' by flooding disturbance. Cottonwood communities are early, mid- or late seral, depending on the age class of the trees and the associated species of the stand. Cottonwoods, however, do not reach a climax stage as defined by Daubenmire (1952). Mature cottonwood stands do not regenerate in place, but regenerate by "moving" up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities.

The process of cottonwood regeneration is well documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel.

In this newly elevated position, with an absence of excessive browsing, fire, and agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes stream banks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations and habitats (The Nature Conservancy 1996).

As cottonwoods mature, other tree species may become established. If the landsurface is subject to reworking by the river, the successional processes will start over with erosion and subsequent flooding deposition. If the land surface is not subject to alluvial processes, for example a high terrace, the cottonwoods will be replaced by upland shrub or tree species that may comprise the climax plant association for that area.

Hansen et al. (1989) describes three stages of disturbance of the *Populus angustifolia/Cornus sericea* plant association. Relatively undisturbed sites have a dense, rich shrub layer of *Cornus sericea* (red-osier dogwood)*, Amelanchier alnifolia* (serviceberry)*, Prunus virginiana* (chokecherry)*,* and several *Salix* (willow) and *Ribes* (currant) species. Moderately disturbed sites have *Symphoricarpos* (snowberry) and *Rosa* (rose) species that increase in abundance as the previously mentioned shrub species decrease in cover. With continued disturbance, *Rosa* and *Symphoricarpos* species may become quite abundant until eventually, shrub cover begins to decline and the site dries out.

Padgett et al. (1989) suggests that the *Populus angustifolia/Cornus sericea* (narrowleaf cottonwood/red-osier dogwood) plant association may be an early- to mid-seral association due to its proximity to the channel. If the channel and resulting terraces remain stable, a conifer/Cornus sericea type may replace this association. In Colorado, some stands of the *Populus angustifolia/Cornus sericea* association appear to be mid- to

late-seral, mature cottonwood forests that are isolated from frequent flooding and sediment deposition. In the late-seral *Populus angustifolia* (narrowleaf cottonwood) stands, *Cornus sericea* (red-osier dogwood) requires a seasonally high water table in order to persist (Padgett et al. 1989). Stands of this association growing at lower elevations and on higher terraces are drier and show signs of heavy grazing. These stands have a greater cover of *Amelanchier utahensis* (Utah serviceberry), *Amelanchier alnifolia* (serviceberry) and *Crataegus rivularis* (river hawthorn) and may indicate over-grazing.

Observations made throughout the western slope of Colorado concur with the assessment made by Padgett *et al*. (1989) (Kittel and Lederer 1993). The *Populus angustifolia/Cornus sericea* plant association was probably once widespread throughout its elevation range in Colorado. Pristine, large examples of this community are now rare in Colorado.

Adjacent Riparian Vegetation: Adjacent riparian areas include woodlands of *Populus angustifolia* (narrowleaf cottonwood). Adjacent shrublands include stands of *Salix exigua* (coyote willow) on pointbars and *Salix monticola* (mountain willow), *Salix boothii* (Booth willow), and *Alnus incana* (thinleaf alder) on the stream banks. *Carex utriculata* (beaked sedge) wetlands also occur.

Adjacent upland vegetation: The vegetation on adjacent hillslopes includes *Picea engelmannii* (Engelmann spruce), *Pseudotsuga menziesii* (Douglas-fir), and *Pinus ponderosa* (ponderosa pine) forests, *Pinus edulis-Juniperus osteosperma* (pinyon pine-Utah juniper) woodlands, *Quercus gambelii* (Gambel oak) and *Artemisia tridentata* (big sagebrush) shrublands.

Management: Because the regeneration and establishment of new stands of cottonwood is dependent upon flooding events, any alteration to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows and reduce flooding frequency and magnitude. This results in fewer flood events that provide conditions for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association can be high and very palatable to livestock. Cottonwood seedlings and saplings are frequently browsed by cattle and *Cornus sericea* (red-osier dogwood) is considered to be an “ice cream” plant (e.g., it is readily eaten and is a preferred browse species) to livestock and wildlife. Excessive grazing and browsing in this association will reduce plant vigor and allow non-native plant species to gain a competitive advantage. If grazed cottonwood dominated riparian areas in Colorado should only be grazed moderately for short periods during the growing season or solely during the winter season (Hansen et al. 1995). *Cornus sericea* (red-osier dogwood) provides good stream bank stability due its rhizomatous growth.

Narrowleaf cottonwood/river hawthorn (*Populus angustifolia/Crataegus rivularis*) plant association

Colorado Natural Heritage Program Rank: G2?/S2?

General Description and Comments: The *Populus angustifolia/Crataegus rivularis* (narrowleaf cottonwood/river hawthorn) plant association is characterized by having dense to sparse canopy cover of mature *Populus angustifolia* (narrowleaf cottonwood) trees. The understory is typically very dense and consists of *Crataegus rivularis* (river hawthorn) and other shrub species including *Cornus sericea* (red-osier dogwood) and various tall *Salix* (willow) species. Graminoid and forb cover is minimal. This association generally occurs away from the immediate stream bank in moderately wide valleys. It also occurs along dry back channels or ephemeral streams.

Related Types/Synonyms: Two communities in the literature are closely related to the Colorado *Populus angustifolia/ Crataegus rivularis* plant association, but contain significant amounts of additional species. These related communities are: the *Populus angustifolia/Amelanchier alnifolia* (narrowleaf cottonwood/ serviceberry) plant association and the *Populus angustifolia/ Cornus sericea* plant association phase *Cornus sericea-Crataegus rivularis* (red-osier dogwood-river hawthorn phase) described by Johnston (1987).

Regional Distribution: The *Populus angustifolia/Crataegus rivularis* (narrowleaf cottonwood/river hawthorn) plant association is described only from Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs in the San Juan National Forest (Richard et al. 1996). Examples of this community type can be found in the McKenzie Creek PCA.

Elevation Range: 6,900-8,000 ft (2,100-2,400 m).

Site Geomorphology: This plant association occurs in moderate to wide valleys back from the main channel, along dry backchannels or along ephemeral streams. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Stream channels are wide and moderately to highly sinuous (Rosgen's Channel Type: B3 and C6).

Wetland Description: Riverine wetland with a seasonal hydroperiod and ocasional to rare flooding.

Soils: The soils are sandy clays and highly stratified alluvium.

Vegetation: *Populus angustifolia* (narrowleaf cottonwood) forms a space to dense canopy with 40-60% cover. *Crataegus rivularis* (river hawthorn) forms a dense shrub canopy with 10-70% cover. *Salix bebbiana* (Bebb willow), *Salix eriocephala* var.

ligulifolia (yellow willow), and *Salix monticola* (mountain willow) can occur as a co-dominant species with 0-20% cover each. Other shrub species are present, but contribute little cover. Graminoid and forb cover is insignificant.

Successional and Ecological Processes: Cottonwood woodlands grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation is constantly being "re-set"' by flooding disturbance. Cottonwood communities are early, mid- or late seral, depending on the age class of the trees and the associated species of the stand. Cottonwoods, however, do not reach a climax stage as defined by Daubenmire (1952). Mature cottonwood stands do not regenerate in place, but regenerate by "moving" up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities.

The process of cottonwood regeneration is well documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel.

In this newly elevated position, with an absence of excessive browsing, fire, and agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes stream banks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations and habitats (The Nature Conservancy 1996).

As cottonwoods mature, other tree species may become established. If the landsurface is subject to reworking by the river, the successional processes will start over with erosion and subsequent flooding deposition. If the land surface is not subject to alluvial processes, for example a high terrace, the cottonwoods will be replaced by upland shrub or tree species that may comprise the climax plant association for that area.

An abundance of *Crataegus rivularis* (river hawthorn) may indicate a late seral stage of the cottonwood stand. *Crataegus* occupies the driest part of the riparian habitat, and may indicate the surface is no longer flooded. In Montana, thickets of *Crataegus* are considered a grazing disclimax. Cattle will browse *Crataegus* and heavy pressure can cause thickets to become open and increaser species such as *Rosa woodsii* (rose), *Symphoricarpos* (snowberry) and *Poa pratensis* (Kentucky bluegrass) become established and abundant (Hansen et al. 1995).

Adjacent Riparian Vegetation: Adjacent riparian communities on the floodplain may include other *Populus angustifolia* (narrowleaf cottonwood) woodlands and *Salix monticola* (mountain willow) thickets.

Adjacent Upland Vegetation: *Pinus ponderosa* (ponderosa pine) and *Populus tremuloides* (quaking aspen) woodlands and *Quercus gambelii* (Gambel oak) occur on the upslopes.

Management: Because the regeneration and establishment of new stands of cottonwood is dependent upon flooding events, any alteration to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows and reduce flooding frequency and magnitude. This results in fewer flood events that provide conditions for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association can be high and very palatable to livestock. Since cottonwood seedlings and saplings are frequently browsed by cattle, cottonwood dominated riparian areas in Colorado should only be grazed moderately for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity (Hansen et al. 1995).

In Montana, thickets of *Crataegus* are considered a grazing disclimax. Cattle will browse *Crataegus* and heavy pressure can cause thickets to become open and increaser species such as *Rosa woodsii* (rose), *Symphoricarpos* (snowberry) and *Poa pratensis* (Kentucky bluegrass) become established and abundant (Hansen et al. 1995).

Crataegus is fire tolerant and has been known to send up sucker sprouts after a fire. Dense thickets provide excellent hiding cover for wildlife species and the berries are food source many birds (Hansen et al. 1995).

Narrowleaf cottonwood-Rocky Mountain juniper (*Populus angustifolia-Juniperus scopulorum*) plant association

Colorado Natural Heritage Program Rank: G2G3/S2

General Description and Comments: *Populus angustifolia* (narrowleaf cottonwood) and *Juniperus scopulorum* (Rocky Mountain juniper) dominated riparian areas are uncommon. The community occurs along lower foothill streams with perennial to intermittent stream flows. Total biomass and canopy cover is usually low. An open canopy of *Populus angustifolia* (narrowleaf cottonwood) and *Juniperus scopulorum* (Rocky Mountain juniper) characterizes the association, often with little else growing in the understory. The species composition and percent cover is variable and depends on aspect, elevation, and stream flow, in addition to the degree of disturbance by recreational use and livestock grazing.

Related Types/Synonyms: Two plant associations are synonymous with the Colorado *Populus angustifolia-Juniperus scopulorum* plant association: the *Populus angustifolia/Physocarpus monogynus-Padus virginiana* (narrowleaf cottonwood/mountain ninebark-chokecherry) plant association (Gerard et al. 1995) and the *Populus angustifolia-Juniperus scopulorum* community type (Durkin *et al*. 1995).

Four communities are closely related to, but are not synonymous with, the Colorado *Populus angustifolia-Juniperus scopulorum* plant association. These communities have *Populus angustifolia* and *Juniperus scopulorum* in the name or descriptions, but have additional tree species not present in the Colorado association. These closely related communities include: *Populus angustifolia/Amelanchier alnifolia* (narrowleaf cottonwood/serviceberry) plant association (Johnston 1987), where *Juniperus scopulorum* is co-dominant, but *Pseudotsuga menziesii* (Douglas-fir), *Picea pungens* (Colorado blue spruce) and *Acer negundo* (boxelder) are present as well; *Populus angustifolia/Poa pratensis* (narrowleaf cottonwood/Kentucky blue grass) plant association (Cooper and Cottrell 1990) includes *Juniperus scopulorum*, but with only 0-10% canopy cover; and *Juniperus scopulorum* Dominance Type and *Juniperus scopulorum/Cornus sericea* (Rocky Mountain juniper/red-osier dogwood) Habitat Type (Hansen et al. 1988, Hansen et al. 1995), where *Populus angustifolia* is present but dying out and may indicate later successional stages of the *Populus angustifolia-Juniperus scopulorum* plant association.

Regional Distribution: The *Populus angustifolia-Juniperus scopulorum* plant association is known from Wyoming (Gerard *et al*. 1995) New Mexico (Durkin *et al*. 1995), and Colorado (Johnston 1987, Cooper and Cottrell 1990, Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs at lower elevations in the White River National Forest, in the Colorado River and Closed Basins, and along narrow foothill streams of the Front Range (Cooper and Cottrell 1990, Johnston 1987, Kittel et

al. 1994, Kittel et al.1996, Colorado Natural Heritage Program 1999). Examples of this community type can be found in the Pleasant Valley Creek PCA.

Elevation Range: 6,000-8,600 ft (1,800-2,600 m).

Site Geomorphology: This plant association occurs along stream banks of narrow ephemeral washes and creeks in steep-sided canyons. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Stream channels are steep and narrow with rocky to sandy bottoms (Rosgen Channel Type: A1-A5). This association can also occur on upper terraces and elevated islands of wide, meandering river reaches such as those found along the Arkansas and Colorado Rivers (Rosgen Channel Type: B4-B5 C3, C4). Valley widths are typically 700 ft (200 m) or less and stream gradients are generally low to moderate (0.5-2.5%). *Juniperus scopulorum* is situated at the high water line and above, while the *Populus angustifolia* grades into the active floodplain area.

Wetland Description: Riverine wetland with a seasonal hydroperiod, with flooding events rare to very rare.

Soil: Soils of this plant association are derived from alluvial deposits. The surface soils consist of loamy sand, clay loams, silty clays or organic matter. Subsurface layers range from sandy loams and loamy sands to clay loams and sandy clay loams with 20-50% gravel and cobbles. Soil depth ranges from 15-25 in (40 to 65 cm). In the Colorado River Basin, the soils classify as sandy-coarse loam, calcareous Camborthids and loamy-clay, calcareous typic Cryothents.

Vegetation: This plant association is characterized by an open to closed canopy of 20-100% cover of *Populus angustifolia* (narrowleaf cottonwood) and scattered to abundant *Juniperus scopulorum* (Rocky Mountain juniper) with 5-85% cover. Typically there is no shrub canopy and little to no herbaceous undergrowth due to dry conditions. However, stream banks with cool, northern aspects can have 0-15% cover of *Pseudotsuga menziesii* (Douglas-fir) and a diversity of shrubs including 0-20% cover each of *Acer glabrum* (Rocky Mountain maple) and *Quercus gambelii* (Gambel oak), *Clematis ligusticifolia* (white virgin's bower) with 0-30%, and 0-5% cover of *Rhus trilobata* (skunkbush). *Poa pratensis* (Kentucky blue grass) can be present in the undergrowth with 0-30% cover.

Successional and Ecological Processes: Cottonwood woodlands grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation is constantly being "re-set"' by flooding disturbance. Cottonwood communities are early, mid- or late seral, depending on the age class of the trees and the associated species of the stand. Cottonwoods, however, do not reach a climax stage as defined by Daubenmire (1952). Mature cottonwood stands do not regenerate in place, but regenerate by "moving" up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities.

The process of cottonwood regeneration is well documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel.

In this newly elevated position, with an absence of excessive browsing, fire, and agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes stream banks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations and habitats (The Nature Conservancy 1996).

As cottonwoods mature, other tree species may become established. If the landsurface is subject to reworking by the river, the successional processes will start over with erosion and subsequent flooding deposition. If the land surface is not subject to alluvial processes, for example a high terrace, the cottonwoods will be replaced by upland shrub or tree species that may comprise the climax plant association for that area.

In Colorado, *Juniperus scopulorum* (Rocky Mountain juniper) appears to be successfully reproducing in stands of the *Populus angustifolia-Juniperus scopulorum* plant association. In Montana, stands of mixed *Populus* spp. and *Juniperus scopulorum* are considered to be early successional communities that will eventually become *Juniperus scopulorum/Cornus sericea* (Rocky Mountain juniper/red-osier dogwood) habitat types (Hansen et al. 1995).

Adjacent Riparian Vegetation: This plant association is often the only riparian community along a stream reach. However, *Eleocharis palustris* (creeping spikerush) wetlands or *Carex* (sedge) species meadows can occur in mesic swales. Stands of *Salix exigua* (coyote willow) can occur along adjacent perennial stream channels.

Adjacent Upland Vegetation: Woodlands of *Pinus edulis* (pinyon pine) and *Juniperus monosperma* (one-seed juniper) occur on dry, south-facing hill slopes. Stands of *Pseudotsuga menziesii* (Douglas-fir) and *Quercus gambelii* (Gambel oak) occur on north-facing slopes. *Artemisia tridentata* (big sagebrush) shrublands also occur on the upslopes.

Management: Because the regeneration and establishment of new stands of cottonwood is dependent upon flooding events, any alterations to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows and reduce flooding frequency and magnitude. This results in fewer flood events that would allow for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association is low to moderate. Cattle frequently browse cottonwood seedlings and saplings, but *Juniperus scopulorum* (Rocky Mountain juniper) is not palatable. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. If grazed cottonwood dominated riparian areas in Colorado should only be grazed moderately for short periods during the growing season or solely during the winter season. This plant association also provides excellent hiding and thermal cover for mammals and birds. *Juniperus scopulorum* berries are a good food source for small mammals and birds (Hansen *et al* 1995).

Fire potential is low to moderate for *Juniperus scopulorum*. Young trees are easily killed by fire, but older trees are more resistant due to their thicker bark. Extremely hot fires can damage older trees (Hansen et al. 1995).

Narrowleaf cottonwood/skunkbrush (*Populus angustifolia/Rhus trilobata*) plant association

Colorado Natural Heritage Program Rank: G3/S3

General Description and Comments: The *Populus angustifolia/Rhus trilobata* (narrowleaf cottonwood/skunkbrush) plant association is characterized by a scattered overstory of *Populus angustifolia* with an occasional *Populus* x *acuminata* (lanceleaf cottonwood) or *Populus deltoides* subsp. *wislizenii* (Rio Grande cottonwood). The shrub understory is a dense layer of *Rhus trilobata*. It occurs in sandstone canyons and on streams adjacent to sand dunes.

Synonyms and Related Types/Synonyms: Two communities in the literature are synonymous with the Colorado *Populus angustifolia/Rhus trilobata* plant association: the *Populus angustifolia/Rhus aromatica* var. *trilobata* (narrowleaf cottonwood/skunkbrush) community type from Utah (Padgett et al.1989) and the *Populus/Rhus aromatica* var. *trilobata* (cottonwood/skunkbrush) community type from Nevada (Manning and Padgett 1995). *Rhus aromatica* var. *trilobata* is a synonym for *Rhus trilobata* var. *trilobata* (Kartesz 1994).

Regional Distribution: This plant association occurs in Nevada (Padgett et al. 1989), Utah (Manning and Padgett 1995), and Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This association occurs on the Uncompahgre Plateau, small tributaries of the western half of the Colorado River Basin, the San Juan National Forest and in the San Luis Valley (Kittel and Lederer 1993, Kittel *et al*. 1994, Kittel *et al*. 1995, Richard *et al*. 1996, and Colorado Natural Heritage Program 1999). Examples of this community type can be found in the Cottonwood Creek, Roubideau Creek, Dry Creek PCAs and the Uncompahgre River Macrosite.

Elevation Range: 5,000-7,100 ft (1,500-2,200 m).

Site Geomorphology: This plant association occurs on immediate river banks, floodplain meanders and narrow benches in narrow to wide, 65-500 ft (20-150 m), sandstone canyons. Stands generally occur within 3 ft (1 m) of the high water mark, but can also occur on higher terraces, up to 10 ft (3 m) above the channel. In the western portion of the Colorado River drainage, this association occurs on small streams in shale canyon areas. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Stream channels are wide and highly sinuous (Rosgen's Channel Type: C3, C4, C6) or wide and moderately sinuous (Rosgen's Channel Type: B3). Occasionally, stream channels are narrow and steep (Rosgen's Channel Type: A3).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Soil: The soils associated with this plant association are often alkaline and of a calcareous parent material. The soil textures are fine sandy loams, clay loams, silty clay loams, and silty clay. In the Colorado River Basin, the soils classify as ustic Torriorthents, Ustifluvents, mesic ardic Ustorthents, and ustalfic Haplargids.

Vegetation: The overstory is dominated by up to 70% cover of *Populus angustifolia* (narrowleaf cottonwood). Other trees include 0-30% cover each of *Populus* x *acuminata* (lanceleaf cottonwood) and *Acer negundo* (boxelder) and 0-10% cover each of *Juniperus osteosperma* (Utah juniper) and *Juniperus scopulorum* (Rocky Mountain juniper).

The shrub layer is dominated by 10-70% cover of *Rhus trilobata* (skunkbrush). Other shrubs include 0-30% cover each of *Prunus virginiana* (chokecherry) and *Berberis fendleri* (barberry), 0-20% cover of *Quercus gambelii* (Gambel oak), 0-10% cover each of *Rosa woodsii* (wood's rose) and *Cornus sericea* (red-osier dogwood), and 0-5% cover of *Amelanchier utahensis* (Utah serviceberry).

The herbaceous undergrowth is usually sparse, but can include 0-20% cover of *Maianthemum stellatum* (false Solomon seal) and 0-10% cover each of *Thalictrum fendleri* (Fendler meadowrue) and *Melilotus officinale* (yellow sweet-clover). Graminoid cover includes 0-20% *Poa pratensis* (Kentucky bluegrass).

Successional and Ecological Processes: Cottonwood woodlands grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation is constantly being "re-set"' by flooding disturbance. Cottonwood communities are early, mid- or late-seral, depending on the age class of the trees and the associated species of the stand. Cottonwoods, however, do not reach a climax stage as defined by Daubenmire (1952). Mature cottonwood stands do not regenerate in place, but regenerate by "moving" up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities.

The process of cottonwood regeneration is well documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly-deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel.

In this newly elevated position, with an absence of excessive browsing, fire, and agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes stream banks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations and habitats (The Nature Conservancy 1996).

As cottonwoods mature, other tree species may become established. If the landsurface is subject to reworking by the river, the successional processes will start over with erosion and subsequent flooding deposition. If the land surface is not subject to alluvial processes, for

example a high terrace, the cottonwoods will be replaced by upland shrub or tree species that may comprise the climax plant association for that area.

In Utah, the *Populus angustifolia/Rhus trilobata* (narrowleaf cottonwood/skunkbrush) plant association is considered a late successional community within the riparian area (Padgett et al. 1989). In southwestern Colorado, *Rhus trilobata* is present in both young and old cottonwood stands. As the stand matures, *Rhus trilobata* becomes more dense and excludes other shrubs. On higher terraces that are less frequently flooded, *Populus angustifolia* does not reproduce. This indicates succession to an upland community. The presence of *Quercus gambelii* (Gambel oak) in some stands may indicate a trend toward an oak upland shrub community (Padgett et al. 1989).

Adjacent Riparian Vegetation: This plant association may intergrade with *Populus deltoides* ssp. *wislizenii/Rhus trilobata* (Rio Grande cottonwood/skunkbrush) forests at lower elevations where the distributions of the two *Populus* (cottonwood) species overlap. *Salix exigua* (coyote willow) shrublands can also occur on adjacent point bars and stream banks.

Adjacent upland vegetation: *Pinus edulis-Juniperus osteosperma* (pinyon pine-Utah juniper) woodlands, *Pinus ponderosa-Quercus gambelii* (ponderosa pine-Gambel oak) forests, *Quercus gambelii* (Gambel oak) scrub, and *Artemisia tridentata* (big sagebrush) and *Chrysothamnus* spp. (rabbitbrush) shrublands often occur on adjacent hill slopes.

Management: Because the regeneration and establishment of new stands of cottonwood is dependent upon flooding events, any alteration to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows and reduce flooding frequency and magnitude. This results in fewer flood events that provide conditions for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association is high and very palatable to livestock. Cottonwood seedlings and saplings are frequently browsed by cattle. However, in California, *Rhus trilobata* is considered useless browse for livestock and only fair to poor browse for wildlife (Padgett *et al*. 1989). In areas with limited cover of palatable species, *Rhus trilobata* may be more heavily browsed. Excessive grazing and browsing of both *Populus angustifolia* and *Rhus trilobata* will reduce plant vigor and allow non-native plant species to gain a competitive advantage. If grazed cottonwood dominated riparian areas in Colorado should only be grazed moderately for short periods during the growing season or solely during the winter season (Hansen *et al*. 1995).

Narrowleaf cottonwood/coyote willow (*Populus angustifolia/Salix exigua*) plant association

Colorado Natural Heritage Program Rank: G4/S4

General Description and Comments: This is a very common plant association of young seedling and sapling *Populus angustifolia* (narrowleaf cottonwood) intermixed with *Salix exigua* (coyote willow). The association occupies point bars, gravel bars, benches and low areas that are flooded annually.

Related Types/Synonyms: The *Populus angustifolia/Salix exigua* plant association described by Durkin et al. (1994 and 1995) is synonymous with the Colorado *Populus angustifolia/Salix exigua* plant association. A closely related community, *Populus angustifolia/*recent alluvial bar (Jones 1990, Hansen *et al*. 1995), is not considered synonymous because many stands do not have *Salix exigua* (coyote willow) present.

Other closely related communities include: the *Populus angustifolia/Salix exigua* Habitat Type (Hess 1981, Baker 1984) which has significant *Betula occidentalis* present, and the *Populus angustifolia/Salix exigua-Betula fontinalis* (narrowleaf cottonwood/coyote willow-river birch) plant association (Johnston 1987).

Regional Distribution: The *Populus angustifolia/Salix exigua* plant association occurs in New Mexico and Colorado (Durkin et al. 1994, 1995, Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs in the Yampa, White, Gunnison, Rio Grande and Arkansas River Basins, and the San Juan National Forest (Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1996, Johnston 1987, Richard et al. 1996). Examples of this community type can be found in the Uncompahgre River Macrosite.

Elevation Range: 6,300-7,500 ft (1,900-2,300 m).

Site Geomorphology: This plant association occurs on recently flooded point bars, low terraces, and stream benches. It is usually well within the active channel and immediate floodplain of the stream and does not occur more than 3-6 ft (1-2 m) above the high-water mark. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Stream channels are wide and slightly sinuous (Rosgen's Channel Type: B3, B4) or wide and moderately sinuous (Rosgen's Channel Type: C3, C4).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Soil: Soils are skeletal (40% gravel and 10-20% cobbles) and shallow, 15 in (35 cm) deep, sands, sandy loams, sandy clay loams, or silty clays over coarse alluvial material.

Vegetation: This plant association is characterized by an open to dense stand of 15-65% cover of *Populus angustifolia* (narrowleaf cottonwood) seedlings (<1.5 m in height) and saplings (<12 cm in diameter) and 5-60% cover of *Salix exigua* (coyote willow). The herbaceous undergrowth is generally weedy (non-native) and sparse due to frequent flooding disturbance. Weedy species include 0-40% cover of *Trifolium repens* (white clover), 0-20% cover of *Agrostis stolonifera* (redtop), and 0-15% cover each of *Poa pratensis* (Kentucky bluegrass) and *Linaria vulgaris* (butter-and-eggs).

Successional and Ecological Processes: Cottonwood woodlands grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation is constantly being "re-set"' by flooding disturbance. Cottonwood communities are early, mid- or late seral, depending on the age class of the trees and the associated species of the stand. Cottonwoods, however, do not reach a climax stage as defined by Daubenmire (1952). Mature cottonwood stands do not regenerate in place, but regenerate by "moving" up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities.

The process of cottonwood regeneration is well documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel.

In this newly elevated position, with an absence of excessive browsing, fire, and agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes stream banks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations and habitats (The Nature Conservancy 1996).

As cottonwoods mature, other tree species may become established. If the landsurface is subject to reworking by the river, the successional processes will start over with erosion and subsequent flooding deposition. If the land surface is not subject to alluvial processes, for example a high terrace, the cottonwoods will be replaced by upland shrub or tree species that may comprise the climax plant association for that area.

Populus angustifolia/Salix exigua (narrowleaf cottonwood/coyote willow) is one of the earliest successional stages of a cottonwood-dominated plant association. *Populus angustifolia* and *Salix exigua* seeds often germinate together on freshly deposited sand bars. If the site becomes more stable and less frequently flooded (i.e., the stream channel migrates away from the site), the *Populus angustifolia* saplings mature, but the *Salix exigua* population declines. The association can become one of several mid- or late-seral floodplain types including *Populus angustifolia/Alnus incana* (narrowleaf cottonwood/thinleaf alder) and *Populus angustifolia/Cornus sericea* (narrowleaf cottonwood/red-osier dogwood).

Adjacent Riparian Vegetation: Thick stands of *Salix exigua* (coyote willow) or *Alnus incana* (thinleaf alder) shrublands often occur within the same reach as *Populus angustifolia/Salix exigua*. *Populus angustifolia/Cornus sericea* (narrowleaf cottonwood/red-osier dogwood) and *Populus angustifolia/Amelanchier* spp. (narrowleaf cottonwood/serviceberry) forests occur on higher terraces.

Adjacent Upland Vegetation: *Pinus ponderosa* (ponderosa pine) forests, *Pinus edulis-Juniperus monosperma* (pinyon pine-one-seed juniper) woodlands, *Quercus gambelii* (Gambel oak) scrub, and *Artemisia tridentata* (big sagebrush) shrublands occur adjacent to rocky valley slopes.

Management: Because the regeneration and establishment of new stands of cottonwood is dependent upon flooding events, any alteration to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows and reduce flooding frequency and magnitude. This results in fewer flood events that provide conditions for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association can be high and very palatable to livestock. Cattle frequently browse cottonwood and willow seedlings and saplings. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. If grazed cottonwood dominated riparian areas in Colorado should only be grazed moderately for short periods during the growing season or solely during the winter season (Hansen et al. 1995).

Salix exigua (coyote willow) is an excellent stream bank stabilizer that can be planted as stems or wattles for restoration purposes. However, cattle may browse the young shoots in the winter and kill newly planted poles.

Narrowleaf cottonwood/strapleaf willow-silver buffaloberry (*Populus angustifolia/Salix eriocephala* var. *ligulifolia-Shepherdia argentea*) plant association

Colorado Natural Heritage Program Rank: G1/S1

General Description and Comments: *Populus angustifolia/Salix eriocephala* var. *ligulifolia-Shepherdia argentea* (narrowleaf cottonwood/strapleaf willow-silver buffaloberry) is an extremely limited plant association in western Colorado. Historically, it was more widespread and common in broad river valleys. Overutilization by livestock and alterations in the river flow regime has caused a decline in its distribution.

Related Types/Synonyms: This is identical to the *Populus angustifolia/Salix ligulifolia-Shepherdia argentea* (narrowleaf cottonwood/ strapleaf willow-silver buffaloberry) plant association described by Baker (1984 and 1989).

Regional Distribution: This plant association is only known to occur in western Colorado (Baker 1984, Baker 1989, Colorado Natural Heritage Program 1999).

Distribution in Colorado: This association occurs in the Gunnison and Colorado River Basins and the San Juan National Forest (Baker 1984, Baker 1989, Kittel et al. 1994, Kittel et al. 1995, and Richard et al. 1996). Examples of this community type can be found in the Uncompahgre River at Eldredge, Uncompahgre River at Ridgway, Roubideau Creek PCAs and the Uncompahgre River Macrosite.

Elevation Range: 6,000-7,100 ft (1,800-2,200 m).

Site Geomorphology: This plant association occurs in narrow to broad, 1000 ft (300 m) wide, alluvial valleys. Mature stands occur on terraces up to 10 ft (2.5 m) above the active channel. Mature stands spread out across wide floodplains, but also occur on narrow floodplains of constricted reaches. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Stream channels are wide and sinuous with low to moderate gradients (1-5%) (Rosgen's Channel Type: C3).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional to rare flooding.

Soils: The soils are slightly to highly effervescent, deep, sandy loams that become increasingly skeletal with depth. In the Colorado River Basin, the soils classify as typic Cryopsamments.

Vegetation: This plant association is characterized by 30% cover of widely spaced, mature *Populus angustifolia* (narrowleaf cottonwood). Seeding and sapling *Populus angustifolia* with 0-40% cover also occur in bands along the river. The shrub layer is diverse and widely spaced. Shrub species include 20-50% cover of *Shepherdia argentea* (silver buffaloberry), 1-40% cover of *Rhus trilobata* (skunkbush), 0-10% cover each of *Salix eriocephala* var. *ligulifolia* (strapleaf willow) and *Alnus incana* (thinleaf alder), 0-

5% cover of *Cornus sericea* (red-osier dogwood), and <1% cover of *Salix exigua* (coyote willow). The herbaceous undergrowth is dominated by introduced hay grasses including 0-20% cover of *Agrostis stolonifera* (redtop) and 1-10% cover of *Poa pratensis* (Kentucky bluegrass). A few native forbs occur, including 0-30% cover of *Clematis ligusticifolia* (white virgin's-bower) and 0-5% cover of *Maianthemum stellatum* (false Solomon seal).

Successional and Ecological Processes: Cottonwood woodlands grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation is constantly being "re-set"' by flooding disturbance. Cottonwood communities are early, mid- or late seral, depending on the age class of the trees and the associated species of the stand. Cottonwoods, however, do not reach a climax stage as defined by Daubenmire (1952). Mature cottonwood stands do not regenerate in place, but regenerate by "moving" up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities.

The process of cottonwood regeneration is well documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel.

In this newly elevated position, with an absence of excessive browsing, fire, and agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes stream banks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations and habitats (The Nature Conservancy 1996).

As cottonwoods mature, other tree species may become established. If the landsurface is subject to reworking by the river, the successional processes will start over with erosion and subsequent flooding deposition. If the land surface is not subject to alluvial processes, for example a high terrace, the cottonwoods will be replaced by upland shrub or tree species that may comprise the climax plant association for that area.

The predominance of non-native grasses in the undergrowth and widely spaced shrubs indicate heavy utilization by cattle. No undisturbed stands of the *Populus angustifolia/ Salix eriocephala* var. *ligulifolia-Shepherdia argentea* (narrowleaf cottonwood/strapleaf willow-silver buffaloberry) plant association are known in Colorado.

Adjacent Riparian Vegetation: Young *Populus angustifolia* (narrowleaf cottonwood) woodlands and *Salix exigua* (coyote willow) and *Salix lucida* ssp. *caudata* (whiplash willow) shrublands occur on adjacent point bars.

Adjacent upland vegetation: *Pinus edulis-Juniperus osteosperma* (pinyon pine-Utah juniper) woodlands occur on adjacent hill slopes.

Management: All known occurrences of the *Populus angustifolia/Salix ligulifolia-Shepherdia argentea* plant association are heavily degraded by improper grazing and/or altered hydrology. Further research is needed to determine the amount, frequency, and duration of spring floods and late-season draw-down rates to provide for riparian forest regeneration and maintenance. Because the regeneration and establishment of new stands of cottonwood is dependent upon flooding events, any alteration to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows and reduce flooding frequency and magnitude. This results in fewer flood events that provide conditions for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association can be high and very palatable to livestock. Cattle frequently browse Cottonwood and willow seedlings and saplings. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. If grazed cottonwood dominated riparian areas in Colorado should only be grazed moderately for short periods during the growing season or solely during the winter season (Hansen et al. 1995).

Narrowleaf cottonwood-Colorado blue spruce/thinleaf alder (*Populus angustifolia-Picea pungens*/*Alnus incana ssp. tenuifolia*) plant association

Colorado Natural Heritage Program Rank: G3/S3

General Description and Comments: This is a common mixed deciduous-evergreen plant association with *Populus angustifolia* (narrowleaf cottonwood) and *Picea pungens* (Colorado blue spruce) co-dominant along a stream reach. Frequently, other conifer trees are present, but not as abundant as *Picea pungens* (Colorado blue spruce). The shrub understory is typically dense and diverse. *Alnus incana* is always present.

Classification Problems: Both *Populus angustifolia* and mixed *Populus angustifolia*-confer plant associations are in the classification. The criteria for identifying a *Populus angustifolia-Picea pungens* plant association is that both species have at least 10% cover. More often than not, the *Populus angustifolia* can be twice as abundant as the *Picea pungens*.

Related Types/Synonyms: In the Colorado literature, the following five names are synonymous with the Colorado *Populus angustifolia-Picea pungens/Alnus incana* (narrowleaf cottonwood-Colorado blue spruce/thinleaf alder) plant association: *Populus angustifolia*-(*Picea pungens*)*/Alnus incana* ssp. *tenuifolia*-*Cornus sericea* (narrowleaf cottonwood-Colorado blue spruce/thinleaf alder-red-osier dogwood) association (Baker 1989, Kittel and Lederer 1993, Richard et al. 1996), *Populus angustifolia-Picea pungens/Alnus incana* ssp. *tenuifolia-Lonicera involucrata* (narrowleaf cottonwood-Colorado blue spruce/thinleaf alder-honeysuckle) association (Baker 1989, Kittel and Lederer 1993), *Populus angustifolia-Picea pungens/Lonicera involucrata* (narrowleaf cottonwood-Colorado blue spruce/honeysuckle) association (Richard et al. 1996), *Populus angustifolia-Picea pungens/*bare ground association (Richard et al. 1996) and *Populus angustifolia-Picea pungens/Alnus incana* association (Baker 1986, Baker 1989, Kittel et al. 1994, Kittel et al. 1995).

Regional Distribution: This plant association is reported only from Colorado, however closely related communities occur in Wyoming, New Mexico (Johnston 1987) and Utah (Padgett et al. 1989).

Distribution in Colorado: This plant association occurs in the Yampa, White, Colorado, Gunnison, and San Miguel River Basins and the Uncompahgre, San Juan and Rio Grande National Forests (Johnston 1987, Hess and Wasser 1982, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Komarkova 1986, Richard et al. 1996, and Kittel et al. 1999). It is also likely to occur along the Colorado Front Range. Examples of this community type can be found in the Cimarron River, Cow Creek-Oben Creek, and Nate Creek PCAs.

Elevation Range: 7300-9000 ft (2200-2700 m).

Site Geomorphology: This association occurs in valleys with narrow to moderately wide floodplains, 30-430 ft (10-130 m), and in deep canyons. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). This association is commonly found on slightly meandering to meandering floodplains of broad reaches (Rosgen's Channel Type: B2-B5, C2-C4). Occasionally, stands occur along steep reaches (Rosgen's Channel Type: A2, A3).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Soils: Soils range from shallow sandy loams to silty clay loams and clays over cobbles and boulders. Profiles are generally highly stratified, with layers of fine soils over layers of coarser sediments. In the White and Colorado River Basins, the soils classify as loamy-skeletal, calcareous aquic typic Cryochrepts. It establishes on narrow terraces, benches, and cobble bars adjacent to the channel.

Vegetation: The overstory is dominated by 20-95% cover of *Populus angustifolia* (narrowleaf cottonwood) and up to 80% cover of *Picea pungens* (Colorado blue spruce). The flooding history and time since the last flood can influence the relative abundance of these two species. At lower elevations, *Pseudotsuga menziesii* (Douglas-fir) may also be present with up to 35% cover.

In the San Juan mountains, *Abies lasiocarpa* (subalpine fir)*, Picea engelmannii* (Engelmann spruce), and *Abies concolor* (white fir) can replace *Picea pungens* (Colorado blue spruce) at higher elevations. Stands with the above conifers have been classified as the *Abies lasiocarpa-Picea engelmannii-Populus angustifolia/ Lonicera involucrata* plant association.

The dense shrub layer consists of up to 95% cover of *Cornus sericea* (red-osier dogwood), 5-70% cover of *Alnus incana* (thinleaf alder), up to 30% cover of *Amelanchier* spp. (serviceberry), and up to 20% cover each of *Acer glabrum* (mountain maple) and *Lonicera involucrata* (honeysuckle). A variety of *Salix* (willow) species may be present with <50% cover. One stand (plot SJ-25) has no alder and 25% *cover Symphoricarpos rotundifolia*, and may represent a drier variation of this community. While the shrub species present can be variable, the overstory mix of *Picea pungens* and *Populus angustifolia* is the best indicator of this community.

The undergrowth is diverse yet sparse, rarely with more than 30% total cover. Common forb species include *Actaea rubra* (baneberry), *Osmorhiza depauperata* (blunt-fruit sweet-cicely), *Maianthemum stellatum* (false Solomon seal), *Geranium richardsonii* (Richardson geranium), *Mertensia ciliata* (mountain bluebell), and *Fragaria virginiana* (mountain strawberry). Graminoid cover is minor.

Successional and Ecological Processes: This mixed deciduous-evergreen plant association is a mid-seral community. With continued fluvial activity, such as flooding, channel migration, sediment deposition, and scouring, narrowleaf cottonwood and blue

spruce will continue to co-occur along the reach. Gradual and slightly sinuous stream channels that have overbank flow and sediment deposition favor establishment of *Populus angustifolia*. *Picea pungens* is favored along reaches in deep valleys with steep canyon walls that provide conditions for strong cold-air drainage. If the floodplain is no longer active, i.e., is no longer flooded because the stream channel has become lower (surface becomes a terrace) or upstream dams control floods, then cottonwoods will eventually die and the conifers may persist.

Some authors suggest mixed riparian stands will eventually become dominated by conifer species (see Padgett et al. 1989, Hansen et al. 1995). In Colorado, observations indicate that with continued fluvial processes, cottonwoods will continue to persist on the stream banks and floodplain. The presence of conifer species on an active floodplain is not necessarily an indication of future "climax" dominance.

Adjacent Riparian Vegetation: The adjacent riparian vegetation depends on the width and complexity of the riparian area. In narrow canyons, *Populus angustifolia* may drop out, leaving a *Picea pungens/Alnus incana* (Colorado blue spruce/thinleaf alder) stands. *Alnus incana* and mixed *Alnus incana-Cornus sericea* (thinleaf alder-red-osier dogwood) or *Alnus incana-Salix drummondiana* (thinleaf alder-Drummond willow) shrublands occur adjacent to the floodplain forest on steep-sided banks. *Salix* (willow) species shrublands occur in low, open areas, on point bars, overflow channels, and islands.

Adjacent Upland Vegetation: At lower elevations, mixed coniferous forests including *Pseudotsuga menziesii* (Douglas-fir), *Pinus ponderosa* (ponderosa pine), *Abies concolor* (white fir), or *Picea pungens* (Colorado blue spruce) occur on adjacent hill slopes. *Pinus edulis-Juniperus monosperma* (pinyon pine-Rocky Mountain juniper) and *Populus tremuloides* (quaking aspen) woodlands, *Quercus gambelii* (Gambel oak) scrub, and *Amelanchier alnifolia* (serviceberry) shrublands also occur. At higher elevations, *Picea engelmannii-Abies lasiocarpa* (Engelmann spruce-subalpine fir) forests occur on adjacent hill slopes.

Management: Because the regeneration and establishment of new stands of cottonwood is dependent upon flooding events, any alterations to the natural flow regime of a river can affect the cottonwood ecosystem. Upstream dams stabilize stream flows and reduce flooding frequency and magnitude. This results in fewer flood events that would allow for cottonwood stand regeneration. Without periodic disturbance by flooding, riparian areas become dominated by late-seral communities. These late-seral communities are dominated by more upland species, such as conifers in montane areas or other, more drought tolerant species in the foothill and plains environments.

Forage productivity for this plant association can be high and very palatable to livestock. Cottonwood seedlings and saplings and the associated shrub species are frequently browsed by cattle. Excessive grazing and browsing will reduce plant vigor and allow non-native plant species to gain a competitive advantage. Cottonwood dominated riparian areas in Colorado are best grazed moderately for short periods during the growing season or solely

during the winter season. This maintains high forage quality and quantity. This plant association also provides excellent hiding and thermal cover for mammals and birds (Hansen et al 1995).

Aspen/Rocky Mountain maple (*Populus tremuloides/Acer glabrum*) plant association

Colorado Natural Heritage Program Rank: G2/S1S2

General Description and Comments: The broad-leaved deciduous tree, *Populus tremuloides* (aspen), dominates the canopy of this forest association. The understory is very lush, with both shrub and herbaceous layers having over 100% cover. Shrubs are primarily broad-leaved deciduous, with *Acer glabrum* (Rocky Mountain maple) being the characteristic and dominant species The Populus tremuloides/Acer glabrum association occurs on north- to northeast-facing moist alluvial terraces. Slopes are moderately steep (11% to 13%) and undulating (Powell 1988).

Related Types/Synonyms: It is possible that stands of this type in northern New Mexico were included in the *Abies lasiocarpa/Acer glabrum* (subalpine fir/Rocky Mountain Maple) or the *Abies concolor/Acer glabrum* (white fir/Rocky mountain maple) habitat types, as aspen in the western US is generally considered seral to coniferous forest (Powell 1988).

Regional Distribution: Very limited distribution; described from only one watershed in the Sawatch Range, with only 2 stands found for sampling. It is likely to occur in north-central New Mexico, where it may be seral to the *Abies lasiocarpa/Acer glabrum* (subalpine fir/Rocky Mountain maple) or the *Abies concolor/Acer glabrum* (white fir/Rocky Mountain maple) associations, but it has not been documented (Powell 1988).

Distribution in Colorado: Has previously been described from one drainage of the Sawatch Range of south-central Colorado, in the San Isabel National Forest (Powell 1988). An example of this community type can be found in the Uncompahgre River Macrosite.

Elevation Range: 9,200 ft (2,800 m) (Powell 1988).

Site Geomorphology: Found in a mountainous region just to the east of the Continental Divide. This region includes the highest ranges in the Rocky Mountain system; many peaks are in excess of 14,000 ft elevation. Extensive Pleistocene glaciation occurred in these ranges. The climate is characterized by cool summers and cold winters. An average of 40% of the annual precipitation falls from June through August, with the remainder occurring as winter and early spring snows. Due to a rain shadow effect from the massive San Juan mountains to the west, annual precipitation (approximately 20 in) is less than what occurs further south in northern New Mexico. Maximum snowfall accumulations are about 26 ft (Powell 1988).

Wetland Description: This is a slope wetland that receives an intermittent hydroperiod with rare flooding.

Soils: Soils are saturated or poorly drained.

Vegetation: The broad-leaved deciduous tree, *Populus tremuloides* (aspen), dominates the canopy of this forest association, with over 90% cover. *P. balsamifera* (balsam poplar) may be present in some stands. The understory is very lush, with both shrub and herbaceous layers having over 100% cover. Shrubs are primarily broad-leaved deciduous, with *Acer glabrum* (Rocky Mountain maple) being the characteristic and dominant species (averaging 56% cover). Occassionally *Acer glabrum* (Rocky Mountain maple) may reach tree stature, some individuals being over 8 m in height. Other important tall shrubs include *Sambucus racemosa* (elderberry)*, Prunus virginiana* (chokecherry)*, Ribes montigenum* (red prickly gooseberry) and *Mahonia repens* (Oregon grape). The herbaceous layer is dominated by perennial forbs, such as *Artemisia franseroides* (sagebrush)*, Oreochrysum parryi* (mountain gold)*, Osmorhiza depauperata* (sweet cicely)*, Smilacina stellata* (Star Solomon's plume) and *Thalictrum fendleri* (meadowrue). Species richness is moderately high for aspen associations, with 49 species of vascular plants occurring in the sampled stands (Powell 1988).

Management: Aspen stands with tall shrub layers are considered prime habitat for establishment of ruffed grouse (Powell 1988).

Aspen/bracken fern (*Populus tremuloides/Pteridium aquilinum*) plant association

Colorado Natural Heritage Program Rank: G4/S3S4

Regional Distribution: The Aspen wetland forest is fairly common in the Rocky Mountain region of Colorado and Utah (Bourgeron and Engelking 1994; Johnston 1987).

Distribution in Colorado: There is one previously described occurrence in the Piceance and Uinta Basins of Colorado (Colorado Natural Heritage Program 1999). Examples of this community can be found in the Beaver Dams Creek and Green Mountain PCAs.

Elevation Range: 6,900-10,200 ft (2,100-3,100 m) (Johnston 1987)

Site Geomorphology: This plant association occurs on broad, gently sloping hillsides and valley bottoms, or along narrow streams.

Soils: This Aspen forest prefers northeast, east and south aspects, on poorly drained loam to sandy loam medium-coarse residual shallow soils (Johnston 1987).

Wetland Description: This is a slope wetland that receives an intermittent hydroperiod with rare flooding.

Management: Graham (1937) notes that if the Bracken fern (*Pteridium aquilinum*) is eaten in large quantities, it is considered slightly poisonous to cattle, horses, and probably sheep.

Douglas fir/red osier dogwood (*Pseudotsuga menziesii/Cornus sericea*) plant association

Colorado Natural Heritage Program Rank: G4/S2

General description and Comments: The *Pseudotsuga menziesii/Cornus sericea* (Douglas-fir/red-osier dogwood) plant association is a limited riparian type in Colorado. It forms small pockets in very narrow, rocky streams and canyons where *Pseudotsuga menziesii* also grows on the adjacent hillslopes.

Related Types/Synonyms: Three closely related communities include the 1) *Pseudotsuga menziesii/Acer glabrum* (Douglas-fir/mountain maple) plant association (Johnston 1987) which is an upland community, and does not contain *Cornus sericea*, 2) the *Pseudotsuga menziesii/Cornus sericea* (Douglas-fir/red-osier dogwood) Habitat Type (Hansen et al. 1995), which has several cottonwood species included in the overstory, and 3) the conifer/*Cornus sericea* community type (Padgett et al. 1989) which includes *Abies lasiocarpa* (subalpine fir) as the dominant overstory species in some stands.

Regional Distribution: This plant association occurs in Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs in the San Juan National Forest (Richard et al. 1996), the San Miguel/Dolores (Kittel and Lederer 1993), Gunnison (Kittel et al. 1995), and White River Basins (Kittel et al. 1994). Examples of this community type can be found in the McKenzie Creek, Roubideau Creek and Dexter Creek PCAs.

Elevation Range: 5,600-8,500 ft (1,700-2,400 m).

Site Geomorphology: This plant association occurs in narrow valleys with variable stream gradients (5-25%) on narrow floodplains and elevated benches. Stands occur well above the stream channel bankfull height, 1-10 ft (0.16-3 m). Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Stream channels are steep and narrow (Rosgen's Channel Type: A3).

Wetland Description: Riverine wetland with a seasonal hydroperiod and rare to occasional flooding.

Soil: The soils are generally well drained, colluvial clay loams to sandy loams. Coarse fragments range from 0 to 25%. The water table is at least one meter below the surface.

Vegetation: *Pseudotsuga menziesii* (Douglas-fir) dominates the overstory with 30-60% cover. Other tree species with less than 10-20% cover each include *Populus angustifolia* (narrowleaf cottonwood), *Populus tremuloides* (quaking aspen), *Abies concolor* (white fir), *Acer negundo* (boxelder), and *Picea pungens* (blue spruce). *Cornus sericea* (red-osier dogwood) forms a dense shrub layer with 20-70% cover. Other shrub species

include *Acer glabrum* (mountain maple) with 0-40% cover, *Quercus gambelii* (Gambel oak), *Alnus incana* (thinleaf alder) with 0-30% cover, and *Ribes* (currant) species with 0-10% cover. The ground is covered with a thick layer of duff and few herbaceous plants.

Successional and Ecological Processes: *Pseudotsuga menziesii* (Douglas-fir) is a non-obligate riparian species. This plant association is limited to narrow canyon bottoms where upland *Pseudotsuga menziesii* forests on north-facing slopes grade into riparian corridors. Narrow canyons with steep slopes create pockets of moist, cool air by funneling cold-air drainage and providing a microsite for *Pseudotsuga menziesii*. *Cornus sericea* (red-osier dogwood) is more abundant on level sites where water tables are periodically high (Johnston 1987). At lower elevations, Douglas-fir can occur in cool valley bottoms where it cannot survive on the valley slopes. Well drained colluvial soils also favor *Pseudotsuga menziesii* establishment.

Adjacent Riparian Vegetation: This association is often the only type within a narrow valley profile. Adjacent riparian areas may have *Cornus sericea* (red-osier dogwood) and *Acer glabrum* (thinleaf alder) communities.

Adjacent Upland Vegetation: *Pseudotsuga menziesii* (Douglas-fir) and *Pinus ponderosa* (ponderosa pine) forests and *Quercus gambelii* (Gambel oak) scrub occur on adjacent hillslopes. *Populus tremuloides* (quaking aspen) and *Pinus edulis-Juniperus osteosperma* (pinyon pine-Utah juniper) woodlands occur on south-facing slopes.

Management: This plant association requires minimal management because the steep and rocky terrain provides intrinsic protection. However, *Cornus sericea* (red-osier dogwood) is considered to be an "ice cream" plant (e.g., it is readily eaten and is a preferred browse species) for livestock and wildlife especially when occurring as an open stand where animals can easily enter the community (Hansen *et al*. 1995).

Pseudotsuga menziesii (Douglas fir) regeneration is favored by fire, which creates suitable seedbeds and eliminates competition. Mature trees are relatively fire resistant, but seedlings and saplings are vulnerable to surface fires. *Cornus sericea* (red-osier dogwood) can survive all but the most severe fires. After fire, new shoots sprout from the surviving rhizomes (Hansen et al. 1995).

Cornus sericea is a very effective stream bank stabilizer and should be considered for revegetating degraded sites. The rapid growth following direct seeding or transplanting allows this shrub to quickly establish on streambanks (Hansen et al. 1995).

PALUSTRINE SCRUB-SHRUB COMMUNITIES—BROAD-LEAVED DECIDUOUS

Thinleaf alder/mesic forb (*Alnus incana* ssp. *tenuifolia*/mesic forb) plant association

Colorado Natural Heritage Program Rank: G3G4Q/S3

General Description and Comments: The *Alnus incana* ssp. *tenuifolia*/mesic forb (thinleaf alder/mesic forb) plant association is characterized by stands of medium-tall, deciduous shrubs and a thick herbaceous undergrowth of forbs and wetland indicator grasses. A low canopy of shorter shrubs may also be present with *Ribes* (currant) and *Salix* (willow) species and *Cornus sericea* (red-osier dogwood). Undisturbed stands have abundant forbs and native grasses. Stands disturbed by season-long livestock grazing have reduced forb cover and an increase in non-native grasses including *Poa pratensis* (Kentucky bluegrass) and *Agrostis stolonifera* (redtop). Large, 22,500 sq. ft (>100 m^2), stands with the native herbaceous undergrowth intact are uncommon.

Related Types/Synonyms: The *Alnus incana* ssp. *tenuifolia*/mesic forb (thinleaf alder/mesic forb) plant association has been described by a variety of names in the literature. These types appear to be synonymous, or nearly so, with the Colorado *Alnus incana/*mesic forb plant association. Synonymous communities include: the *Alnus incana* association and an *Alnus incana* Springs association (Kovalchik 1987), the *Alnus incana* community type (Hansen et al. 1995), the *Alnus incana*/mesic forb community type (Manning and Padgett 1995, Padgett et al. 1989), and the *Alnus incana/Ribes hudsonianum* community type (Youngblood et al. 1985).

Closely related communities include: the *Alnus incana* ssp. *tenuifolia/Rudbeckia laciniata* association (Cooper and Cottrell 1990), the *Alnus incana-Betula fontinalis/Salix* spp. and *Alnus incana-Salix drummondiana/Equisetum arvense* plant associations (Johnston 1987). *Alnus tenuifolia* is a synonym for *Alnus incana* ssp. *tenuifolia* (Kartesz 1994). Other closely related communities dominated by *Alnus tenuifolia* occur in Alaska, but grow in very wet, swampy areas with an understory of *Calamagrostis canadensis* (bluejoint reedgrass) and *Equisetum* (horsetail) species (Viereck et al. 1992).

Regional Distribution: This plant association occurs in Oregon (Kovalchik 1987), Nevada (Manning and Padgett 1995), Utah (Padgett et al. 1989), Montana (Hansen *et al*. 1995), Idaho, Wyoming (Youngblood et al. 1985, Jones 1992), and Colorado (Cooper and Cottrel 1990, Johnston 1987, Colorado Natural Heritage Program 1999).

Distribution in Colorado: This association occurs throughout the Rocky Mountains of Colorado (Cooper and Cottrell 1990, Johnston 1987, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kettler and McMullen 1996, Richard et al. 1996, Colorado Natural Heritage Program 1999). Examples of this community type can be found in the Red Creek PCA.

Elevation Range: 6,400-9,600 ft (2,000-2,900 m).

Site Geomorphology: This plant association occurs along narrow, 130-230 ft (40-70 m) wide, alluvial benches and terraces of canyons and valleys. It also occurs as narrow bands in wider valleys, >400 ft (>120 m), and occasionally forms a wide band on the floodplain. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Stream channels are highly variable. They can be steep (3-12% gradient) and narrow (Rosgen's Channel Type: A3, A4, A6) or wider, rocky, and moderately sinuous (Rosgen's Channel Type: B2, B3, B4, B5). Occasionally, stream channels are low gradient and highly sinuous (Rosgen's Channel Type: C3, C4), narrow and highly sinuous (Rosgen's Channel Type: E3), or braided (Rosgen's Channel Type: D5).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Soil: Soils are well drained silt loams, loams, sandy clay loams, or sandy loams. Some profiles have a high percentage of organic matter and are either skeletal or stratified with skeletal layers. Some profiles have significant silt fractions in the upper layers. Soils in the Colorado River Basin, classify as sandy oxyaquic Cryumbrepts, loamy typic Cryorthents, fragmental (calcareous) Cryaquents and loamy over sandy Typic Cryoboralfs.

Vegetation: *Alnus incana* ssp. *tenuifolia* (thinleaf alder) creates a dense, tall (15-25 ft) shrub canopy with 20-95% cover. Other shrubs include 0-30% cover of *Lonicera involucrata* (honeysuckle), 0-20% cover of *Salix geyeriana* (Geyer willow), 0-15% cover each of *Salix monticola* (mountain willow) and *Salix eriocephala* var. *ligulifolia* (strapleaf willow), and 0-10% cover each of *Salix drummondiana* (Drummond willow) and *Salix bebbiana* (Bebb willow). A few trees may be present along the edges of the stand including 0-20% cover each of *Picea engelmannii* (Engelmann spruce) and *Populus tremuloides* (quaking aspen) and 0-10% cover of *Populus angustifolia* (narrowleaf cottonwood).

The ground is generally very wet and covered with tall, 3-7 ft (1-2 m), forbs and graminoids. Forbs include 0-70% cover of *Heracleum lanatum* (cow parsnip), 0-45% cover of *Angelica ampla* (giant angelica), 0-20% cover each of *Mertensia ciliata* (mountain bluebells) and *Rudbeckia lanciniata* (cutleaf coneflower), and 0-15% cover of *Viola canadensis* (Canada violet). Graminoids include 0-25% cover of *Glyceria* spp. (mannagrass), 0-20% cover each of *Calamagrostis canadensis* (bluejoint reedgrass) and *Carex utriculata* (beaked sedge), and 0-5% cover of *Carex microptera* (small-wing sedge). A dense cover of 0-30% *Equisetum arvense* (field horsetail) and 0-10% cover each of *Equisetum pratense* (meadow horsetail) and *Hippochaete hyemalis* (scouring rush) may be present.

Successional and Ecological Processes: *Alnus incana* ssp. *tenuifolia* (thinleaf alder) is a long-lived, early-seral species. It is one of the first species to establish on fluvial or glacial deposits as well as the spoils of placer mining (Viereck 1970, Van Cleve et al.

1971, Chapin et al. 1994, Hansen et al. 1989). After establishment, young stands of *Alnus incana* are continually flooded. As stands mature, the stems can slow flood waters and trap sediment. Fine-textured sediments accumulate on top of the coarser alluvial material and the land surface eventually rises above annual flood levels. Flooding is then less frequent and soils begin to develop (Padgett et al. 1989).

Alnus incana is shade-intolerant (Viereck 1970, Chapin et al. 1994), and many mature stands in Colorado are restricted to stream bank edges, possibly because these are the only sites where light can penetrate the neighboring overstory canopy. *Alnus incana* has been observed on high-gradient streams and is thought to require well-aerated water (Hansen et al. 1988, Padgett et al. 1989).

Undisturbed *Alnus incana* (thinleaf alder) stands may become dominated by *Salix* (willow) species or conifer stands (Hansen et al. 1989). In Alaska, thick stands of alders inhibit succession by competing with spruce for nutrients and light (Chapin et al. 1994). In Utah, *Acer negundo* (boxelder) often becomes the dominant canopy species on more xeric sites (Padgett et al. 1989).

Alnus incana (thinleaf alder) fixes atmospheric nitrogen through a symbiotic relationship with the bacteria *Frankia* and increases the ecosystem nitrogen supply with the deposition of nitrogen-rich leaf litter (Binkley 1986). The annual input of nitrogen to soils from alder species ranges from 16 to 150 kg/ha annually compared to 1 to 10 kg/ha/yr deposited by atmospheric precipitation alone (Binkley 1986, Bowman and Steltzer *in press*). Nitrogen rich detritus is an important source of nutrients for the aquatic ecosystem as well.

Adjacent Riparian Vegetation: *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests occur along narrow reaches and on higher ground above stream banks and floodplains. Along wider reaches, *Populus angustifolia* (narrowleaf cottonwood) and mixed *Populus angustifolia*-conifer (narrowleaf cottonwood-evergreen) forests or *Salix drummondiana* (Drummond willow), *Salix exigua* (coyote willow), *Salix boothii* (Booth willow), and *Salix monticola* forb (Rocky Mountain willow) shrublands occur on stream banks and floodplains. *Calamagrostis canadensis* (bluejoint reedgrass) and *Carex utriculata* (beaked sedge) meadows may also occur in low-lying swales on adjacent floodplains.

Adjacent Upland Vegetation: At higher elevations, *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests and *Populus tremuloides* (quaking aspen) woodlands occur on adjacent hillslopes. At lower elevations, open woodlands of *Pinus ponderosa* (ponderosa pine) and *Juniperus osteosperma* (Utah juniper) occur on south-facing slopes, while thick forests of *Pseudotsuga menziesii* (Douglas-fir) and *Pinus contorta* (lodgepole pine) occur on north-facing slopes.

Management: The *Alnus incana* ssp. *tenuifolia*/mesic forb (thinleaf alder/mesic forb) plant association is a relatively long-lived and stable community, but can change in response to the impacts of improper livestock grazing. Dense stands of *Alnus incana*

(thinleaf alder) may hinder livestock access. *Alnus incana* (thinleaf alder) is not particularly palatable to livestock, but can be trampled as animals search for more palatable forb species (Hansen et al. 1995). Season-long grazing reduces the native forb cover and allows non-native grasses to increase. This may convert the site to an *Alnus incana*/mesic graminoid (thinleaf alder/mesic grasses) community. With rotation and rest, this type may be reverted back to the *Alnus incana* ssp. *tenuifolia*/mesic forb plant association (Padgett et al. 1989, Hansen et al. 1995).

In addition, if the herbaceous undergrowth of the *Alnus incana/*mesic forb plant association is dominated by non-native, weedy species, the stand may be a product of improper grazing. If the undergrowth is dominated by native forbs, the site is near potential.

Most fires kill *Alnus incana* (thinleaf alder) dominated stands, resulting in a sparse herbaceous understory and bank destabilization due to root death. *Alnus incana* ssp. *tenuifolia* sprouts quickly when cut at 4-5 year intervals and can be used as pole plantings for restabilizing stream banks. Cutting in spring and winter results in rapid sprouts. Cutting in the summer results in fewer, slow-growing sprouts (Hansen et al. 1995).

Bog birch/mesic forb-mesic graminoid (*Betula glandulosa/*mesic forb-mesic graminoid) plant association

Colorado Natural Heritage Program Rank: G3G4/S3

General Description and Comments: The *Betula glandulosa/*mesic forb-mesic graminoid (bog birch) plant association occurs with various *Salix* (willow) species and an understory of graminoid and/or forb species. This association typically occurs in small pockets within a mosaic of *Salix* dominated shrublands and *Carex* (sedge) meadows. It also occurs on peat that is saturated throughout the growing season

Related Types/Synonyms: A similar *Betula glandulosa/Carex scopulorum* (bog birch/rock sedge) plant association occurs in the Gunnison National Forest and a similar *Betula glandulosa/Carex rostrata* (bog birch/beaked sedge) habitat type occurs in Montana. Both of these similar types have different understory species (Johnston 1987, Hansen et al. 1995). A similar *Betula glandulosa/Carex lasiocarpa* (bog birch/slender sedge) plant association occurs in Idaho, but no plot data is available to verify its species composition (Bourgeron and Engelking 1994).

Regional Distribution: This plant association and similar types occur in Montana (Hansen et al. 1995), Idaho (Bourgeron and Engelking 1994), and Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: There were two good occurrences documented for this plant association during the 1997 survey: Blue River-North of Silverthorne and the Muggins Gulch site. This plant association also occurs in the Routt National forest, on the east slope of the Gore Range in central Colorado, and in the Gunnision River Basin (Kettler and McMullen 1996, Kittel et al. 1995, Sanderson and Kettler 1996). Examples of this community type can be found at the Ironton Park PCA.

Elevation Range: 8,500-10,000 ft (2,600-3,000 m).

Site Geomorphology: Most stands of the *Betula glandulosa/*mesic forb-mesic graminoid (bog birch/mesic forb-mesic graminoid) plant association occur in subalpine meadows and willow communities. This association occurs in areas where soils are saturated from snowmelt for a significant part of the growing season. One stand occurs in a relatively narrow valley on a moderately wide bench or floodplain dissected by many small channels in the Gunnison River Basin. The stand is small in size, approximately 100 by 150 ft (30 by 45 m). One stand in the Gore Range occurs in a fen on the upper forested edge of a very slightly inclined area above a beaver pond. The vegetation receives water from several small seeps and springs in the stand. In the forest above the stands, there are several small, ephemeral channels. The water table appears to be at or near the surface for most of the growing season.

Wetland Description: Riverine and Slope wetland, with a seasonal to year long hydroperiod and occasional flooding.

Soils: Soils are deep, organic peat.

Vegetation: *Betula glandulosa* (bog birch) dominates the canopy with 20-80% cover. However, one stand along a very narrow reach below a wide, wet subalpine valley is dominated by 50% cover of *Picea engelmannii* (Engelmann spruce) and *Pinus contorta* (lodgepole pine). Other shrubs include 0-20% cover each of *Salix planifolia* (planeleaf willow), *Salix monticola* (Mountain willow), *Salix wolfii* (wolf willow), and *Pentaphylloides floribunda* (shrubby cinquefoil) and 1-10% cover each of *Salix brachycarpa* (barrenground willow) and *Lonicera involucrata* (honeysuckle).

The herbaceous undergrowth grows on small hummocks and is usually dominated by a dense mixture of mesic forbs and mesic graminoids. Mesic graminoids include 0-30% cover of *Calamagrostis canadensis* (bluejoint reedgrass), 0-10% cover each of *Carex aquatilis* (aquatic sedge), *Carex utriculata* (beaked sedge), and *Deschampsia caespitosa* (tufted hairgrass), and 0-5% cover of *Carex norvegica* (Scandinavian sedge). Forb species include 0-10% cover each of *Epilobium angustifolium* (fireweed), *Caltha leptosepala* (marsh marigold), *Ligusticum filicinum* (fernleaf ligusticum), *Angelica pinnata* (small-leaved angelica), *Mertensia ciliata* (mountain bluebells), and *Thalictrum alpinum* (arctic meadowrue) and 0-5% cover of *Conioselinum scopulorum* (hemlock parsley).

Successional and Ecological Processes: This plant association may be a mid-seral community on a long successional trajectory. As hummocks develop on peatland they may become more heavily dominated by *Salix* (willow) species. Due to cold temperatures and a short growing season, this process may take several decades to occur.

Adjacent Riparian Vegetation: *Salix planifolia/Carex aquatilis* (planeleaf willow/aquatic sedge), *Salix wolfii/*mesic forb (wolf willow/mesic forb), *Salix geyeriana/Calamagrostis canadensis* (Geyer willow/bluejoint reedgrass), and *Pentaphylloides floribunda/Deschampsia caespitosa* (shrubby cinquefoil/tufted hairgrass), and *Eleocharis quinqueflora* (spikerush) meadows are also present.

Adjacent Upland Vegetation: This information is not available.

Management: Forage production for this plant association can be moderate to high because of the herbaceous understory. Livestock will heavily graze *Carex* (sedge) species meadows in narrow riparian and wetland areas if they are located within extensive rangelands. Overgrazing causes reduced vigor of shrubs and eventually, the shrub cover may be completely eliminated. Overgrazing can also cause soil compaction and stream bank sloughing due to the wet nature of the soils. *Betula glandulosa* (bog birch) is a valuable browse for elk (Hansen et al. 1995).

The dense network of roots of *Betula glandulosa* and the rhizomatous nature of *Carex* species provide effective stream bank stabilization. *Betula glandulosa* may also overhang the stream bank and provide cover and shade for fish (Hansen et al. 1995).

Burning of this association can temporarily increase the productivity of *Carex* species, but livestock grazing must be eliminated for one year prior to burning. Care should be taken when burning the stands because they provide valuable stream bank stability (Hansen et al. 1995).

River birch/mesic forb (*Betula occidentalis*/mesic forb) plant association

Colorado Natural Heritage Program Rank: G3/S2

General Description and Comments: The *Betula occidentalis/*mesic forb (river birch/mesic forb) plant association is a tall (5-8 ft, 1.5-2.5 m), narrow band of shrubs lining a stream channel. The undergrowth can be sparse or a thick carpet of grasses and forbs. In undisturbed stands, forb species richness can be high, with over thirty species in one stand. At higher elevations, conifer trees on the upslopes intermix with *Betula occidentalis* at the stream bank.

Related Types/Synonyms: The *Betula occidentalis*/mesic forb community types (Manning and Padgett 1995, Padgett et al. 1989) is synonymous with the Colorado *Betula occidentalis*/mesic forb plant association.

Closely related communities include: the *Betula occidentalis*-*Cornus sericea* (river birch-red-osier dogwood) community type (Padgett et al. 1989), the *Betula occidentalis* community type (Hansen et al. 1995) which includes degraded stands with abundant non-native grasses in the undergrowth, the *Alnus incana-Betula occidentalis* (thinleaf alder-river birch) community type (Kittel 1994), the *Alnus incana-Betula fontinalis/Salix* spp. (thinleaf alder-river birch/willow) plant association (Johnston 1987). *Betula fontinalis* is a synonym for *Betula occidentalis* (Kartesz 1994).

Distribution in Colorado: Examples of this community type can be found in the Roubideau Creek PCA.

Elevation Range: 6,400-8,800 ft (2,000-2,700 m).

Site Geomorphology: This plant association occupies moderately wide stream benches and floodplains in narrow to moderately wide valleys and on hillside seeps. At lower elevations along sunny valley bottoms, well-developed, large occurrences occupy relatively flat stream benches and often extend away from the channel edge. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Stream channels are wide, rocky/cobble-bottomed, moderately steep, and sinuous (Rosgen's Channel Type: B2, B3, B4), wide, cobble-bottomed, less steep, and highly sinuous (Rosgen's Channel Type: C3), or braided from beaver activity (Rosgen's Channel Type: D6). This association also occurs along small floodplains of steep-gradient, narrow streams where the valley side slope meets the stream edge (Rosgen's Channel Type: A2). In these stands, *Betula occidentalis* (river birch) is squeezed between large boulders and herbaceous growth is limited to small pockets. This association also occurs around seeps adjacent to the stream channel and along isolated springs on hillslopes away from the valley bottom.

Wetland Description: Riverine and Slope wetland, with a seasonal to year long hydroperiod and occasional flooding.

Soil: Soils are fairly shallow, ranging from 12 to greater than 25 in (30 to >60 cm). Most soils have a surface layer of 50-90% organic matter. Subsurface layers are clay loams, sandy clays, and sandy loams. Most profiles have signs of saturation (mottles) at about 4-10 in (10-25 cm) depth. Skeletal layers, derived from alluvium, occur at a greater depth. Stands along narrow, steep stream channels occur between large alluvial and colluvial boulders and have almost no soil development. In the Colorado River Basin, the soils classify as fragmental calcareous lithic Cryorthents, fine-loamy ustic Torrifluvents.

Vegetation: *Betula occidentalis* (river birch) forms a nearly continuous tall-shrub to small-tree canopy along the stream bank with 15-90% cover. Other shrubs include 0-40% cover each of *Alnus incana* spp. *tenuifolia* (thinleaf alder) and *Cornus sericea,* (red-osier dogwood), 0-25% cover of *Salix exigua* (coyote willow), 0-20% cover each of *Jamesia americana* (cliff jamesia), *Amelanchier utahensis* (Utah serviceberry), and *Prunus virginiana* (chokecherry), and 0-10% cover of *Salix monticola* (Rocky Mountain willow). Along narrow valleys at higher elevations, conifers may overhang the stream edge. Conifer cover includes 0-65% cover of *Pseudotsuga menziesii* (Douglas-fir), 0-30% cover of *Abies lasiocarpa* (subalpine fir), and 0-20% cover of *Picea pungens* (blue spruce).

Due to the dense shrub canopy, herbaceous undergrowth is usually limited (<10% cover). Forb cover includes 0-40% *Maianthemum stellatum* (false Solomon seal)*,* 0-35% cover of *Heracleum sphondylium* (cow parsnip), 0-20% cover of *Thalictrum fendleri* (Fendler meadowrue), and 0-10% cover of *Rudbeckia laciniata* (cutleaf coneflower). Graminoid cover is usually low and includes 0-35% cover each of *Poa pratensis* (Kentucky bluegrass) and *Equisetum* spp. (horsetail), 0-25% cover of *Carex utriculata* (beaked sedge), and 0-20% cover of *Juncus balticus* (Baltic rush). An abundance of non-native grass species is considered an indication of heavy grazing.

Successional and Ecological Processes: The *Betula occidentalis*/mesic forb (river birch) plant association is considered a mid-seral type. With heavy grazing, this association may succeed to a *Salix* (willow) dominated association (Hansen et al. 1995). On wetter sites, the undergrowth potential may be for mesic grasses such as *Calamagrostis canadensis* (bluejoint reedgrass) and *Carex* spp. (sedge). This association may also be an early successional stage for conifer-dominated associations (Padgett et al. 1989).

Betula occidentalis can tolerate flooding (Hansen et al.1988), but not a permanent inundation of water. *Betula occidentalis* occurs at slightly lower elevations and on lower-gradient stream reaches than *Alnus incana* spp. *tenuifolia* (thinleaf alder). Because *Betula occidentalis* communities occupy low elevation, foothill habitats in Colorado, they are more threatened by development and stream impoundments than *Alnus incana* spp. *tenuifolia* or *Cornus sericea* (red-osier dogwood) riparian communities. Consequently, few large, undisturbed, and unaltered stands of the *Betula occidentalis*/mesic forb plant association exist today.

Adjacent Riparian Vegetation: The *Betula occidentalis*/mesic forb plant association is often the only association along narrow reaches. However, *Populus angustifolia* (narrowleaf cottonwood) and *Populus tremuloides* (quaking aspen) woodlands occur on adjacent floodplains. *Cornus sericea* (red-osier dogwood) and *Salix monticola* (Rocky Mountain willow) shrublands occur on adjacent wider floodplains. *Salix exigua* (coyote willow) shrublands occur on nearby sand bars while open hay meadows occur on adjacent cultivated floodplains.

Adjacent Upland Vegetation: Adjacent upland communities include *Pinus edulis-Juniperus osteosperma* (pinyon pine-Utah juniper) and *Pinus ponderosa* (ponderosa pine) woodlands on south-facing slopes. *Pseudotsuga menziesii* (Douglas-fir) and mixed *Abies* (fir) and *Pinus* (pine) forests are present on north-facing slopes.

Management: Due to the dense shrub cover, stands of this plant association may hinder livestock access. In the Arkansas River Basin, this plant association has a lush undergrowth dominated by native grasses and forbs in areas where livestock grazing is minimal. With season-long grazing, however, non-native grasses, such as *Poa pratensis* (Kentucky bluegrass) and *Agrostis stolonifera* (redtop), may begin to dominate the undergrowth. Livestock grazing can also reduce stream bank stability and cause sloughing. *Betula occidentalis* provides shade, organic matter, and overhanging banks for fish habitat (Hansen et al. 1988).

Betula occidentalis is an effective streambank stabilizer. Nursery grown seedlings can be successfully transplanted and will typically grow quickly (Hansen et al. 1988). Fire can easily kill Betula occidentalis shoots due to the shrub's thin bark. However, new shoots will resprout from uninjured basal buds (Hansen et al. 1988).

Drummond willow/bluejoint reedgrass (*Salix drummondiana/Calamagrostis canadensis*) plant association

Colorado Natural Heritage Program Rank: G3/S3

General Description and Comments: The *Salix drummondiana/Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) plant association is characterized by a dense canopy of *Salix drummondiana* (Drummond willow) and a thick undergrowth of *Calamagrostis canadensis* (bluejoint reedgrass). This association is often associated with beaver activity along streams and can also occur within the riparian mosaic with *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests.

Classification Problems: Without catkins (the flowering stalk), *Salix drummondiana* (Drummond willow) can be difficult to distinguish from the similar looking *Salix geyeriana* (Geyer willow). Both species are tall, greater than 5 ft (2 m), montane willows with strongly pruinose (a waxy covering that rubs off, similar to the coating on a plum) current-year twigs. Luckily, the two species can be distinguished using only vegetative characteristics. *Salix geyeriana* (Geyer willow) leaves are never more than 0.5 in (13 mm) wide and *Salix drummondiana* (Drummond willow) leaves are, on average, over 0.5 in (13 mm) wide (on non-sucker shoots) (Welsh et al. 1987).

Related Types/Synonyms: The *Salix drummondiana-Salix planifolia/Calamagrostis canadensis* (Drummond willow-planeleaf willow/bluejoint reedgrass) plant association (Kettler and McMullen 1996), the *Salix drummondiana/Calamagrostis canadensis* plant association (Komarkova 1986, Johnston 1987) and the *Salix drummondiana/ Calamagrostis canadensis* habitat type (Hansen et al. 1995) are synonymous with the Colorado *Salix drummondiana/Calamagrostis canadensis* plant association.

Closely related communities include: the *Calamagrostis canadensis* community type, (Hansen et al 1995, Padgett et al. 1989, Girard et al 1995), Komarkova 1986) which can have a few scattered stems of *Salix drummondiana*, but in general lacks any willow canopy, the *Salix drummondiana-Salix monticola/Calamagrostis canadensis-Carex rostrata* (Drummond willow-Rocky Mountain willow/bluejoint reedgrass-beaked sedge) plant association and the *Salix drummondiana-Salix monticola-Salix planifolia-Salix wolfii/Calamagrostis canadensis-Carex rostrata* (Drummond willow-planeleaf willow-wolf's willow/bluejoint reedgrass-beaked sedge) plant associations (Baker 1989) which probably includes stands dominated solely by *Salix drummondiana.*

Regional Distribution: This plant association occurs in Montana (Hansen et al. 1995) and Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs in scattered locations on the West Slope in the Yampa, Colorado and Gunnison River Basins (Kittel and Lederer 1993, Baker 1989, Sanderson and Kettler 1996, Johnston 1987, Komarkova 1986) and in the San Juan (Richard et al. 1996) and Routt National Forests (Kettler and McMullen 1996). Examples of this community type can be found in the East Dallas Creek PCA.

Elevation Range: 7,800-10,200 ft (2,400-3,100 m).

Site Geomorphology: This plant association occurs as small, isolated patches in forest and shrubland openings along channels in narrow valley bottoms. *Salix drummondiana* (Drummond willow) usually occurs along steep, narrow stream margins. It is often associated with beaver activity and can occasionally occur along low-gradient streams. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996).

Wetland Description: Riverine wetland with a seasonal hydroperiod and occasional flooding.

Soils: According to Johnston (1987), the soils classify as Cryaqualls and Cryaquepts. Stands in the Routt National Forest occur on soils with a gravel layer near the surface.

Vegetation: *Salix drummondiana* (Drummond willow) dominates the shrub overstory with 30-95% cover. *Salix planifolia* (planeleaf willow) is often present with 0-20% cover. The graminoid layer is dominated by 10-40% cover of *Calamagrostis canadensis* (bluejoint reedgrass). *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge) may be present with 0-30% cover each. Forb cover is relatively low.

Successional and Ecological Processes: The *Salix drummondiana*/mesic forb (Drummond willow/mesic forb) plant association is often an early colonizer of first-order, boulder-strewn, steep streams. Only a few stands representing the *Salix drummondiana/Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) plant association have been found in Colorado and livestock grazing has probably altered the species composition of these stands. The abundance of this association appears to be limited to saturated wetland environments and therefore may be dependent on beaver populations that maintain a high water table. In addition, near beaver activity, this association may be a mid-successional community that will eventually become *Salix planifolia* (planeleaf willow) or *Salix monticola* (mountain willow) type as the area dries slightly and becomes filled-in by sedimentation (Sanderson and Kettler 1996).

Adjacent Riparian Vegetation: *Carex utriculata* (beaked sedge) or *Calamagrostis canadensis* (bluejoint reedgrass) meadows, *Alnus incana* (thinleaf alder), *Salix geyeriana* (Geyer willow) and *Salix monticola* (mountain willow) shrublands, and *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests occur within the riparian mosaic.

Adjacent Upland Vegetation: *Populus tremuloides* (aspen) woodlands and *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests occur on adjacent hillsides.

Management: *Salix drummondiana* (Drummond willow) is highly palatable to livestock and wildlife (Kovalchik 1987). *Calamagrostis canadensis* (bluejoint reedgrass) is

moderate to highly palatable when foliage is young. With high grazing pressure, the production and vigor of both *Calamagrostis canadensis* and *Salix drummondiana* (Drummond willow) will decrease. Overgrazing by livestock can dry sites, increase non-native grass cover, and result in decreased vigor of willow root structure and eventually eliminate them from the site. The wet and often saturated soils of this plant association are also vulnerable to compaction by livestock and heavy equipment. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams abate channel downcutting, bank erosion, and downstream movement of sediment. Beaver dams raise the water across the floodplain and provide year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raises the channel bed and creates a wetland environment (Hansen et al. 1995).

Prescribed burning in this association is an effective method of rejuvenating decadent clumps of the associate willow species. The willows will vigorously sprout following fires, especially in wetter stands. Quick, hot fires produce more sprouts than slower fires. *Calamagrostis canadensis* is an aggressive invader of moist, burned sites due to its propagation from seed and rhizomes (Hansen et al. 1995).

The rhizomatous growth habit makes *Calamagrostis canadensis* a valuable species for stabilizing or rehabilitating mountain streams. *Salix drummondiana* is also useful for revegetating stream banks. The best results come from transplanting nursery grown cuttings. Cuttings should be taken in the spring from dormant 2-4 year-old wood. Cuttings should be 12-20 in (30-50 cm) long and at least 0.5 in (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen et al. 1995).

Coyote willow/bare ground (*Salix exigua*/bare ground) plant association

Colorado Natural Heritage Program Rank: G5/S5

General Description and Comments: *Salix exigua* (coyote willow) is one of the most common willow species in Colorado. It comprises two associations, the *Salix exigua*/mesic graminoid and the *Salix exigua*/bare ground. These are easy to recognize as they are nearly pure stands of the willow, with few other species present. An undergrowth of dense grasses and forbs covering at least 30% of the ground falls into the mesic graminoid type, while an undergrowth of a few, widely scattered forbs and grasses, where exposed cobbles or sand characterizes the ground cover, constitutes the *Salix exigua*/bare ground association. *Salix exigua*/bare ground association occurs within the annual flood zone of a river on point bars, islands, sand or cobble bars and stream banks, while the *Salix exigua*/mesic graminoid association generally occurs along backwater channels and other perennial wet, but less scoured sites, such as floodplain swales and irrigation ditches.

Related Types/Synonyms: The *Salix exigua*/barren ground plant association (Culver and Sanderson 1996, Kittel et al. 1994, 1995), the *Salix exigua* plant association (Richard et al. 1996), the *Salix exigua/*bench (Manning and Padgett 1995), the *Salix exigua*/barren (Padgett et al. 1989), and the *Salix exigua*/sparse and *Salix exigua*/scour (Durkin et al. 1995, Durkin et al. 1997) are synonymous with the Colorado *Salix exigua*/bare ground plant association.

Closely related communities include: unclassified stands of *Salix exigua* (Jones and Walford 1995), the *Salix exigua* community type (Hansen *et al*. 1995), and the *Salix exigua*-*Salix* spp./*Poa* spp. (Johnston 1987).

Regional Distribution: This plant association occurs in Nevada (Manning and Padgett et al. 1995), Utah (Padgett et al. 1989), and New Mexico (Durkin et al. 1995, 1997).

Distribution in Colorado: This association occurs throughout Colorado, on the western slope (Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995), on the eastern plains (Christy 1973, Culver and Sanderson 1996, Kittel et al. 1996), and along the foothills and mountains of the eastern front range (Kittel et al. 1996, Kittel et al. 1997). Examples of this plant community type can be found in the Uncompahgre River Macrosite.

Elevation Range: 4,500-8,500 ft (1,400-2,600 m).

Site Geomorphology: This early seral plant association occurs primarily on sand and cobble bars of larger (second order and up) rivers. It is associated with annual flooding and inundation and will grow well into the channel, where it is flooded, even in drier years. It can form large, wide stands on mid-channel islands on larger rivers such as the Gunnison, Colorado and South Platte Rivers, or narrow stringer bands on small, rocky tributaries. Streams were classified according to the "Rosgen Classification of Natural

Rivers" (Rosgen 1996). This plant association occurs along a wide variety of stream reaches: from moderately sinuous and moderate gradient reaches (Rosgen's Channel Type: B2-B6), to broad, meandering rivers with wide floodplains (Rosgen's Channel Type: C3-C5) or broad, braided channels (Rosgen's Channel Type: D5). Many stands also occur within highly entrenched or eroding gullies (Rosgen's Channel Type: F3, F6).

Wetland Description: Riverine wetland with a seasonal hydroperiod and annual flooding.

Soil: Soils of this association are typically coarse alluvial deposits of sand, silt and cobbles that are highly stratified with depth from flooding scour and deposition. Highly stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Occasionally, this association occurs on deep pockets of sand. In the Colorado River Basin, the soils are stratified sand/loam/clay and classify as Cryorthents, oxyaquic Cryorthents, typic Cryaquents, typic Cryopsamments, and oxyaquic Cryofluvents.

Vegetation: This association is characterized by an almost exclusive canopy of 10-90% cover of *Salix exigua* (coyote willow) with very little herbaceous cover. Occasionally, there is up to 10% cover of either *Populus angustifolia* (narrowleaf cottonwood) or *Populus deltoides* (plains cottonwood) seedlings in the understory. Combined bare soil, gravel, cobble and rock ground cover estimates are typically high.

Successional and Ecological Processes: The *Salix exigua*/bare ground (coyote willow/bare ground) plant association is considered an early seral community, capable of colonizing freshly deposited sand and gravel bars. *Salix exigua* (coyote willow) is an excellent soil stabilizer with a deep root system and flexible stems that can withstand flooding. *Salix exigua* reduces erosion potential by increasing the friction of stream flow, trapping sediments and building a protected seed bed for a number of tree and shrub species. Succession without disturbance may lead to a greater understory cover, which in turn facilitates the establishment of shrub and tree seedlings. The presence of cottonwood seedlings within this association indicates succession to a cottonwood stand, if seedlings survive subsequent flooding events.

Adjacent Riparian Vegetation: Because this is one of the most abundant riparian plant associations in Colorado, nearly any type of riparian vegetation may be adjacent. *Populus angustifolia* (narrowleaf cottonwood), *Populus deltoides* (plains cottonwood) or *Juniperus scopulorum* (Rocky Mountain juniper) woodlands are often present. Along the South Platte River, the *Populus deltoides*-(*Salix amygdaloides*)/*Salix exigua* (plains cottonwood-peachleaf willow/coyote willow) early seral (seedlings and sapling size trees only) community occurs on adjacent sand bars and low terraces, and older stands of *Populus deltoides-Salix amygdaloides/Spartina pectinata* (plains cottonwood-peachleaf willow/prairie cordgrass) occur on higher terraces. Other adjacent riparian vegetation includes *Tamarix ramosissima* (salt cedar), *Alnus incana* (thinleaf alder), *Cornus sericea* (red-osier dogwood) or *Betula occidentalis* (water birch) shrublands, and *Eleocharis*

palustris (spikerush), *Typha angustifolia* (narrow-leaved cattail) or *Carex* (sedge) wetlands.

Adjacent Upland Vegetation: Agricultural fields (sugar beets, winter wheat, and others) and rolling hills of *Artemisia filifolia* (silversage), xeric tall-grass prairies and *Bouteloua gracilis* (blue grama) short-grass prairies occur on surrounding rolling hills and plains of the South Platte River on the eastern plains. In the steep canyons of the foothills, upland vegetation includes *Pseudotsuga menziesii* (Douglas-fir) and *Pinus ponderosa* (ponderosa pine) forests, *Pinus edulis* (pinyon pine), *Juniperus monosperma* (one-seed juniper) and *Juniperus osteosperma* (Utah juniper) woodlands, *Quercus gambelii* (Gambel oak) shrublands, and *Artemisia tridentata* (big sagebrush) and *Sarcobatus vermiculatus* (greasewood) scrub. In the lower montane, upland vegetation includes *Pinus contorta* (lodgepole pine) and *Populus tremuloides* (aspen) forests.

Management: Forage production is typically low to moderate in *Salix exigua* stands due to the high densities of stems. The dense overstory may limit livestock movement within the association (Manning and Padgett 1995). Overgrazing by livestock will reduce the vigor of the willows present and may eventually eliminate them from the site. The opening up of *Salix exigua* stands may result in the invasion of introduced and non-palatable native species. However, release from heavy grazing pressure will allow *Salix exigua* to reestablish itself, provided it has not been completely eliminated from the site. Soil compaction is generally not a problem in this association because of the high coarse fragment content of the soils. However, fine textured soils are subject to compaction when moist (Hansen et al. 1995).

The limited information on fire as a management tool in this association indicates that *Salix exigua* vigorously sprouts following fire. Quick, hot fires result in more sprouts than slow fires which are actually more damaging to willows and tend to result in fewer sprouts (Hansen et al. 1995).

Salix exigua is an excellent streambank stabilizer due to its ability to send up individual stems from an underground root system. It also has an excellent capability of re-colonizing and spreading on disturbed areas. Once *Salix exigua* becomes established on disturbed areas, other shrubs and herbaceous species can become established as well. Removal of this association and subsequent stream bank exposure can lead to severe degradation and devastating results (Hansen et al. 1995).

Salix exigua can be useful for revegetating degraded sites and exposed sand/gravel bars since it will produce many roots along the entire stem. For best results, cuttings should be taken in the spring from dormant two to four year old wood. The cuttings should be 30-50 cm (12-20 in) long and >1 cm (0.5 in) in diameter. To insure survival, the cuttings should be rooted and grown in a nursery. Roots and shoots can be expected within 10 days of planting (Hansen et al. 1995).

Coyote willow/mesic graminoid (*Salix exigua*/mesic graminoid) plant association

Colorado Natural Heritage Program Rank: G5/S5

General Description and Comments: *Salix exigua* (coyote willow) is one of the most common willow species in Colorado. It comprises two associations, the *Salix exigua*/mesic graminoid and the *Salix exigua*/bare ground. These are easy to recognize as they are nearly pure stands of the willow, with few other species present. An undergrowth of dense grasses and forbs covering at least 30% of the ground falls into the mesic graminoid type, while an undergrowth of a few, widely scattered forbs and grasses, where exposed cobbles or sand characterizes the ground cover, constitutes the *Salix exigua*/bare ground association. *Salix exigua*/bare ground association occurs within the annual flood zone of a river on point bars, islands, sand or cobble bars and stream banks, while the *Salix exigua*/mesic graminoid association generally occurs along backwater channels and other perennial wet, but less scoured sites, such as floodplain swales and irrigation ditches.

Related Types/Synonyms: The *Salix exigua*/mesic graminoid community types (Padgett et al. 1989, Jones and Walford 1995) are synonymous with the Colorado *Salix exigua*/mesic graminoid plant association.

Regional Distribution: This plant association occurs in Wyoming (Jones and Walford 1995), Utah, Nebraska, Kansas, Oklahoma (The Nature Conservancy 1996) and Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs throughout the western slope (Kittel and Lederer 1993, Richard et al. 1996), along the Colorado Front Range (Friedman 1993, 1994, Kittel 1994, Cooper and Cottrell 1990), the mainstream and tributaries of the South Platte River (Christy 1973, Kittel et al. 1996, Kittel et al. 1997), and in southeastern Colorado on the Comanche National Grasslands (Culver et al. 1996). Examples of this plant community type can be found in the Roubideau Creek PCA.

Elevation Range: 5,700- 9,100 ft (1,750-2,700 m).

Site Geomorphology: This plant association usually occurs within 1 meter vertical distance of the stream channel on point bars, low floodplains, terraces and along overflow channels. It can also occur away from the stream channel in mesic swales or along the margins of beaver ponds. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Stream channels are broad to narrow meandering with sand or cobble beds (Rosgen's Channel Type: C5).

Wetland Description: Riverine wetland with a seasonal hydroperiod and annual to frequent flooding.

Soil: Soils are typically somewhat more developed than the *Salix exigua*/bare ground plant association due to a slightly more stable environment and greater input of organic

matter. However, the soils are generally thin (<1 m) and skeletal with depth (10-50% cobbles). Textures are typically loamy sands interspersed with layers of silty clays and alternating with coarse sands. Upper layers (10-30 cm) often have 25-30% organic matter.

Vegetation: *Salix exigua* dominates the canopy of this association with 15-90% cover, giving the association its characteristic grayish-green color. Other willow species can occur in the canopy including 0-25% cover of *Salix eriocephala* var. *ligulifolia* (yellow willow) and 0-15% cover of *Salix monticola* (Rocky Mountain willow). The undergrowth has at least 20-35% cover of various graminoid species including *Carex lanuginosa* (woolly sedge), *Eleocharis palustris* (spikerush) and *Juncus balticus* (Baltic rush). Non-native *Poa pratensis* (Kentucky bluegrass) can be significant with 0-41% cover.

Several stands along the Arikaree River had significant amounts of *Panicum virgatum* (switchgrass), *Sorghastrum nutans* (indiangrass), and *Spartina pectinata* (prairie cordgrass) in the undergrowth due their proximity to tall-grass wet meadows. These stands are included as a variation within this plant association.

Forb cover is generally low, but can include a high percentage of non-native species such as 0-30% cover of *Medicago lupulina* (black medic), and 0-10% cover of *Melilotus officinalis* (sweetclover).

Successional and Ecological Processes: This plant association is typical of recent floodplains and highly disturbed, low, wet areas and is considered early-seral. The amount of herbaceous growth in the understory is an indication of the amount of time since the last scouring (or depositional) flood event. *Salix exigua* (coyote willow) is an excellent soil stabilizer with a deep root system and flexible stems that can withstand flooding. *Salix exigua* reduces erosion potential by increasing the friction of stream flow, trapping sediments and building a protected seed bed for a number of tree and shrub species. The presence of cottonwood seedlings within this association indicates succession to a cottonwood stand (and may represent the *Populus angustifolia* or *Populus deltoides/Salix exigua* plant associations), if seedlings survive subsequent flooding events.

Adjacent Riparian Vegetation: Stands of *Populus angustifolia* (narrowleaf cottonwood) or *Populus deltoides-Salix amygdaloides* (plains cottonwood-peach-leaf willow) woodlands, *Prunus virginiana* (chokecherry) and *Ribes* spp. (currant) thickets, or irrigated hay meadows generally occur on higher terraces and adjacent elevated floodplains. Stands of *Carex aquatilis* (water sedge) can occur in adjacent wet areas and *Symphoricarpos* spp. (snowberry) shrublands occur in drier areas of the floodplain.

Adjacent Upland Vegetation: Streams cutting through steep rock gullies and canyons often have *Pinus ponderosa* (ponderosa pine) or *Pinus edulis* (pinyon pine) and *Juniperus monosperma* (one-seed juniper) woodlands on the uplands with *Quercus gambelii* (Gambel oak) thickets on lower slopes. *Pseudotsuga menziesii* (Douglas fir) forests can

occur on north facing canyon walls. Irrigated hay meadows and other agricultural crops commonly occur on the immediate uplands of more gentle streams.

Management: Forage production is typically low to moderate in *Salix exigua* stands due to the high densities of stems. The dense overstory may limit livestock movement within the association (Manning and Padgett 1995). Overgrazing by livestock will reduce the vigor of the willows present and may eventually eliminate them from the site. The opening up of *Salix exigua* stands may result in the invasion of introduced and non-palatable native species. However, release from heavy grazing pressure will allow *Salix exigua* to reestablish itself, provided it has not been completely eliminated from the site. Soil compaction is generally not a problem in this association because of the high coarse fragment content of the soils. However, fine textured soils are subject to compaction when moist (Hansen et al. 1995).

The limited information on fire as a management tool in this association indicates that *Salix exigua* vigorously sprouts following fire. Quick, hot fires result in more sprouts than slow fires, which are actually more damaging to willows and tend to result in fewer sprouts (Hansen et al. 1995).

Salix exigua is an excellent streambank stabilizer due to its ability to send up individual stems from an underground root system. It also has an excellent capability of re-colonizing and spreading on disturbed areas. Once *Salix exigua* becomes established on disturbed areas, other shrubs and herbaceous species can become established as well. Removal of this association and subsequent stream bank exposure can lead to severe degradation and devastating results (Hansen et al. 1995).

Salix exigua can be useful for revegetating degraded sites and exposed sand/gravel bars since it will produce many roots along the entire stem. For best results, cuttings should be taken in the spring from dormant two to four year old wood. The cuttings should be 30-50 cm (12-20 in) long and >1 cm (0.5 in) in diameter. To insure survival, the cuttings should be rooted and grown in a nursery. Roots and shoots can be expected within 10 days of planting (Hansen et al. 1995).

Rocky Mountain willow/mesic forb (*Salix monticola*/mesic forb) plant association

Colorado Natural Heritage Program Rank: G3/S3

General Description and Comments: The *Salix monticola*/mesic forb (Rocky Mountain willow/mesic forb) plant association is a tall (5-8 ft, 1.5-2.5 m), deciduous shrubland with a fairly open canopy and an herbaceous layer dominated by a variety of forbs and grasses. While no single herbaceous species is a clear dominant, total forb cover is generally greater than 30% and exceeds total graminoid cover.

Classification Problems: *Salix monticola* appears to be in the center of its distribution in Colorado, where it frequently forms large thickets with few other willow species present. Literature from Utah, Wyoming, Montana, Idaho, Nevada, and Oregon indicate that *Salix monticola* looses importance north and west of Colorado, where *Salix monticola* mixes with other *Salix* species. For example, in central and eastern Utah, *Salix monticola* dominated stands are infrequent and due to structural and ecological similarities are included in *Salix boothii* (Booth willow) associations (Padgett et al. 1989), and in Idaho, *Salix monticola* also has a limited distribution and largely associates with other *Salix* (willow) species (Brunsfeld and Johnson 1985).

Related Types/Synonyms: *Salix monticola* occurs as nearly pure stands in Colorado, but is replaced by other *Salix* (willow) species such as *Salix boothii* and *Salix drummondiana* further north and west of the state line. A similar *Salix boothii*/mesic forb (Booth willow/mesic forb) type described from Utah and southeastern Idaho includes stands that occasionally have some *Salix monticola* as an associated canopy species and *Calamagrostis canadensis* as the dominant undergrowth have been described by Johnston (1987) and Cooper and Cottrell (1990). However, the *Salix monticola*/mesic forb plant association tends to have a higher forb cover compared to the *Calamagrostis canadensis* types. The similar types include a *Salix drummondiana/ Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) plant association from the Gunnison National Forest in Colorado, a *Salix geyeriana-Salix* spp./*Calamagrostis canadensis* plant association from Idaho, Wyoming and Colorado (Johnston 1987) and a *Salix monticola/Calamagrostis canadensis* from the Colorado Front Range (Cooper and Cottrell 1990).

There are no synonyms in the literature for any of the Colorado *Salix monticola* plant associations. One closely related community is the *Salix drummondiana/Mertensia ciliata* plant association (Cooper and Cottrell 1990) which has some *Salix monticola.*

Regional Distribution: This plant association occurs in Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association is a major type in the upper montane areas of the San Miguel/Dolores (Kittel and Lederer 1993), Colorado, White (Kittel et al. 1994), Gunnison (Kittel et al. 1994) and South Platte River Basins (Cooper and Cottrell 1990, Kittel et al. 1997) as well as the western half of the San Juan National Forest

(Richard et al. 1996). Examples of this community type can be found in the West Dallas Creek and Buckhorn Lakes PCAs.

Elevation Range: 6,600-10,700 ft (2,000-3,260 m).

Site Geomorphology: The *Salix monticola*/mesic forb (mountain willow/mesic forb) plant association occurs along broad, swift-moving streams and active floodplains in narrow to moderately wide valleys (20-250 m). The ground surface is usually undulating, from past flooding or beaver activity. Stands form narrow bands at the stream edge, ranging from 1-6 ft (0-1.2 m) above the channel elevation. In wider valley bottoms, stands occur further from the bank, but never more than 2.5 ft. (0.75 m) above the annual high water mark. Streams are classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). Most stands occur adjacent to fairly straight, wide, and shallow channels ranging from bedrock to silty-bottomed reaches (Rosgen's Channel Type: B1-B6). A few stands occur on meandering, cobble-bottomed reaches (Rosgen's Channel Type: C3) or streams braided by beaver activity (Rosgen's Channel Type: D6).

Wetland Description: Riverine wetland with a seasonal hydroperiod and frequent flooding.

Soils: Soils are fine textured sandy clays to silty and sandy clay loams. Mottling and gleyed layers are common within 5 in (12 cm) of the ground surface indicating elevated water tables for part of the year. Coarse material varies from 0 to 80% in the upper horizons. In the Colorado River Basin, the silts classify as Cryofluvents and Cryorthents.

Vegetation: *Salix monticola* (mountain willow) forms a dense to open canopy with 20-100% cover and a very diverse, rich forb layer in the undergrowth. Other shrub species present at higher elevations include a variety of *Salix* (willow) species with 0-60% cover and *Lonicera involucrata* (bush honeysuckle) with 0-10% cover. At lower elevations, other shrubs include 0-30% cover of *Crataegus rivularis* (hawthorn), 0-20% cover each of *Ribes inerme* (gooseberry) and *Salix eriocephala* (yellow willow), and 0-10% cover of *Alnus incana* (thinleaf alder).

Successional and Ecological Processes: *Salix monticola* (mountain willow) dominated plant associations appear to be long lived and stable. They occur on mesic sites that support a diversity of graminoids and forbs. *Salix monticola* appears to grow only where the water table does not drop below 3 ft. (1 m) of the surface. It appears to be limited to cold, wet environments in broad valley bottoms at high elevations. Due to the colder environments, organic matter builds up in the soils, and it is likely that succession to other associations is slow (Padgett et al. 1989). The presence of dying conifer trees in these associations may indicate an increase in the water table.

The *Salix monticola*/mesic forb (mountain willow/mesic forb) plant association occurs on mesic sites and supports a rich diversity of forbs. On broad, hummocky floodplains

stands can form extensive willow carrs. Sites with a higher abundance of exotic forbs and graminoids may be grazing-induced. At higher elevations, this association grades into the *Salix planifolia*/mesic forb (planeleaf willow/mesic forb) association. Stands with abundant *Salix planifolia* present may indicate a transition between higher sites dominated by *Salix planifolia* and the wider, lower montane areas where *Salix monticola* becomes more abundant.

Adjacent Riparian Vegetation: *Populus angustifolia* (narrowleaf cottonwood), *Populus angustifolia-Picea pungens* (narrowleaf cottonwood-blue spruce) forests and *Salix planifolia* (planeleaf willow), *Salix wolfii* (Wolf willow), *Salix boothii* (Booth willow), *Salix geyeriana* (Geyer willow) or *Alnus incana* (thinleaf alder) shrublands occur on well-drained, adjacent floodplains. Mesic meadows of *Carex aquatilis* (aquatic sedge), *Eleocharis quinqueflora* (spikerush) or *Juncus balticus* (Baltic rush) also occur on flat areas of the floodplain. In narrow valleys at higher elevations, *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests occur.

Adjacent Upland Vegetation: At higher elevations, *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) forests and *Populus tremuloides* (aspen) woodlands occur on adjacent hill slopes. At lower elevations, *Pinus ponderosa* (ponderosa pine), *Pinus ponderosa-Quercus gambelii* (ponderosa pine-Gambel oak) and mixed *Pinus contorta* (lodgepole pine) forests occur on adjacent hill slopes.

Management: Stands with an abundance of non-native and increaser herbaceous species in the undergrowth are likely grazing induced shifts from either the native forb component of the *Salix monticola*/mesic forb plant association, or a shift from another *Salix monticola* dominated plant association. Improper livestock grazing can dry sites, increase non-native cover, and reduce the vigor of willow root structure. Rest periods from grazing are recommended in order to provide time for plant regrowth. Late summer and fall grazing is not recommended because willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995, Kovalchik and Elmore 1992).

Disturbed stands or stands with a history of improper grazing may respond to rest and rotation periods. These stands may have potential for higher graminoid biomass including species such as *Carex aquatilis* (water sedge) and *Calamagrostis canadensis* (bluejoint reedgrass).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams abate channel down cutting, bank erosion, and downstream movement of sediment. Beaver dams raise the water table across the floodplain and provide year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raises the channel bed and creates a wetland environment (Hansen et al. 1995).

Prescribed burning in this plant association is also an effective method of rejuvenating decadent stands of willows. The willow species in this plant association vigorously

sprout following quick, hot fires. Slow burning fires can actually damage the plants (Hansen et al. 1995).

Salix monticola (mountain willow) is an effective stream bank stabilizer. It can probably be grown and transplanted from nursery cuttings in the same manner as *Salix geyeriana*. Cuttings should be taken in the spring from dormant, 2-4 year-old wood. cuttings should be 12-20 in (30-50 cm) long and at least 0-5 in (1cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen et al. 1995).

PALUSTRINE EMERGENT COMMUNITIES--PERSISTENT

Water sedge-beaked sedge-perched wetland (*Carex aquatilis-Carex utriculata*-perched wetland) plant association

Colorado Natural Heritage Program Rank: G3/S3

General Description and Comments: This plant association is recognized by the presence of both *Carex aquatilis* and *Carex utriculata* in roughly equal proportions. It occurs at moderate to high elevations in depressions, or on slopes where the water table is at or near the surface for most of the growing season. Although this plant association is often associated with small order streams, it occurs on hillslopes above the stream margins.

Classification Problems: There remains some question as to whether the *Carex aquatilis-Carex utriculata* plant association is a distinct type or simply an intermixing of the *Carex aquatilis* and *Carex utriculata* plant associations (Padgett et al. 1989). In Colorado, we considered the latter two associations as clearly distinct types, occurring on different environmental settings. *Carex aquatilis* typically occurs on mineral soils often having a high organic component, while pure *Carex utriculata* stands typically occur on organic soils.

However, there are stands that do not easily classify into any one of the three plant associations. And although there is ample stand data on the *Carex aquatilis-Carex utriculata* plant association, more information is needed to clearly sort out the various classes of composition and environmental settings.

Related Types/Synonyms: The *Carex aquatilis-Carex utriculata*-perched wetland plant association has been distinguished and separated from the *Carex aquatilis-Carex utriculata* plant association, a common association that generally occurs in small to moderate size patches in very shallow, slow-moving to still water or on saturated soils near low-order streams, lakes, and backwater areas of larger rivers. The *Carex rostrata-Carex aquatilis* community type (Girard et al. 1995, Komarkova 1986, as cited in Reid and Bourgeron 1991, Hess and Wasser 1982), the *Carex rostrata*-(*Carex aquatilis* phase) (Hansen et al. 1989) community type, the *Carex aquatilis/Carex utriculata* (Johnson 1987) plant association and the *Carex utriculata-Carex aquatilis* (Cooper 1986) plant associations are considered synonymous with the Colorado *Carex aquatilis-Carex utriculata* plant association. *Carex utriculata* has often been incorrectly identified as *Carex rostrata*, in Colorado (Weber 1987, Weber and Whitmann 1996).

Regional Distribution: This plant association occurs in subalpine meadows throughout the Rocky Mountains including Montana (Hansen et al. 1989), Idaho, Utah, Wyoming (Girard et al. 1995) and Colorado (Johnston 1987, Komarkova 1986, as cited in Reid and Bourgeron 1994, Hess and Wasser 1982, Colorado Natural Heritage Program 1999). It also may occur in Arizona and Nevada (Bourgeron and Engelking 1994).

Distribution in Colorado: This association occurs throughout the Rocky Mountains of Colorado (Hess and Wasser 1982, Johnston 1987, Kettler and McMullen 1996, Kittel et al. 1994, Kittel et al. 1995, Komarkova 1986, as cited in Reid and Bourgeron 1994, Richard et al. 1996). Examples of this type of plant community are found in the Wildhorse Basin PCA.

Elevation Range: 8,200-11,100 ft (2,500-3,400 m).

Site Geomorphology: This plant association occurs in broad, glaciated, subalpine meadows that remain saturated with snowmelt runoff for most of the growing season. It is also often associated with beaver activity and low order streams, occuring on hillslopes above Riverine systems; however, the hydrology of this plant association is more influenced by seeps and groundwater than stream water.

Wetland Description: Slope wetland, with a permanent hydroperiod.

Soils: Soils are often organic, thick, and peaty or sandy clays and sandy clay loams originating from glacial till. In the Colorado River Basin, soils classify as loamy, clayey or sandy typic and cumulic Cryaquolls.

Vegetation: This plant association has relatively low species diversity due to saturated soil conditions. *Carex aquatilis* (water sedge) and *Carex utriculata* (beaked sedge) co-dominate the association with 20-70% cover. Both species are present in equal or near equal amounts. For example, a stand with 10% cover of each *Carex* species would classify as this type, however a stand with 10% *Carex aquatilis* and 80% *Carex utriculata* would classify as a *Carex utriculata* plant association. Other forb and graminoid cover is sparse.

Successional and Ecological Processes: The difficulty in classifying mixed stands of *Carex aquatilis* and *Carex utriculata* has been discussed in the literature and attempts have been made to differentiate the types based on soil characteristics. Sanderson and Kettler (1996) note a dominance of *Carex utriculata* on organic soils and *Carex aquatilis* on mineral soils. Kittel et al. (1995) note the opposite trend where *Carex aquatilis* appears to occur more often on rich Histisols, while *Carex utriculata* occurs on less nutrient rich soils. Richard et al. (1996) note that pure stands of *Carex utriculata* tend to occur on mineral soils with some organic epipedons, a trend also noted by Padgett et al. (1989).

Adjacent Riparian Vegetation: This plant association commonly is part of a riparian or wetland mosaic, intermixing with pure stands of *Carex aquatilis* (water sedge), *Carex utriculata* (beaked sedge), and *Juncus balticus* (Baltic rush) or *Salix planifolia* (planeleaf willow), *Salix brachycarpa* (barrenground willow), *Salix wolfii* (Wolf willow), *Salix boothii* (Booth willow, or *Salix geyeriana* (Geyer willow) shrublands. *Deschampsia caespitosa* (tufted hairgrass) grasslands often occur on drier margins and *Veratrum tenuipetalum* (Colorado false hellebore) patches often occur on moist toe-slope seeps.

Adjacent Upland Vegetation: *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann spruce) and *Pinus contorta* (lodgepole pine) forests and *Artemisia tridentata* (big sagebrush) shrublands occur on adjacent hillslopes.

Management: Livestock in riparian areas in mid- to high- elevation rangelands can heavily utilize Palatable Carex (sedge) species. Overgrazing by livestock can dry sites, increase non-native grass cover, and result in decreased vigor of native species root structure that can eventually eliminate them from the site. The wet and often saturated soils of this plant association are also vulnerable to compaction by livestock and heavy equipment. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant growth. Late summer and fall grazing is not recommended if there are adjacent willow shrublands, as willow species are vulnerable to pruning damage due to limited regrowth at the end of the growing season (Hansen et al. 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams create a high water table, abate channel downcutting, bank erosion, and movement of sediment by slowing the stream flow and reducing stream gradients. Beaver dams raise the water table across the floodplain and provide year-round saturated soils. Plant establishment and sediment build-up behind beaver dams raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity rather than removing them (Hansen et al. 1995).

Burning of this plant association temporarily increases the productivity of *Carex aquatilis* (aquatic sedge) and *Carex utriculata* (beaked sedge). However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after to prevent livestock from damaging young, palatable regrowth and to allow for root reserve build up (Hansen et al 1995).

Carex aquatilis and *Carex utriculata* (beaked sedge) are effective stream bank stabilizers due to their rhizomatous root growth. They tend to form a dense, thick sod that is highly resistant to erosion (Hansen et al. 1995).

Beaked sedge-perched wetland (*Carex utriculata*-perched wetland) plant association

Colorado Natural Heritage Program Rank: G3/S3

General Description and Comments: The *Carex utriculata* (beaked sedge) plant association is a wet meadow community that occurs at moderate to high elevations, on slopes or in depressions where the water table is usually near the surface for most of the growing season.

Classification Problems: *Carex utriculata* has been incorrectly identified as *Carex rostrata* in previous Colorado literature (Weber and Whitman 1992).

Related Types/Synonyms: The *Carex utriculata*-perched wetland has been identified as a distinct community based on its unique landscape position and hydrologic regime, and separated from *Carex utriculata*, a common wet meadow community that occurs around the edges of montane lakes and beaver ponds, along the margins of slow-moving reaches of streams and rivers, and in marshy swales and overflow channels on broad floodplains. The *Carex rostrata* community types from Oregon (Kovalchik 1987), Nevada (Manning and Padgett 1995), Utah (Padgett et al. 1989), Montana (Hansen et al. 1995), Idaho, Wyoming (Youngblood et al. 1985, Girard et al. 1995) and Colorado (Cooper and Cottrell 1990) are synonymous with the Colorado *Carex utriculata* plant association. Closely related communities are more broadly defined, and probably contain stands that would match the Colorado *Carex rostrata-Carex aquatilis* (Hess and Wasser 1982), the *Carex aquatilis-Carex utriculata-Carex utriculata* Phase (Johnston 1987), and the *Carex aquatilis-Carex rostrata-Deschampsia caespitosa* (Baker 1989) plant association.

Regional Distribution: This plant association occurs in Oregon (Kovalchik 1987), Nevada (Manning and Padgett 1995), Utah (Padgett et al. 1989), Idaho, Wyoming (Youngblood et al. 1985, Jones and Walford 1995), Montana (Hansen et al. 1995), and Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs in Rocky mountain National Park, Roosevelt, Arapaho, White River, Routt, Bunnison and San Juan National Forests (Johnston 1987, Kettler and McMullen 1996, Richard et al. 1996), and the Yampa, San Miguel/Dolores (Kittel and Lederer 1993), White, Colorado (Kittel et al. 1994), Gunnison (Kittel et al. 1995), Arkansas (Kittel et al. 1996), South Platte River Basins (Kittel et al. 1997) and the Rio Grande and Closed Basins (Colorado Natural Heritage Program 1999). Examples of this plant community type can be found in the West Dallas Creek PCA.

Elevation Range: 7,500-9,600 ft (2,300-2,900 m).

Site Geomorphology: *Carex utriculata*-perched wetland (beaked sedge) on saturated soils of slopes and depressions where the water table is at or near the surface for most of the growing season. The community may be associated with wet meadows above beaver

ponds and low order streams, occuring on hillslopes above Riverine systems; however, the hydrology of this plant association is more influenced by seeps and groundwater than stream water.

Wetland Description: Slope wetland, with a permanent hydroperiod.

Soils: Soils are saturated organics or fine silty clays to clays. Mottling may occur within a few centimeters of the surface.

Vegetation: This plant association is characterized by nearly pure stands of *Carex utriculata* (beaked sedge) (20-98%). Graminoids dominate the herbaceous layer and can be quite diverse. Other *Carex* (sedge) species present include *Carex lenticularis* and *Carex microptera* (small-wing sedge), but usually with low cover (<10-30%). Other graminoid species present are *Glyceria striata* (fowl mannagrass), *Calamagrostis canadensis* (Canadian reedgrass), *Juncus balticus* (mountain rush). Forb cover is low (<10%). Willow carrs (shrublands) are often adjacent and a few scattered willows will occur within the *Carex utriculata* (beaked sedge) stand, such as *Salix monticola* (mountain willow), *Salix drummondiana* (Drummond willow), *Salix geyeriana* (Geyer willow) or *Salix planifolia* (planeleaf willow).

Successional and Ecological Processes: The *Carex utriculata*-perched wetland plant association occurs on mesic to saturated sites, such as low-lying depressions, slopes and other places of topographical convergence where the water table is close to the surface or springs emerge. It is an early-seral species and is known to invade margins of newly formed beaver ponds, as well as the freshly exposed silt beds of drained beaver ponds (Padgett et al. 1989). With time, the *Carex utriculata* plant association may grade into a *Carex aquatilis* and *Calamagrostis canadensis* associations. *Calamagrostis canadensis* dominates the driest sites with the lowest water tables and colonizes drying stands of *Carex utriculata* and *Carex aquatilis* (Cooper 1986).

Adjacent Riparian Vegetation: This association is often part of a wetland mosaic, with *Salix monticola, Salix drummondiana,* and *Salix geyeriana* shrublands. It also occurs adjacent to and intergrades with *Carex aquatilis* or *Eleocharis palustris* meadows. *Populus angustifolia-Picea pungens, Populus angustifolia* and *Picea pungens* riparian forests occur on adjacent stream terraces in narrower valleys.

Adjacent Upland Vegetation: *Abies lasiocarpa-Picea engelmannii* forests, *Populus tremuloides* woodlands occur on adjacent hillslopes at higher elevations with *Pinus ponderosa* and *Populus tremuloides* forests and *Quercus gambelii* shrublands occurring on adjacent hillslopes at lower elevations.

Management: *Carex utriculata* generally occupies the wettest habitats in the wet meadow area. The soils are highly susceptible to compaction and churning. Heavy use by livestock can dry the site, increase non-native grass cover, and reduce the vigor of willow root structure. However, *Carex utriculata* has low palatability, especially late in

the season (Herman 1970). The wet and often saturated soils of this plant association are also vulnerable to compaction by livestock and heavy equipment. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because adjacent willow individuals are vulnerable to pruning damage due to limited regrowth before the end of the growing season (Hansen et al. 1995, Kovalchik and Elmore 1992).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams aid in controlling channel down cutting, stream bank erosion, and downstream movement of sediment. Beaver dams raise the water table and provide water for hydrophytic plants including willows and sedges. The trapping of sediment behind beaver dams, along with plant reproduction, raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity in an area versus their removal (Hansen et al. 1995).

Burning of this plant association temporarily increases the productivity of *Carex utriculata* (beaked sedge) and *Carex aquatilis* (aquatic sedge). However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after burning. This is necessary in order to keep livestock from consuming young, palatable regrowth. Prescribed burning is also an effective method of rejuvenating decadent clumps of willows. Willow species in the plant association vigorously sprout following quick, hot fires. Slow burning fires can actually damage the plants (Hansen et al. 1995).

Inland saltgrass (*Distichlis spicata* var. *spicata*) plant association

Colorado Natural Heritage Program Rank: G5/S3

General Description and Comments: This plant association is characterized by open to thick stands of pure *Distichlis spicata* var. *spicata* (inland saltgrass) growing on alkaline or saline soils in basins, swales or on pond margins.

Related Types/Synonyms: Synonymous *Distichlis spicata* var. *spicata* community types are documented from the Colorado Front Range (Baker 1984) and Montana (Hansen et al. 1995). Closely related communities having various associated species include *Distichlis spicata* var. *spicata-Sporobolus airoides-Elytrigia smithii* (inland saltgrass-alkali sacaton-western wheatgrass) documented from Colorado, Wyoming, Nebraska, Kansas, Oklahoma and Utah (Johnston 1987).

Regional Distribution: This plant association and similar types occur in Montana (Hansen et al. 1995), Saskatchewan, Wyoming, Nebraska, Kansas, Oklahoma, Utah, and Colorado (Johnston 1987, Baker 1984, Colorado Natural Heritage Program 1999).

Distribution in Colorado: This association has been documented along the Colorado Front Range (Baker 1984), on the eastern plains (Steve Kettler, personnel communication), in the San Luis Valley in south-central Colorado (Colorado Natural Heritage Program 1999), and in the Yampa, White and Colorado River Basins (Kittel and Lederer 1993, Kittel et al. 1994).

No PCAs were created for *Distichlis spicata* var. spicata (inland saltgrass); however, good examples of the community were found at the Sazama and Jade Road Sites of Local Significance.

Elevation Range: 5,000-7,550 ft (1,530-2,300 m).

Site Geomorphology: The plant association occurs on alkaline or saline soils; soils that have been formed from the accumulation of bases and soluble salts in poorly drained areas. This association occurs along narrow streams or the margins of playa lakes. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996).

Wetland Description: Slope and Riverine wetland, with a seasonal to permanent hydroperiod and occasional flooding.

Soils: Soils are alkaline and have textures of sandy clay, sandy loams, and sandy clay loams with gravel and cobbles. The soils may be heavily gleyed and can have fine, distinct mottles at a depth of about 20 in (50 cm). Soils in the Colorado River Basin classify as loamy (calcareous) typic Cryaquents.

Vegetation: This plant association is characterized by almost pure stands of *Distichlis spicata* var. *spicata* (inland saltgrass) with 3-90% cover. Occasionally several stems of *Chrysothamnus nauseosus* (rubber rabbitbrush) or *Sarcobatus vermiculatus* (greasewood) can be present with less than 3% cover. In degraded stands, *Iva axillaris* (poverty weed) can be present with 0-20% cover.

Successional and Ecological Processes: *Distichlis spicata* var. *spicata* (inland saltgrass) is a warm season grass and grows from early summer until fall primarily from rhizomes. *Distichlis spicata* var. *spicata* can tolerate low to moderately alkaline soils and is resistant to trampling by livestock. Cover of plants, but eventually *Hordeum jubatum* (foxtail barley) will take over if heavy grazing persists (Jones and Walford 1995). In heavily grazed stands of *Sporobolus aeroides* (alkali sacaton), *Distichlis spicata* var. *spicata* will increase significantly. This community type may be considered climax if the salt content of the soil remains steady. Increasing the salt content may change the association to a *Puccinellia aeroides* (Nuttall's alkaligrass) dominated type (Johnston 1987).

Adjacent Riparian Vegetation: Adjacent vegetation includes meadows of *Triglochin* spp. (arrowgrass), *Eleocharis palustris* (common spikerush), *Juncus balticus* (Baltic rush), and *Carex* spp. (sedge).

Adjacent Upland Vegetation: Adjacent upland vegetation includes *Sarcobatus vermiculatus* (greasewood) and *Artemisia tridentata* (big sagebrush) shrublands and *Juniperus osteosperma* (Utah juniper woodlands).

Management: *Distichlis spicata* var. spicata (inland saltgrass) is not particularly palatable to livestock and forage production is low in this plant association. With prolonged heavy grazing, *Hordeum jubatum* (foxtail barley) may replace *Distichlis spicata* var. *spicata*. In heavily grazed stands of *Sporobolus airoides* (alkali sacaton), *Distichlis spicata* var. *spicata* will increase significantly. *Distichlis spicata* var. *spicata* can be effective in revegetating degraded saline and alkaline sites due to its rhizomatous growth (Hansen et al. 1995).

Creeping spikerush (*Eleocharis palustris*) plant association

Colorado Natural Heritage Program Rank: G5/S4

General Description and Comments: The *Eleocharis palustris* (creeping spikerush) plant association is a conspicuous, common emergent association that occurs in shallow, mostly still water. Most of the sites where it occurs experience water levels that fluctuate to some degree throughout the growing season. It is recognized by the clear dominance, although sometimes sparse cover, of *Eleocharis palustris.*

Related Types/Synonyms: The *Eleocharis palustris* (creeping spikerush) plant association is described by several authors and all are considered synonymous with the Colorado *Eleocharis palustris* plant association. These communities include: the *Eleocharis palustris* plant association described from Colorado, New Mexico, Utah, Wyoming and Idaho (Kittel and Lederer 1993, Cooper 1993, Cooper and Severn 1992, Durkin et al. 1995, Johnston 1987, Padgett et al. 1989, Youngblood et al. 1985) and the *Eleocharis palustris* association from central Oregon (Kovalchik 1987).

Regional Distribution: The *Eleocharis palustris* (creeping spikerush) plant association occurs in Oregon (Kovalchik 1987), Idaho, Wyoming (Youndblood et al. 1985), Montana (Hansen et al. 1995), Utah (Padgett et al. 1989), New Mexico (Durkin et al. 1995) and Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: The *Eleocharis palustris* plant association is common throughout the state and is documented in the Yampa and San Miguel River Basins (Kittel and Lederer 1993), Routt and San Juan National Forests (Kettler and McMullen 1992, Richard et al. 1996), near Crested Butte (Cooper 1993) and in the Rio Grande and Closed Basins (Cooper and Severn 1992, Colorado Natural Heritage Program 1999).

No PCAs were created for Eleocharis palustris; however, good examples of the community were found at the Natural Pond PCA, and the Miller Mesa Site of Local Significance.

Elevation Range: 5,500-10,000 ft (1,700-3,050 m).

Site Geomorphology: This association occurs on wet sand bars and on finer substrates in backwater areas within the stream channel at low elevations. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). This association usually occurs along narrow, sinuous (Rosgen's Channel Type: E3, E4) headwater rivulets where ground water flow is lateral, primarily fed from toe slope seeps.

Wetland Description: Riverine, Slope, and Depressional wetland with a seasonal hydroperiod, may experience occasional flooding.

Soils: High elevation stands consistently occur on organic (highly sapric) soils, or on a thick organic horizon that overlays fine to coarse alluvial material. Lower elevation

stands occur on fresh alluvial deposits of fine-textured loamy sands, clays, and sandy clays. Two samples from the Arikaree River had considerable organic content in the upper 4-8 in. (10-20 cm).

Vegetation: *Eleocharis palustris* (creeping spikerush) can be very open with a sparse cover to quite dense, but is always the dominant species (10-80%). Because the *Eleocharis palustris* plant association occurs within a wide elevational range, the species composition can be quite variable. On the western slope in low elevation stands, co-occurring species include: *Phalaroides arundinacea* (common reed), *Juncus balticus* (mountain rush) and *Scirpus americanus* (threesquare bulrush) as well as the introduced *Melilotus officinale* (sweet clover) and *Bromus inermis* (smooth brome). Forb cover can also include: *Sparganium angustifolium* (narrowleaf bur-reed), *Lemna* spp. (duckweed) and *Potamogeton* spp. (pondweed). On the eastern plains, co-occurring species include: *Leersia oryzoides* (rice cutgrass) (15-40%), *Scirpus pungens* (bulrush) (20-30%), *Panicum virgatum* (switchgrass) (10-15%), *Carex lanuginosa* (wooly sedge) (10%), and *Spartina pectinata* (prairie cordgrass) (0-10%).

At higher, montane elevations other graminoids present include: *Carex aquatilis* (water sedge), *Carex utriculata* (beaked sedge), and *Deschampsia caespitosa* (tufted hairgrass), with 0 to 10% cover each. Forb cover is typically low, but can be high up to 30% in some stands. Common forb species include: *Pedicularis groenlandica* (elephant head), *Rhodiola integrifolia* (king's crown), and *Caltha leptosepala* (marsh marigold).

Successional and Ecological Processes: At lower elevations the *Eleocharis palustris* plant association occurs well within the active channel and is inundated annually. This early seral community colonizes backwater eddies and shallow edges of slow moving reaches of small and larger rivers. It is probably an ephemeral community, scoured out each year during high spring flows. This association has been described as an early seral stage by Padgett et al. (1989). They describe light colored soils for the sites, indicating an early phase of soil development. At montane elevations, this association occurs in ponded sites on faster moving streams. If siltation occurs, sites may become dominated by *Carex utriculata* (beaked sedge). At higher elevations, this association appears to be stable. It occurs near seeps on soils with deep organic layers, often sapric, and saturated throughout the growing season.

Adjacent Riparian Vegetation: At higher elevations *Carex aquatilis* (water sedge) or *Carex utriculata* (beaked sedge) meadows and *Salix wolfii* (Wolf willow) or *Salix planifolia* (planeleaf willow) shrublands occur within the riparian mosaic. At lower elevations *Scirpus pungens* and *Scirpus lacustris* (bulrush) can occur within the stream channel and wet meadow prairies of *Panicum virgatum* (switchgrass) and *Sorghastrum nutans* (indiangrass) occupy the immediate stream banks and low floodplains. Sands of *Populus deltoides* (plains cottonwood) and *Salix amygdaloides* (peachleaf willow) can also occur scattered across the floodplain.

Adjacent Upland Vegetation: Low elevation streams on the Western Slope have *Pinus edulis*-*Juniperus* spp. (Pinyon-juniper) woodlands and *Artemisia tridentata* (sagebrush)

or *Sarcobatus vermiculatus* (greasewood) shrublands on adjacent hillslopes. At higher montane and subalpine elevations, *Abies lasiocarpa-Picea engelmannii* (subalpine fir-Engelmann) forests occupy adjacent slopes. On the eastern plains, rolling upland hills are occupied by *Bouteloua gracilis* (blue grama) short grass prairie, or *Artemisia* (sandsage) shrublands.

Management: The low palatability of *Eleocharis palustris* and seasonally wet soils limit the grazing value of this type for livestock (Hansen et al. 1995).

Beaked spikesedge (*Eleocharis rostellata*) plant association

Colorado Natural Heritage Program Rank: G2G3/S2S3

General Description and Comments: This association is uncommon and localized to calcareous wet meadows, seeps and stream margins, often associated with mineral springs.

Regional Distribution: The *Eleocharis rostellata* (beaked spikesedge) association is uncommon and localized to southwest South Dakota and southwest Nebraska (Larson 1993), Mammoth Hot Springs, Wyoming (Chadde et al. 1988), and Escalante Canyon, Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs in Escalante Canyon (Colorado Natural Heritage Program 1999). Examples of this community type can be found in the Escalate Wetland PCA.

Elevation Range: 6,200 ft (1,890 m).

Site Geomorphology: This association is found on calcareous wet meadows, seeps and stream margins, often associated with mineral springs (Larson 1993).

Wetland Description: Slope and Riverine wetland, with a permanent hydroperiod, may experience occasional flooding.

Soils: Substrates are composed of travertine and *Chara* deposits. A thin (5 cm) layer of undecomposed *Eleocharis* stems covers much of the substrate surface. This type is located in perennially flowing warm water. Electrical conductivity is also high (Chadde et al. 1988).

Vegetation: Species diversity of this type is low. In addition to *Eleocharis rostellata, Scirpus acutus, Aster eatonii,* and *Polypogon monspeliensis* may be present in small amounts. A dense layer of algae is also typically found overlying the travertine substrate (Chadde et al. 1988).

Adjacent Riparian Vegetation: Adjacent sites support the *Scirpus acutus* association. The *Carex rostata* and *Pentaphylloides floribunda/Deschampsia caespitosa* associations are common on drier sites (Chadde et al. 1988).

Adjacent Upland Vegetation: Upland communities are dominated by *Artemisia tridentata* ssp. *vaseyana, Festuca idahoensis, Elymus cinereus,* and *Poa pratensis* (Chadde et al. 1988).

Common reed (*Phragmites australis*) plant association

Colorado Natural Heritage Program Rank: G4/S3

General Description and Comments: The *Phragmites australis* (common reed) plant association is a tall (3-5 ft, 1-1.5 m) reed community often growing in small wet patches in seeps and backwater areas of large floodplains, around the fringes of irrigation ponds, ditches, and along railroad embankments that have poor drainage.

Related Types/Synonyms: The following three names appear synonymous with the Colorado *Phragmites australis* (common reed) plant association: the *Phragmites australis* (common reed) type documented from northwestern Colorado (Baker 1982), the *Phragmites australis* community type documented from Montana (Hansen et al. 1995), and a *Phragmites communis/Carex lacustris* (common reed/sedge) type documented from Nebraska (Johnston 1987). *Phragmites communis* is a synonym for *Phragmites australis* (Kartesz 1994).

Regional Distribution: This plant association occurs in Montana (Hansen et al. 1995), Nebraska (Johnston 1987) and Colorado (Baker 1982, Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association occurs on the western slope in the White and Colorado River Basins (Baker 1982, Kittel et al. 1995) and on the eastern plains near Pueblo (Steve Kettler, CNHP ecologist, *personnal communication*). Examples of this plant community type can be found in the Uncompahgre River Macrosite.

Elevation Range: 6,500 ft (1,980 m).

Site Geomorphology: This plant association occurs in seeps, along irrigation ditches and outflows, and in oxbow lakes.

Wetland Description: Slope and Riverine wetland, with a permanent hydroperiod, may experinece occasional flooding.

Soils: Soils classify as coarse-loamy, calcareous typic Cryaquents.

Vegetation: The vegetation is characterized by almost pure stands of *Phragmites australis* (common reed) with 80% cover and a few stems of *Salix exigua* (coyote willow).

Successional and Ecological Processes: *Phragmites australis* generally requires seasonal flooding in the spring (Johnston 1987). This species has strong rhizomes that allow it to outcompete all but the most aggressive weedy species. With heavy disturbance, however, exotic species such as *Cirsium arvense* (Canada thistle) may invade this plant association (Hansen et al. 1995).

Adjacent Riparian Vegetation: *Salix exigua* (coyote willow) shrublands and *Typha* spp. (cattail) wetlands occur in adjacent riparian areas.

Adjacent Upland Vegetation: *Juniperus osteosperma* (Utah juniper) woodlands occur on adjacent hill slopes.

Management: *Phragmites australis* (common reed) is highly palatable to livestock and wildlife, especially when the plants are young and growing vigorously. *Phragmites australis* is moderately tolerant of grazing. However, heavy grazing pressure may reduce the size and extent of stands (Hansen et al. 1995).

Phragmites australis can be an effective stream bank stabilizer due to its rhizomatous growth. The rhizomes hold and stabilize the bank while above ground vegetation traps and filters sediments (Hansen et al. 1995).

Alkali cordgrass (*Spartina gracilis*) plant association

Colorado Natural Heritage Program Rank: G4?/S2

General Description and Comments: The *Spartina gracilis* (alkali cordgrass) plant association is a wetland meadow with sparse to thick cover of grasses and grass-like plants. Few stands have been documented in Colorado, so its classification is tentative.

Related Types/Synonyms: Baker (1984) lists a *Spartina gracilis* (salt meadow) which is synonymous with the Colorado *Spartina gracilis* (alkali cordgrass) plant association. Closely related communities are the *Spartina pectinata* (alkali cordgrass) community type (Hansen et al. 1995), which includes *Spartina gracilis* dominated stands because they occur in similar habitats, and the *Distichlis stricta* community (Ungar 1974) in which *Spartina gracilis* can dominate the outer margins.

Regional Distribution: This association occurs in Canada, Washington, Utah (Baker 1984) and Colorado (Baker 1984, Colorado Natural Heritage Program 1999).

Distribution in Colorado: This association has previously been described on the lower Yampa River (Colorado Natural Heritage Program 1999) and in the San Luis Valley (Hanson 1929). An example of this community type can be found in the Escalante Wetland PCA.

Elevation Range: 5,900 ft (1,800 m).

Site Geomorphology: This association occurs on moist sandy overflow channels and backwater areas of large rivers, and poorly drained swales on the eastern plains. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). One plot occurred adjacent to strogly meandering, low gradient channel (Rosgen's Channel Type: C3).

Wetland Description: Riverine and Slope wetland, with a seasonal hydroperiod, may experience occasional flooding.

Soils: The soils are fine-textured silt-loam and clay loams and alkaline (Ungar 1974).

Vegetation: *Spartina gracilis* (alkali cordgrass) is the clear dominant, although cover can be sparse (30-60%). Other graminoids present include: *Scirpus pungens* (common threesquare), *Elytrigia repens* (quackgrass), *Agrostis gigantea* (redtop). Forbs species present tend to be weedy and in insignificant amounts.

Successional and Ecological Processes: The *Spartina gracilis* plant association tolerates alkaline soils to the exclusion of other species. It also tolerates burial by flood deposition and readily re-sprouts, pushing up sharp shoots (Weaver 1965). If the soil salinity drops, the community will become dominated by less alkaline tolerant plants.

Adjacent Riparian Vegetation: *Ribes* spp. and *Shepherdia argentea* (silver buffalo berry) shrublands occur on adjacent floodplains. *Eleocharis* spp. meadows occur on adjacent wet swales and overflow channels.

Adjacent Upland Vegetation: *Artemisia tridentata* (big sagebrush) shrublands and *Pinus edulis-Juniperus monosperma* (pinon pine-Utah juniper) woodlands occur on surrounding hill slopes.

Management: Stands of *Spartina pectinata* (alkali cordgrass) have high production rates, however the rough-edged leaves make for poor forage quality, and it is not readily eaten by livestock or wildlife. Its tall height and thick growth provide shade and cover for wildlife and certain bird species (Hansen et al. 1988). It can make excellent hay if cut two or three times each growing season, thereby reducing forage coarseness (Weaver 1965, Hansen et al. 1988). *Spartina gracilis* (alkali cordgrass) may respond in similar ways.

Narrow-leaf cattail-common cattail (*Typha angustifolia-Typha latifolia*) plant association

Colorado Natural Heritage Program Rank: G5/S3

General Description and Comments: The *Typha angustifolia-Typha latifolia* (narrowleaf cattail-common cattail) plant association is a commonly seen tall, dark green community growing in 2-4 ft of standing water. It is found in the shallow edges of ponds and lakes, and can occur in backwaters of larger river floodplains.

Classification Problems: In Colorado, *Typha angustifolia* and *Typha latifolia* are almost impossible to distinguish in the field. They occupy the same habitats and have been ovserved to co-occur. We propose one community that can be dominate by either of the two species or by a co-mingling of the two.

Related Types/Synonyms: The *Typha* spp. dominated wetlands described by Hansen et al. (1991). Jones and Walford (1995), Padgett et al. (1989) and the Midwest Heritage Task Force (Faber-Langendoen 1996) are considered synonymous with the Colorado *Typha angustifolia-Typha latifolia* plant association. A closely related community, the *Typha latifolia/Sagittaria latifolia* plant association, occurs in Nabraska, north eastern Colorado, wetern Wyoming, eastern Idaho, and North Dakota by Johnston (1987).

Regional Distribution: This association occurs throughout the northern and central Great Plain states, the Dakotas, Montana, Wyoming (Johnston 1987), Nebraska, Kansas, northern Texas, northwestern Oklahoma (Faber-Langendoen 1996) and Colorado (Colorado Natural Heritage Program 1999).

Distribution in Colorado: This plant association is not well documented in the literature, but the species is known to occur throughout the plains of eastern Colorado (Weber 1990). During this study the *Typha angustifolia-Typha latifolia* (cattail) plant association was observed along overflow channels and oxbow lakes of the mainstem of the South Platte River and in small ponded areas around stock ponds and railroad embankments.

No PCAs were created for *Typha angustifolia-Typha latifolia*; however, good examples of the community were found at the Cimarron State Wildlife Area, Sazama and Jade Road Sites of Local Significance

Elevation Range: 4,000-4,300 ft (1,200-1,300 m).

Site Geomorphology: This plant association occurs in standing water at least 1 foot in depth. It is found along the margins of beaver ponds, overflow channels, back water sloughs, floodplains swales, drainage ditches, begind railroad embankments, and anyplace where water collects to at least 2-3 ft in depth and remains for two-thirds of thd growing season. Streams were classified according to the "Rosgen Classification of Natural Rivers" (Rosgen 1996). This association can be found on nearly every type of

channel, but typically along meadering, low gradient streams (Rosgen's Channel Type: C5, F5, and D5).

Wetland Description: Riverine and Depressional wetland, with a permanent hydroperiod, may be subject to occasional flooding.

Soils: Soils are deep, heavy silty caly loam and organic mucks. Some profiles have 10-30% coarse material and are fairly well drained, others remain anoxic throughout most of the year.

Vegetation: *Typha angustifolia* forms near -monotypic (70-85%) stands between 3 and 6 ft tall (1-2 m). Other species include *Potamogeton* spp. (0-25%), *Spartina pectinata* (0-1%), and *Veronica* spp. (0-3%).

Successional and Ecological Processes: *Typha angustifolia* occupies inundated and disturbed grounds and can tolerate deeper water and higher alkalinity levels than *Typha latifolia* (Great Plains Flora Association 1986). *Typha* species are prolific seed producers, spreading rapidly to become the early colonizers of wet mineral soil and will persist under wet conditions (Hansen et al. 1995). Its roots and lower stems are well adapted to prolonged submergence, but it requires periods of draw-down for seed germination to occur (Hansen et al. 1995).

Adjacent Riparian Vegetation: *Scirpus* (bulrush) marshes and *Carex* (sedge) meadows can be found adjacent to the *Typha* (cattail) plant association. Stands of *Populus deltoides* (plains cottonwood) and *Salix amygdaloides* (peachleaf willow) occur on higher terraces.

Adjacent Upland Vegetation: On the plains, *Bouteloua gracilis* (blue grama) short grass prairies or agricultural fields occur on the uplands.

Management: This association does not provide much forage for livestock. It is an important wetland type for many species of birds and waterfowl. It is reported, however, that with heavy livestock use stands can be converted to the *Carex nebrascensis* community type in Montana (Hansen et al. 1995).

PALUSTRINE AQUATIC BED COMMUNITIES—ROOTED VASCULAR

Water smartweed (*Polygonum amphibium*) plant association

Colorado Natural Heritage Program Rank: G5/S3

General Description and Comments: The *Polygonum amphibium* (water smartweed) plant association is found in meadows, marshes, springs, fens, streams, ponds and lakes, usually where water is fresh. Distribution is occasional nearly cosmopolitan (Larson 1993).

Related Types/Synonyms: Previously tracked as *Polygonum cocciineum*.

Regional Distribution: *Polygonum amphibium* is a minor type in central and eastern Montana, eastern Idaho, and throughout Colorado (Hansen et al. 1995).

Distribution in Colorado: Distribution in Colorado has not been well documented. An example of this type of plant community is found in the Natural Pond PCA.

Elevation Range: 6,900-11,650 ft (2,100-3,550 m).

Site Geomorphology: Occurs in small patches in riparian and wetland complexes.

Wetland Description: Depressional wetland, with a permanent hydroperiod.

Soils: This community type occurs on most soil textures from fine clay to sandy loam, and is intolerant of saline or alkaline conditions (Hansen et al. 1995).

Vegetation: This community type is an aggressive invader of shallow water and exposed mud flats where there is minimal wave action, forming dense, monotypic stands (Hansen *et al*. 1995).

Successional and Ecological Processes: Shore vegetation around reservoirs is a mosaic of short lived plant communities that survive one or more years before being eliminated by a combination of high water or grazing. These shore communities are composed primarily of early successional species that become established either during the fall or spring when water levels are low. Repeated annual drawdowns perpetuate this disturbance and associated vegetation (Hansen et al. 1995).

Adjacent Riparian Vegetation: Adjacent communities may include those dominated by *Typha latifolia*, or *Scirpus acutus*, or open water.

Management: Potential threats to this community type are alterations of wetland processes as a result of impoundments, diversions, roads, and clear cutting. Trampling from livestock may eliminate this community type (Hansen et al. 1995).

Leafy Pond Weed (*Potamogeton foliosus*) plant association

Colorado Natural Heritage Program Rank: G5/S3

General Description and Comments: The *Potamogeton foliosus* (leafy pond weed) plant association occurs on shallow water of rivers, streams, lakes and ponds and is common in most of the northern Great Plains (Larson 1993). The *Potamogeton foliosus* plant association consists of submerged narrow-leaf pondweeds that may grow in dense masses. In general, the *Potamogeton* species are not well-collected in Colorado (Weber 1987) and *Potamogeton* spp. plant associations have been poorly studied. Further study will reveal better information on which species commonly co-occur, the distribution of the communities, and the environmental conditions under which they occur. With this in mind, the *Potamogeton* spp. Plant associations as currently presented can be considered tentative.

Related Types/Synonyms: Sanderson and Kettler describe the *Potamogeton foliosus-Potamogeton pusillus* plant association, and states that either *Potamogeton foliosus or Potamogeton pusillus* can be the dominant species in this plant association, while often one is not present. It is possible that these stands represent two distinct communities, but since environmental conditions and community structure were so similar for all of the sampled stands, they were grouped into this one tentative plant association (Sanderson and Kettler 1996).

Cooper (1993) reports a *Potamogeton pectinatus-Potamogeton pusillus* plant association in which he includes a stand dominated by *Potamogeton pusillus* without *Potamogeton pectinatus* present. This community is closely related to the one described in this report.

Distribution in Colorado: These stands are found in small ponds throughout the montane region of Colorado (Sanderson and Kettler 1996). An example of this type of plant community is found in the Natural Pond PCA.

Elevation Range: 7,450-9,600 ft (2,250-2,950 m) (Sanderson and Kettler 1996).

Site Geomorphology: This plant association occurs is still or nearly still water less than 1 meter deep (Sanderson and Kettler 1996).

Wetland Description: Depressional wetland, with a permanent hydroperiod.

Vegetation: *Potamogeton foliosus* dominates tjese sites with up to 90% cover. *Potamogeton pectinatus* is commonly an associate, occasionally as a co-dominant. Other submerged aquastics (e.g., *Myriophyllum sibiricum*) may also be present *Sparganium angustifolium* also frequently occurs with low cover in this type.

Adjacent Riparian Vegetation: Shoreline communities found in association with the *Potamogeton foliosus-Potamogeton pusillus* plant association include *Bidens cernua* and *Eleocharis palustris* plant associations. The aquatic *Myriophyllum sibiricum* plant

association is commonly near or intermixed with the *Potamogeton richardsonii-Potamogeton pusillus* plant association. It may also be found adjacent to and mixed with *Sparganium angustifolium* stands (Sanderson and Kettler 1996).

Management: *Potamogeton* spp. are important waterfowl food (Weber 1987).

LITERATURE CITED

Adamus, P.R. 1993. Irrigated Wetlands of the Colorado Plateau: Information Synthesis and Habitat Evaluation Method. US EPA Environmental Research Lab. Corvallis, OR.

Adamus, P.R. and L. Stockwell. 1983. A Method for Wetland Functional Assessment, Vol. I and Vol. II. U.S. Department of Transportation. Federal Highway Administration, Washington, DC.

Adamus, P.R., L.T. Stockwell, E.J. Clairain, Jr., M.E. Morrow, L.P. Pozas, and R.D. Smith. 1991. Wetland Evaluation Technique (WET), Vol. I: Literature Review and Evaluation Rationale. U. S. Army Corps of Engineers, Springfield, VA.

Alexander, B.G. 1981. A preliminary forest habitat classification for the Lincoln National Forest, New Mexico. USDA Forest Service Final Report of Contract 53-82-FT-9-104. Rocky Mountain Forest and Range Experiment Station, Flagstaff, AZ.

Anderson, M., P. Bourgeron, M.T. Bryer, R. Crawford, L. Engelking, D. Faber-Langendoen, M. Gallyoun, K. Goodin, D.H. Grossman, S. Landaal, 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, Virginia.

Andrews, R.R. and R R. Righter. 1992. Colorado Birds. Denver Museum of Natural History, Denver CO.

Aplet, G.H., R.D. Laven, and F.W. Smith. 1988. Patterns of community dynamics in Colorado Engelmann spruce-subalpine fir forests. *Ecology* 69:312-319.

Bailey, R.G., P.E. Avers, T. King, and W.H. McNab. 1994. Ecoregions and subregions of the United States (map). Scale 1:7,5000,000; colored. U.S. Geological Survey, Washington, DC.

Baker, W.L. 1982. Natural vegetation of the Piceance Basin, Colorado, App. D. *In* J.S. Peterson and W.L. Baker, eds. Inventory of the Piceance Basin, Colorado. Report submitted to the Bureau of Land Management, Craig, CO. Colorado Natural Heritage Inventory, Denver, CO.

Baker, W.L. 1984. A preliminary classification of the natural vegetation of Colorado. *Great Basin Naturalist* 44(4):647-676.

Baker, W.L. 1986. Riparian vegetation of the montane and subalpine zones in west-central and southwestern Colorado. Report submitted to The Nature Conservancy, Colorado Field Office, Boulder, CO and the Colorado Natural Areas Program, Denver, CO.

Baker, W.L. 1989. Classification of the riparian vegetation of the montane and subalpine zones in western Colorado. *Great Basin Naturalist* 49 (2):214-228.

Behnke, R.J. and D.E. Benson. 1980. Endangered and threatened fishes of the upper Colorado River Basin. Bulletin 503A. Cooperative Extension Service, Colorado State University, Fort Collins, CO.

Berglund, J. 1996. Montana wetland field evaluation form and instructions. Prepared for Montana Department of Transportation, Helena, MT by Morrison-Maierle Environmental Corporation, Helena, MT.

Binkley, D. 1986. Forest Nutrition Management. John Wiley & Sons, Inc., New York, NY.

Blair, R., ed., 1996. The Western San Juan Mountains: Their Geology, Ecology, and Human History. University Press of Colorado, Niwot, CO.

Boto, K.G. and W.H. Patrick, Jr. 1979. Ther role of wetlands in the removal of suspended sediments. Pages 479-489. *In:* P.E.Greespm, J.R. Clark, and J.E. Clark, editors. Wetland Functions and Values: The State of Our Understanding, American Water Resources Association, Minneapolis, MN.

Bourgeron, P.S. and L.D. Engelking, editors. 1994. A preliminary vegetation classification of the Western United States. Report prepared by the Western Heritage Task Force for The Nature Conservancy, Boulder, CO.

Bourgeron, P.S. and J.S. Tuhy. 1989. Vegetation classification for the Colorado Plateau. Rocky Mountain Heritage Task Force, The Nature Conservancy, Lakewood, CO.

Bowman, W.D. and H. Steltzer. *In* press. Positive feedbacks to anthropogenic nitrogen deposition in Rocky Mountain alpine tundra. *Ambio*.

Boyce, D.A. 1977. Vegetation of the South Fork of the White River Valley, Colorado. Dissertation. University of Colorado, Boulder, CO.

Bradshaw, A.D. 1987. Reclamation of land and ecology of ecosystems. *In*: Jordan, William R. III et al., editors. Restoration Ecology. Cambridge University Press, New York, NY.

Brinson, M. M., 1993. A Hydrogeomorphic Classification for Wetlands. Wetlands Research Program Technical Report WRP-DE-4. U.S. Army Corps of Engineers, Springfield, VA.

Brinson, M. M. and R. Rheinhardt. 1996. The role of reference wetlands in functional assessment and mitigation. *Ecological Applications* 6(1):69-76.

Brunsfield, S.J. and F.D. Johnson. 1985. Field guide to the willows of east-central Idaho. Bulletin No. 39. Wildlife and Range Experiment Station, University of Idaho, Moscow, ID.

Carter, V. and R.P. Novitzki. 1988. Some comments on the relation between ground water and wetlands. *In*: D.D. Hook *et al.*, editors. The Ecology and Management of Wetlands, Vol. 1. Ecology of Wetlands, Timber Press, Portland, OR.

CDOW. 1986. Colorado Division of Wildlife, Colorado Stream Data Bank, Second Edition. DOW-R-M-2-86. Denver, CO.

CDOW. 1987. Colorado Division of Wildlife, Colorado Lake Data Bank, First Edition. DOW-R-M-1-87. Denver, CO.

Chadde, S.W., P.L. Hansen, and R.D. Pfister. 1988. Wetland plant communities of the northern range, Yellowstone National Park. Final contract report. School of Forestry, University of Montana, Missoula, MT.

Chapin, F.S., III., L.R. Walker, C.L. Fastie, and L.C. Sharman. 1994. Mechanisms of primary succession following deglaciation at Glacier Bay, Alaska. *Ecological Monographs* 64(2):149-175.

Christy, S. 1973. An analysis of the woody vegetation on the South Platte River flood plain in northeastern Colorado. Thesis. University of Northern Colorado, Greeley, CO.

Chronic, H. 1980. Roadside Geology of Colorado. Mountain Press, Missoula, MT.

Colorado Bird Observatory. 1997. Reference guide (1996) to the monitoring and conservation status of Colorado's breeding birds. Brighton, CO.

Colorado Geological Survey, Colorado Department of Natural Resources, Colorado School of Mines Division of Environmental Science, and Engineering, and Colorado State University's Department of Earth Resources. 1998. Characterization and functional assessment of reference wetlands in Colorado; a preliminary investigation of hydrogemorphic (HGM) classification and functions for Colorado's wetlands. Report prepared for Colorado Department of Natural Resources and U.S. Environmental Protection Agency, Region VIII, Denver, CO.

Colorado Natural Heritage Program (CNHP). 1999. Biological and Conservation Data (BCD) System. Data from field surveys. Colorado Natural Heritage Program, Fort Collins, CO.

Cooper, D.J. 1986. Ecological studies of wetland vegetation, Cross Creek Valley, Holy Cross Wilderness Area, Sawatch Range, Colorado. Technical Report No. 2. Holy Cross Wilderness Defense Fund.

Cooper, D.J. 1993. Wetlands of the Crested Butte region: mapping, functional evaluation, hydrologic regime. Report prepared for Town of Crested Butte, CO and Environmental Protection Agency , Region VIII, Denver CO.

Cooper, D.J. and T.R. Cottrell. 1990. Classification of riparian vegetation in the northern Front Range. Report prepared for The Nature Conservancy's Colorado Field Office, Boulder, CO.

Cooper, D.J. and C. Severn. 1992. Wetlands of the San Luis Valley, Colorado: an ecological study and analysis of the hydrologic regime, soil chemistry, vegetation and the potential effects of a water table drawdown. Report submitted to the State of Colorado Division of Wildlife, the US Fish and Wildlife Service and the Rio Grande Water Conservation District

Cowardin, L.M., V. Carter, F.C. Golet, and E. LaRoe. 1979. Classification of Wetlands and Deepwater Habitats of the United States. FWS/OBS-79/31. U.S. Fish and Wildlife Service, Washington, DC.

Culver, D.R., M.A. March, S.M. Kettler, and C.A. Pague. 1996. Natural heritage inventory of significant animals and plants and classification of riparian plant associations: Timpas Grazing District and Kim Grazing Association, Commanche National Grassland. Report prepared for U.S. Forest Service, Pike-San Isabel National Forest, La Junta, CO by Colorado Natural Heritage Program, Fort Collins, CO.

Culver, D.R. and J.S. Sanderson. 1996. Natural heritage assessment of wetlands and riparian areas in Routt County, CO. Report prepared for the Colorado Department of Natural Resources, Denver, CO by Colorado Natural Heritage Program, Fort Collins, CO.

Dahl, T.E. 1990. Wetland Losses in the United States 1780's to 1980's. U.S. Fish and Wildlife Service, Washington, DC.

Daubenmire, R. 1952. Forest vegetation of northern Idaho and adjacent Washington, and its bearing on concepts of vegetation classification. *Ecological Monographs* 22(4):301-330.

DeVelice, R.L., J.A. Ludwig, W.H. Moir, F. Ronco, Jr. 1986. A Classification of Forest Habitat Types of Northern New Mexico and Southern Colorado. USDA Forest Service General Technical Report RM-131. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, CO.

Dick-Peddie, W.A. 1993. New Mexico Vegetation: Past, Present, and Future. University of New Mexico Press, Albuquerque, NM.

Dix, R.J. and J.D. Richards. 1976. Possible changes in species structure of the subalpine forest induced by increased snowpack. *In* H.W. Steinhoff and J.D. Ives, eds. Ecological impacts of snowpack augmentation in the San Juan Mountains, Colorado. Report submitted to the Division of Atmospheric Water Resources, United States Bureau of Reclamation. Colorado State University, Ft. Collins, CO.

Durkin, P., M. Bradley, S.E. Carr, E. Muldavin, and P. Mehlhop. 1995. Riparian/wetland vegetation communities of the Rio Grande: a classification and site evaluation. Report submitted to the New Mexico Environment Department, Surface Water Quality Bureau. New Mexico Natural Heritage Program, University of New Mexico, Albuquerque, NM.

Durkin, P., M. Bradley, E. Muldavin, and P. Mehlhop. 1994. A riparian/wetland vegetation community classification of New Mexico: Pecos River Basin, Volume 1. Report submitted to the New Mexico Environment Department, Surface Water Quality Bureau. New Mexico Natural Heritage Program, Albuquerque, NM.

Ehrlich, P.R., D.S. Dobkin, and D. Wheye. 1988. The Birders Handbook. Simon and Shuster, Inc. New York, NY.

Environmental Laboratory. 1987. Corps of Engineers Wetlands Delineation Manual. Technical Report Y-87-1. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Faber-Langendoen, D., ed. 1996. Midwest regional community classification. Conservation Science Department, Midwest Region, The Nature Conservancy, Minneapolis, MN.

Friedman, J.M., M.L. Scott, G.T. Auble. 1997. Water management and cottonwood forest dynamics along prairie streams. *In* F.L. Knopf and F.B. Samson, eds. Ecology and Conservation of Great Plains Vertebrates. Springer-Verlag, Inc., New York, NY.

Girard, M., D.L. Wheeler, and S.B. Mills. 1995. Draft classification of riparian communities on the Bighorn National Forest. Report prepared for U.S.D.A., Forest Service, Sheridan, WY.

Graham, E.H. 1937. Botanical studies in the Uinta Basin of Utah and Colorado. *Annals of the Carnegie Museum* 26:1-432.

Great Plains Flora Association. 1986. Flora of the Great Plains. University Press of Kansas, Lawrence, KS.

Hammerson, G.A. 1982. Amphibians and reptiles in Colorado. Colorado Division of Wildlife. Denver, CO.

Hansen, P.L., S.W. Chadde, and R.D. Pfister. 1988. Riparian Dominance Types of Montana. Montana Forest and Conservation Experimental Station Miscellaneous Publication No. 49. University of Montana, Missoula, MT.

Hansen, P.L., R.D. Pfister, K. Boggs, B.J. Cook, J. Joy, and D.K. Hinckley. 1995. Classification and management of Montana's riparian and wetland sites. Miscellaneous Publication No. 54. Montana Forest and Conservation Experiment Station, School of Forestry, The University of Montana. Missoula, MT.

Hansen, P., R. Pfister, K. Boggs, J. Pierce, and S. Chadde. 1989. Classification and management of riparian sites in central and eastern Montana. Draft version 1. Montana Riparian Association, University of Montana, Missoula, MT.

Hanson, H.C. 1929. Range resources of the San Luis Valley. Bulletin 335. Pages 5-61. Colorado Experiment Station, Fort Collins, CO.

Hermann, F.J. 1970. Manual of the Carices of the Rocky Mountains and Colorado Basin. Agriculture Handbook No. 374. U.S.D.A., Forest Service. Rocky Mountain Forest and Experiment Station, Fort Collins, CO.

Hess, K. 1981. Phyto-edaphic study of habitat types of the Arapaho-Roosevelt National Forest, Colorado. Dissertation, Colorado State University, Fort Collins, CO.

Hess, K. and C.H. Wasser. 1982. Grassland, shrubland, and forestland habitat types of the White River-Arapaho National Forest. Region Two. R2-Ecol-87-2. Report prepared for U.S.D.A. Forest Service, Rocky Mountain Forest and Experiment Station, Fort Collins, CO.

Hoag, T. 1997. The Uncompahgre: Conserving riparian lands. *In*: Managing Colorado Watersheds for Riparian and Wetland Values: Proceedings of the Ninth Annual Conference, Colorado Riparian Association. October 14-16,1997. Montrose CO.

Jankovsky-Jones, M. 1994. Environmental factors affecting the distribution of riparian plant associations in the Roaring Fork River Basin, Colorado. Thesis. University of Wyoming, Laramie, WY.

Johnston, B. 1987. Plant Associations of Region Two. Edition 4. R2-ECOL-87-2. U.S.D.A. Forest Service, Rocky Mountain Forest and Experiment Station, Fort Collins, CO.

Jones, G. 1990. Workplan for a uniform statewide riparian vegetation classification. Wyoming Natural Diversity Database (The Nature Conservancy), Laramie, WY.

Jones G. 1992. A preliminary classification of riparian vegetation types of the Medicine Bow Range and the Sierra Madre. Report submitted to the Medicine Bow National Forest. Wyoming Natural Diversity Database (The Nature Conservancy), Laramie, WY.

Jones, G.P. and G.M. Walford. 1995. Major riparian vegetation types of eastern Wyoming. Report submitted to the Wyoming Department of Environmental Quality, Water Quality Division. Wyoming Natural Diversity Database (The Nature Conservancy), Laramie, WY.

Kadlec, R.H. and J.A. Kadlec. 1979. The use of freshwater wetlands as a tertiary wastewater treatment alternative. *Crit. Rev. Environ. Control* 9:185-212.

Kartesz, J.T. 1994. A Synonymized Checklist of the Vascular Flora of the United States, Canada, and Greenland. Second edition. Vol. 1. Timber Press, Inc., Portland, OR.

Keen, R.A. 1996. Weather and Climate. *In*: Blair, R., ed., pp. 113-126. The Western San Juan Mountains: Their Geology, Ecology, and Human History. University Press of Colorado, Niwot, CO.

Kelly, J.R. Jr., M.K. Laubhan, F.A. Reid, J.S. Wortham, and L.H. Fredrickson. 1993. Options for water-level control in developed wetlands. Leaflet 13.4.8. U.S.D.I. National Biological Survey, U.S. Fish and Wildlife, Washington, DC.

Kettler, S. M. and A. McMullen. 1996. Routt National Forest Riparian Vegetation Classification. Report prepared for the U.S. Forest Service, Routt National Forest. Colorado Natural Heritage Program, Ft. Collins, CO.

Kittel, G.M. 1994. Montane riparian vegetation in relation to elevation and geomorphology along the Cache la Poudre River, Colorado. Thesis. University of Wyoming, Laramie, WY.

Kittel, G. M. and N. Lederer. 1993. A preliminary classification of the riparian vegetation of the Yampa and San Miguel/Dolores River basins. Report prepared for the Colorado Department of Health and Environmental Protection Agency, Region VIII, Denver, CO. The Nature Conservancy, Boulder, CO.

Kittel, G.M., R.J. Rondeau, N. Lederer, and D. Randolph. 1994. A classification of the riparian vegetation of the White and Colorado River basins, Colorado. Report prepared for the Colorado Department of Natural Resources, Denver, CO and the U.S. Environmental Protection Agency, Region VIII, Denver, CO. Colorado Natural Heritage Program, Fort Collins, CO.

Kittel, G. M., R. J. Rondeau, and S. M. Kettler. 1995. A classification of the riparian vegetation of the Gunnison River Basin, Colorado. Report prepared for the Colorado Department of Natural Resources, Denver, CO and the U.S. Environmental Protection Agency, Region VIII, Denver, CO. Colorado Natural Heritage Program, Fort Collins, CO.

Kittel, G., R.J. Rondeau, and A. McMullen. 1996. A classification of the riparian vegetation of the lower South Platte and parts of the upper Arkansas River Basins, Colorado. Report submitted to the Colorado Department of Natural Resources, Denver, CO and the Environmental Protection Agency, Region VIII, Denver, CO. Colorado Natural Heritage Program, Ft. Collins, CO.

Kittel, G., E., VanWie, and M. Damm. 1997. A classification of the riparian vegetation of the South Platte River Basin (and part of the Republican River Basin), Colorado. Report submitted to the Colorado Department of Natural Resources, Denver, CO and the Environmental Protection Agency, Region VIII, Denver, CO. Colorado Natural Heritage Program, Ft. Collins, CO.

Knorr, O. A. 1993. Black Swift (*Cypseloides niger*) nesting site characteristics: some new insights. *Avocetta* 17:139-140.

Komarkova, V. 1986. Habitat types on selected parts of the Gunnison and Uncompahgre National Forests. Report prepared for U.S.D.A. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Kovalchik, B.L. 1987. Riparian Zone Associations, Deschutes, Ochoco, Fremont, and Winema National Forests. United States Forest Service R6 ECOL-TP-279-87. Pacific Northwest Region, Bend, OR.

Kovalchik, B.L. and W. Elmore. 1992. Effects of cattle grazing systems on willow-dominated plant associations in central Oregon. *In*: Proceedings-Symposium on Ecology and Management of Riparian Shrub Communities. General Technical Report INT-289. U.S.D.A. Forest Service, Intermountain Research Station, Ogden, UT.

Kruger, Rick. U.S. Fish and Wildlife Service, Grand Junction Office. Telephone interview. 8 January, 1999.

Larson, G.E. 1993. Aquatic and wetland vascular plants of the northern Great Plains. General Technical Report RM-238. U.S.D.A. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Lyon, P., T. Stephens, J. Siemers, D. Culver, P. Pineda, and J. Zoerner. 1999. The Uncompahgre River Basin, A Natural Heritage Assessment, Volume I. Colorado Natural Heritage Program, Ft. Collins CO.

Manning, M.E. and W.G. Padgett. 1995. Riparian community type classification for Humbolt and Toiyabe National Forests, Nevada and eastern California. R4-ECOL-95-01. U.S.D.A. Forest Service, Intermountain Region, Ogden, UT.

Mitsch, W. J. and J. G. Gosselink. 1993. Wetlands. Second Edition. VanNostrand Reinhold, New York, N.Y.

National Research Council. 1995. Wetlands: Characteristics and Boundaries. National Academy Press, Washington, DC.

NDIS (Colorado Natural Diversity Information Source). System for Conservation Planning. Online. Internet. 12 January, 1999. http://ndis.nrel.colostate.edu/escop/index2.html

Osborn, R.G., G. Kittel, and M.S. Reid. 1999. Riparian Plant Associations of Colorado and Vegetation Classification of the Western United States. U.S. Department of the Interior. USGS. Fort Collins, Colorado. CD-ROM.

Padgett, W. G., A. P. Youngblood, and A. H. Winward. 1989. Riparian community type classification of Utah and southeastern Idaho. R4-ECOL-89-01. U.S.D.A. Forest Service, Intermountain Region, Ogden, UT.

Pague, C.P., L. Grunau, A.M. Loar, M.W. Sherman, K.E. Pague, M.B. Wunder, D.J. Shinneman, T.P. Schuerman, and S.M. Zwicker. 1997. Conservation status of the rare and imperiled vertebrates of Colorado. Colorado Natural Heritage Program, Fort Collins, CO.

Peet, R.K. 1981. Forest vegetation of Colorado Front Range: composition and dynamics. *Vegetatio* 45:3-75.

Powell, D.C. 1985. Aspen community types of the Pike and San Isabel National Forests. U.S.D.A. Forest Service, Pike and San Isabel National Forest, Pueblo, CO.

Powell, D.C. 1988. Aspen community types of the Pike and San Isabel National Forests in south-central Colorado. USDA Forest Service Report R2-ECOL-88-01. Rocky Mountain Region, Pike and San Isabel National Forests, Pueblo, CO.

Proebstel, D.S. 1994. Taxonomic identification of Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) in Colorado--draft report. Colorado Division of Wildlife, Fort Collins, CO.

Rector, C.D., E.W. Mustard, and S.T. Windell. 1979. Lower Gunnison River Basin Wetland Inventory and Evaluation. USDA (SCS). Denver, CO.

Reid, M.S. and P.S. Bourgeron. 1991. A preliminary classification of the riparian plant communities of the Yampa River Basin. Report prepared by The Nature Conservancy, Boulder, CO.

Reynolds, R.T. 1983. Management of western coniferous forest habitat for nesting *Accipiter* hawks. General Technical Report. U.S. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Richard, C., G. Kittel, and S. Kettler. 1996. A classification of the riparian vegetation of the San Juan National Forest. Report to be submitted to the San Juan National Forest, Durango, CO. Colorado Natural Heritage Program, Colorado State University, Ft. Collins, CO.

Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.

Sanderson, J. and S. Kettler. 1996. A preliminary wetland vegetation classification for a portion of Colorado's west slope. Report prepared for the Colorado Department of Natural Resources, Denver, CO and the Environmental Protection Agency, Region VIII, Denver, CO. Colorado Natural Heritage Program, Fort Collins, CO.

Schlesinger, W.H. 1991. Biogeochemistry. Academic Press Inc. New York NY.

Sherman, Rick. Colorado Division of Wildlife, Montrose Office. Telephone interview. 8 January, 1999.

Smith, R.D., A. Ammann, C. Bartoldus, and M.M. Brinson. 1995. An approach for assessing wetland functions using hydrogeomorphic classification, reference wetlands, and functional indices. Technical Report WRP-DE-9. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Somers, P. and L. Floyd-Hanna. 1996. Wetlands and Riparian Habitats, And Rivers. *In* Blair, R., ed. pp. 175-192. The Western San Juan Mountains: Their Geology, Ecology, and Human History. University Press of Colorado, Niwot, CO.

Steen, O.A. and R.L Dix. 1974. A preliminary classification of Colorado subalpine forests. Dept. of Botany and Plant Pathology, Colorado State University, Ft. Collins, CO.

Stone, Glen. U.S. Bureau of Reclamation, Water Engineer, Grand Junction Office. Personal Communication. 9 January, 1999.

Terres, J. K. 1980. The Audubon Society Encyclopedia of North American Birds. Alfred A. Knopf, New York, NY.

The Nature Conservancy. 1992. Upper Colorado River Basin bioreserve strategic plan. The Nature Conservancy, Colorado Field Office, Boulder, CO.

The Nature Conservancy. 1996. Yampa River site conservation plan. The Nature Conservancy, Boulder, CO.

Tweto, O. 1979. Geological Map of Colorado. Scale 1:500,000, colored. U.S.G.S., Denver, CO.

Unger, I.A. 1974. Halophyte communities of Park County, Colorado. *Bulletin of the Torrey Botanical Club* 101(3)145-152.

USDA (SCS). 1967 Soil Survey Delta-Montrose Area, Colorado. U.S. Govt. Printing Office. Washington, DC.

USDA (SCS). 1981. Potential for On-farm Irrigation Improvements, Lower Gunnison Basin Colorado River Salinity Control Program. USDA (SCS). Denver, CO.

U.S. Fish and Wildlife Service, Region 6. 1997. Peatland mitigation policy considerations. Ecological Services, Colorado Field Office.Lakewood, CO.

USGS Water Resources for Colorado. 1999. Colorado Historic Water Data. Online. Internet. 15 January, http://nwis-colo.cr.usgs.gov/historic.html

Van Cleve, K., L.A. Viereck, and R.L. Schlentner. 1971. Accumulation of nitrogen in alder (*Alnus*) ecosystems near Fairbanks, Alaska. *Arctic and Alpine Research* 3(2):101-114.

Veblen, T.T., K.S. Hadley, M.S. Reid, and A.J. Rebertus. 1991. The response of subalpine forests to spruce beetle outbreak in Colorado. *Ecology* 72:213-231.

Viereck, L.A. 1970. Forest succession and soil development adjacent to the Chena River in interior Alaska. *Arctic and Alpine Research* 2(1):1-26.

Viereck, L.A., C.T. Dyrness, A.R. Batten, and K.J. Wenzlick. 1992. The Alaska Vegetation Classification. General Technical Report PNW-GTR-286. Pacific Northwest Research Station, Portland, OR.

Walford, G.M. 1993. Spatial variation in riparian vegetation along the Animas River, CO. Thesis. University of Wyoming, Laramie, WY.

Warren, J., P. Obert, S.Woodis, and R. Neis. 1993. Monitoring and Evaluation Report for the Lower Gunnison, Colorado Unit of the Colorado River Basin Salinity Control Program: 1992 Annual Report. USDA (SCS) Field Offices in Delta and Montrose, CO.

Weaver, J.E. 1965. Native Vegetation of Nebraska. University of Nebraska Press, Lincoln, NE.

Webb, J.S., S. McGinness and H.M. Lappin-Scott. 1998. Metal removal by sulphate-reducing bacteria from natural and constructed wetlands. *Journal of Applied Microbiology* (84): 240-248.

Weber, W.A. 1987. Colorado Flora: Western Slope. Colorado Associated University Press, Boulder, CO.

Weber, W.A. 1990. Colorado Flora: Eastern Slope. University Press of Colorado, Niwot, CO.

Weber, W.A. and R.C. Wittmann. 1992. Catalog of the Colorado Flora: A Biodiversity Baseline. University Press of Colorado, Niwot, CO.

Weber, W.A. and R.C. Wittmann. 1996. Colorado Flora: Western Slope. Revised Edition. University Press of Colorado, Niwot, CO.

Welsh, S.L., N.D. Atwood, L.C. Higgins, and S. Goodrich, editors. 1987. A Utah Flora. *Great Basin Naturalist Memoir* No. 9. Brigham Young University, Provo, UT.

Western Regional Climate Center. 1997. http:\\www.wrcc.sage.dri.edu/ summary/climsmco.html. Reno, NV.

Wheye, D. 1992. Birds in Jeopardy: The Imperiled and Extinct Birds of the United States and Canada, Including Hawaii and Puerto Rico. Stanford University Press, Stanford.

Wilson, E.O., editor. 1988. Biodiversity. National Academy Press, Washington, DC.

Windell, J.T., B.E. Willard, D.J. Cooper, S.Q. Foster, C.F. Knud-Hansen, L.P. Rink, and G.N. Kiladis. 1986. An Ecological Characterization of Rocky Mountain Montain and Subalpine Wetlands. U.S. Fish Wildlife Service *Biol. Rep*. 86(11).

Woodis, Steve. 1998. Wildlife Habitat Mitigation through the Salinity Control Program. Montrose USDA Service Center Newsletter. Montrose, CO.

Young, M.K., R.N. Schmal, T.W. Kohley, and V.G. Leonard. 1996. Conservation status of Colorado River cutthroat trout. General Technical Report RM-GTR-282. U.S.D.A. Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.

Youngblood, A.P. and R.L. Mauk. 1985. Coniferous Forest Habitat Types of Central and Southern Utah. USDA Forest Service General Technical Report INT-187. Intermountain Research Station, Ogden, UT.

Youngblood, A. P., W.G. Padgett, and A H. Winward. 1985. Riparian community type classification of eastern Idaho-Western Wyoming. R4-ECOL-85-01. U.S.D.A. Forest Service, Intermountain Region, Odgen, UT