

Biological Survey of Eagle County, Colorado 2000 Final Report



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

March 2000



Biological Survey of Eagle County, Colorado 2000 Final Report

**Prepared by:
Kim Fayette
Mike Wunder*
Scott Schneider**

**Prepared for:
Eagle Valley Land Trust**

*e-mail address: mbw@lamar.colostate.edu

Acknowledgements

The Colorado Natural Heritage Program would like to acknowledge and sincerely thank the Eagle County advisory group organized by the Eagle Valley Land Trust for providing us with invaluable support and advice. The following groups and individuals participated in this role: Colorado Division of Wildlife, especially Bill Andree, Bill Clark, Bill Heicher, and Craig Wescoatt; U. S. Forest Service, especially Joe Door and Marsha Raus, Bureau of Land Management, especially Leonard Coleman and Carla Scheck; Gore Range Science School, especially Ryland Gardner; Vail Nature Center, especially Ken Neubecker; and John Amoroso. Special thanks to Brad Udall for his strong support from beginning to end.

We greatly appreciate the assistance we received in the field from technicians and volunteers alike. We'd like to extend special thanks to Mike Goar, Carla Hanson, Steve Kettler, Cyndi Mosch, and Renee Rondeau for invaluable assistance in the field.

The information management staff with the CNHP was responsible for integrating the data into the Biological Conservation Database, especially Jodie Bell, Jill Handwerk, and Jeremy Siemers. Special thanks to Tracy Davis for producing the maps of the potential conservation areas.

The herbaria at the University of Colorado and Colorado State University were sources of pertinent information.

Funding for the county-wide Natural Heritage Inventory was provided by Great Outdoors Colorado, Eagle County, The U.S. Forest Service, and the Bureau of Land Management. Special thanks to Leonard Coleman, Julie Grode, the Eagle County Commissioners, Lee Upham, and especially to Brad Udall for making this possible.

We appreciate all the quality time the numerous reviewers spent on this report. Thanks to John Amoroso, Bill Andree, John Armstrong, Mike Goar, Bill Heicher, Cyndi Mosch, Renee Rondeau, Carla Scheck, and Rob Schorr.

Table of Contents

| | |
|--|-----------|
| Executive Summary | 4 |
| Methods | 5 |
| Collect Available Information | 5 |
| Identify Rare Or Imperiled Species And Significant Plant Communities With Potential To Occur In Eagle County | 5 |
| Element Ranking | 5 |
| Legal Designations | 6 |
| Identify Targeted Inventory Areas..... | 7 |
| Contact Landowners | 7 |
| Conduct Field Surveys | 7 |
| Element Occurrence Ranking..... | 8 |
| Delineate Potential Conservation Area Boundaries | 8 |
| Potential Conservation Area Ranking..... | 9 |
| Results | 10 |
| Natural History Information | 13 |
| Plants | 13 |
| <i>Cypripedium fasciculatum</i> (purple lady’s-slipper)..... | 13 |
| <i>Cystopteris montana</i> (mountain bladder fern)..... | 14 |
| <i>Draba crassa</i> (thick-leaf whitlow-grass)..... | 15 |
| <i>Draba lonchocarpa</i> var. <i>lonchocarpa</i> (lancepod whitlowgrass)..... | 16 |
| <i>Draba oligosperma</i> (fewseed whitlowgrass)..... | 17 |
| <i>Draba spectabilis</i> var. <i>oxyloba</i> (showy draba) | 18 |
| <i>Eriophorum altaicum</i> var. <i>neogaeum</i> (Altai cottongrass)..... | 19 |
| <i>Platanthera sparsiflora</i> var. <i>ensifolia</i> (canyon bog-orchid) | 20 |
| <i>Listera borealis</i> (northern twayblade)..... | 21 |
| <i>Mentzelia multicaulis</i> (manystem blazingstar) | 22 |
| <i>Penstemon harringtonii</i> (Harrington's beardtongue)..... | 23 |
| <i>Sullivantia hapemanii</i> var. <i>purpusii</i> (hanging garden sullivantia) | 26 |
| Animals..... | 27 |
| American Peregrine Falcon (<i>Falco peregrinus anatum</i>)..... | 27 |
| Bald Eagle (<i>Haliaeetus leucocephalus</i>)..... | 28 |
| Barrow’s Goldeneye (<i>Bucephala islandica</i>)..... | 29 |
| Black Swift (<i>Cypseloides niger</i>)..... | 30 |
| Boreal Toad (<i>Bufo boreas boreas</i>)..... | 31 |
| Colorado River Cutthroat Trout (<i>Oncorhynchus clarki pleuriticus</i>) | 32 |
| Northern Goshawk (<i>Accipiter gentilis</i>) | 33 |
| Roundtail Chub (<i>Gila robusta</i>)..... | 34 |
| Spotted Bat (<i>Euderma maculatum</i>)..... | 35 |
| Townsend’s Big-eared Bat (<i>Corynorhinus townsendii pallescens</i>)..... | 36 |
| Plant Communities | 37 |
| <i>Abies lasiocarpa</i> / <i>Alnus incana</i> | 38 |
| <i>Abies lasiocarpa</i> / <i>Mertensia ciliata</i> | 41 |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i> - <i>Cornus sericea</i> | 43 |
| <i>Alnus incana</i> /Mesic Forbs | 45 |
| <i>Artemisia tridentata</i> / <i>Leymus cinereus</i> | 47 |
| <i>Betula occidentalis</i> /Mesic Forbs..... | 49 |
| <i>Betula occidentalis</i> /Mesic Graminoids | 51 |
| <i>Cardamine cordifolia</i> - <i>Mertensia ciliata</i> - <i>Senecio triangularis</i> | 53 |
| <i>Carex aquatilis</i> | 55 |
| <i>Carex aquatilis</i> - <i>Carex utriculata</i> | 57 |
| <i>Carex utriculata</i> | 59 |
| <i>Danthonia intermedia</i> | 61 |

| | |
|---|------------|
| <i>Deschampsia cespitosa</i> | 62 |
| <i>Eleocharis quinqueflora</i> | 64 |
| <i>Festuca idahoensis-Festuca thurberi</i> | 65 |
| <i>Juniperus scopulorum- Cercocarpus montanus</i> | 66 |
| <i>Picea pungens/Alnus incana ssp. tenuifolia</i> | 67 |
| <i>Picea pungens/Cornus sericea</i> | 69 |
| <i>Pinus edulis/Stipa comata</i> | 71 |
| <i>Pseudotsuga menziesii/Cornus sericea</i> | 72 |
| <i>Populus angustifolia/Alnus incana ssp. tenuifolia</i> | 74 |
| <i>Populus angustifolia-Juniperus scopulorum</i> | 77 |
| <i>Populus angustifolia/Salix ligulifolia-Shepherdia argentea</i> | 80 |
| <i>Populus tremuloides/Alnus incana ssp. tenuifolia</i> | 82 |
| <i>Psuedotsuga menziesii/ Paxistima myrsinites</i> | 84 |
| <i>Quercus gambelii- Cercocarpus montanus/ Carex geyeri</i> | 85 |
| <i>Quercus gambelii-Symphoricarpos oreophilus</i> | 86 |
| <i>Salix drummondiana/Calamagrostis canadensis</i> | 87 |
| <i>Salix drummondiana/mesic forb</i> | 89 |
| <i>Salix monticola/Calamagrostis canadensis</i> | 91 |
| <i>Salix monticola/Carex utriculata</i> | 94 |
| <i>Salix monticola/mesic forb</i> | 96 |
| <i>Salix planifolia/Calamagrostis canadensis</i> | 98 |
| <i>Salix wolfii/Carex utriculata</i> | 101 |
| <i>Shepherdia argentea</i> | 104 |
| Potential Conservation Areas | 106 |
| Berry Creek | 109 |
| Black Mountain | 111 |
| Blue Hill..... | 113 |
| Cabin Creek..... | 115 |
| Castle Peak..... | 117 |
| Cattle Creek..... | 119 |
| Christine State Wildlife Area | 121 |
| Colorado River | 123 |
| Colorado River Seeps | 126 |
| Cross Creek..... | 128 |
| Crown | 131 |
| Deep Creek..... | 134 |
| Dry Lake | 137 |
| East Brush Creek | 139 |
| East Lake Creek..... | 141 |
| East Meadow Creek | 143 |
| Edwards | 145 |
| Elk Ridge | 147 |
| Fall Creek..... | 149 |
| Grouse Creek..... | 151 |
| Gypsum Creek..... | 153 |
| Hardscrabble | 155 |
| Hat Creek | 157 |
| Holy Cross City | 159 |
| Horse Mountain | 161 |
| Milk Creek | 163 |
| Norman Creek | 165 |
| North Fork Deep Creek..... | 167 |
| North Fork Fryingpan | 169 |
| Pitkin/Booth Creeks..... | 172 |
| Polk Creek..... | 174 |

| | |
|--|------------|
| Red Dirt Creek | 176 |
| Red Hill..... | 178 |
| Seven Hermits | 180 |
| Sheep Creek Uplands..... | 182 |
| Sweetwater Creek Uplands | 184 |
| Taylor Creek | 186 |
| Two Elk Trail..... | 188 |
| West Lake Creek | 190 |
| Yarmony Creek | 192 |
| <i>Literature Cited</i> | 194 |
| <i>Appendix</i> | 199 |
| Colorado’s Natural Heritage Program | 199 |

Table of Tables

| | |
|--|-----|
| Table 1. Definition of Colorado Natural Heritage Imperilment Ranks..... | 6 |
| Table 2. Federal and State Agency Special Designations..... | 7 |
| Table 3. Biodiversity Rank Definitions..... | 9 |
| Table 4. Ranks and Status of the Rare and Imperiled Elements of Eagle County | 10 |
| Table 5. Potential Conservation Areas of Eagle County Displayed By Biodiversity Rank | 107 |

Executive Summary

Eagle County, in northwestern Colorado, is marked by high montane habitats bordered by the northern edge of the Sawatch range to the south, the Gore range to the east, and the Flat Tops to the west. With funding from Great Outdoors Colorado! (GOCO), Eagle County, and the U.S. Forest Service, the Eagle Valley Land Trust, a private nonprofit conservation organization, contracted the Colorado Natural Heritage Program to inventory Eagle County for areas of special biological significance. The primary goal of the project was to identify the locations in Eagle County that have natural heritage significance. Such locations were identified by: 1) examining existing biological data from the Colorado Natural Heritage Program's database, 2) accumulating additional existing information on rare or imperiled plant species, animal species, and significant plant communities (collectively called **elements**), and, 3) conducting extensive field surveys. Areas that were found to contain significant elements were delineated as "proposed conservation areas." These areas were prioritized on the basis of their biological importance and are presented in this report.

Fourteen priority species of plants, three of mammals, 11 of birds, two of fishes, one amphibian and one invertebrate species, and 53 significant plant communities were documented. Of this list, only two species are federally recognized under the Endangered Species Act (ESA), the Bald Eagle (*Haliaeetus leucocephalus*) is recognized as threatened, and the boreal toad (*Bufo boreas boreas*) is recognized as "warranted for listing, but precluded by other priorities".

We have identified 40 proposed conservation sites (see Table 5 – Page 105), containing 53 of the 86 elements documented from Eagle County. If protected, these sites would help to conserve the biological integrity of Eagle County and Colorado. Of greatest overall significance, is the preponderance of Harrington's beardtongue (*Penstemon harringtonii*) in Eagle County. This plant is globally restricted in range to six counties in Colorado. Eagle County maintains the heart of the distribution. Additionally, the boreal toad occurrences in Eagle County are extremely noteworthy. Populations of this amphibian in the southern Rocky Mountains have experienced dramatic reductions over the past few decades. Further, recent taxonomic review suggests that the boreal toads occurring in the southern Rocky Mountains are so genetically distinct from boreal toads commonly found in the Pacific Northwest that the toads of the southern Rockies represent their own species. For these reasons, breeding locales of good quality are extremely important to the long-term persistence of this element. The East Lake Creek potential conservation area addresses the best known breeding location for boreal toad in Eagle County. While there are sure to be additional locations discovered in the future, current knowledge shows the East Lake Creek locale as having range-wide significance for the boreal toad. Finally, the Deep Creek potential conservation area is worth mentioning in this summary for the compilation of ecological values it addresses. Deep Creek is a pristine and intact landscape that supports a healthy cross section of unique plant communities as well as more than a few of the significant species to be found in Eagle County,

Of the 40 proposed conservation sites, we identified five that were ranked as *very significant* (B2), 22 as *significant* (B3), four as *moderate* (B4), and nine of *general biodiversity significance* (B5). Overall, the concentration and quality of imperiled elements and habitats attest to the fact that conservation efforts in Eagle County will have both state and global significance.

Methods

The methods for assessing and prioritizing conservation needs over a large area are necessarily diverse. The Colorado Natural Heritage Program follows a general method that is continuously being developed specifically for this purpose. The Eagle County Biological Inventory was conducted in several steps summarized below. Additionally, input from a guidance committee of local public and private interests was sought at all stages.

Collect Available Information

The CNHP databases were updated with information regarding the known locations of species and significant plant communities within Eagle County. A variety of information sources were searched for this information. The Colorado State University museums and herbarium were searched, as were plant and animal collections at the University of Colorado, Western State, Rocky Mountain Herbarium, and local private collections. The Colorado Division of Wildlife and the U.S. Forest Service provided extensive data on the fishes of Eagle County as well as information regarding the status of the boreal toad. Both general and specific literature sources were incorporated into CNHP databases, in the form of either locational information or as biological data pertaining to a species in general. Such information covers basic species and community biology including range, habitat, phenology (reproductive timing), food sources, and substrates. This information was entered into CNHP databases.

Identify Rare Or Imperiled Species And Significant Plant Communities With Potential To Occur In Eagle County

The information collected in the previous step was used to refine the potential element list and to refine our search areas. In general, species and plant communities that have been recorded from Eagle County, or from adjacent counties, are included in this list. Species or plant communities that prefer habitats that are not included in this study area were removed from the list.

The amount of effort given to the inventory for each of these elements was prioritized according to the element's rank. Globally rare (G1 - G3) elements were given highest priority, state rare elements were secondary.

Element Ranking

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, 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 that across its global range (its Global or G-rank). Taken together, these two ranks give an instant picture of the degree of imperilment of an element. For example, the lynx, which is thought to be secure in northern North America but is known from less than 5 current locations (excluding recent transplants) in Colorado, is ranked G5S1. The Rocky Mountain Columbine which is known only from Colorado, from about 30 locations, is ranked a G3S3. Further, a tiger beetle that is only known from one location in the world at the Great Sand Dunes National Monument is ranked G1S1. CNHP actively collects, maps, and electronically processes specific occurrence information for elements considered globally (G1-G3) or state rare (generally S1-S3). 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 terms in Colorado. 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 non-breeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

Table1. 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 locations 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 locations), 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 locations).
- 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, 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.
- G/TQ** Indicates uncertainty about taxonomic status.
- G/SH** Historically known, but not verified for an extended period.
- G#T#** Trinomial rank (T) is used for subspecies or varieties. These species or subspecies 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.

Legal Designations

Natural Heritage imperilment ranks are not legal designations and should not be interpreted as such. 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 Statutes 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 most species that would have been included in the former Category 1. This includes those species for which the U.S. Fish and Wildlife 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.

| |
|---|
| <p>Federal Status:</p> <p>1. U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993) and (61 Federal Register 7598, 1996) LE Endangered; species or subspecies formally listed as endangered. E(S/A) Endangered due to similarity of appearance with listed species. LT Threatened; species or subspecies formally listed as threatened. P Proposed Endangered or Threatened; species or subspecies formally proposed for listing as endangered or threatened. C Candidate: species or subspecies 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.</p> <p>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.</p> <p>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.</p> <p>State Status:</p> <p>1. Colorado Division of Wildlife E Endangered T Threatened SC Special Concern</p> |
|---|

Identify Targeted Inventory Areas

Survey sites were chosen based on their likelihood of harboring rare or imperiled species or significant plant communities. Known locations were targeted so that they could be verified and updated, and additional potential areas were chosen. Areas with potentially high natural values were chosen using satellite imagery, aerial photographs, geology maps, vegetation surveys, personal recommendations from knowledgeable local residents, and numerous roadside surveys by our field scientists. Aerial photography is perhaps the most useful tool in this step of the process. High altitude infrared photographs at 90 meter resolution were used for this project and are well suited for assessing vegetation types and, to some extent, natural conditions on the ground.

Because of the overwhelming number of potential sites and limited resources, surveys for all elements were prioritized by the degree of imperilment. For example, all species with Natural Heritage ranks of G1-G3 were the primary target of our inventory efforts. Although species with lower Natural Heritage ranks were not the main focus of inventory efforts, many of these species occupy similar habitats as the targeted species, and were searched for and documented as they were encountered.

Contact Landowners

Obtaining permission to conduct surveys on private property was essential to this project. Once survey sites were chosen, land ownership of these areas was determined using records at the Eagle County assessor's office. Landowners were then either contacted by phone or mail or in person. If landowners could not be contacted, or if permission to access the property was denied, this was recorded and the site was not visited. Under no circumstances were properties surveyed without landowner permission.

Conduct Field Surveys

Survey sites where access could be obtained were visited at the appropriate time as dictated by the phenology of the individual elements. The methods used in the surveys necessarily vary according to the elements that were being targeted. In most cases, the appropriate habitats were visually searched in a systematic fashion that would attempt to

cover the area as thoroughly as possible in the given time. Some types of organisms require special technique in order to capture and document their presence. These are summarized below:

Amphibians: visual or with aquatic nets

Bats: mist nets or harp traps

Insectivores: shrews only, pit fall traps

Birds: visual or by song/call, evidence of breeding sought

Insects: aerial net

Plant communities: visual, collect qualitative or quantitative composition data

When necessary and permitted, voucher specimens were collected and deposited in local university museums and herbaria.

When a rare species or significant plant community was discovered its precise location and known extent was recorded on 1:24,000 scale topographic maps. Other data recorded at each occurrence included numbers observed, breeding status, habitat description, disturbance features, observable threats, and potential protection and management needs. The overall significance of each occurrence, relative to others of the same element, was estimated by rating the quality (size, vigor, etc.) of the population or community, the condition or naturalness of the habitat, the long-term viability of the population or community, and the defensibility (ease or difficulty of protecting) of the occurrence. These factors are combined into an element occurrence rank, useful in refining conservation priorities.

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 the most ecologically viable, thus focusing conservation efforts where they will be most successful. The EO-Rank is based on 3 factors:

- ?? 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.
- ?? 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.
- ?? 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 are 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 Viability has not been assessed, but element is known to be extant
- H Historically known, but not verified for an extended period of time

Delineate Potential Conservation Area Boundaries

Finally, since the objective for this inventory is to prioritize specific areas for conservation efforts, proposed conservation planning boundaries were delineated. These 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. Conservation areas may include a single occurrence of a rare element or a suite of rare element

occurrences or significant features. These boundaries are considered preliminary and additional information about the site or the element may call for alterations to the boundaries.

Data collected in the field are essential to delineating such a boundary, but other sources of information such as aerial photography are also used. Additionally, CNHP staff consider a number of factors that include, but are not limited to:

- the 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.

The proposed boundary does not automatically exclude all activity. It is hypothesized 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 preliminary conservation planning boundary should be carefully considered and evaluated for their consequences to the element on which the conservation unit is based. Please note that these boundaries are based primarily on our understanding of the ecological systems. A thorough analysis of the human context and potential stresses was not conducted. 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.

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.

Potential Conservation Area Ranking

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. If an element occurrence is unranked due to a lack of information the element occurrence rank is considered a C rank. Similarly, if an element is a GU or G? it is treated as a G4. Based on these ranks, each site is assigned a biodiversity (or B-) rank.

Table 3. Biodiversity Rank Definitions

| | |
|-----------|--|
| B1 | <u>Outstanding Significance</u> : only site known for an element or an excellent occurrence of a G1 species. |
| B2 | <u>Very High Significance</u> : 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 | <u>High Significance</u> : excellent example of any community type, good occurrence of a G3 species, or a large concentration of good occurrences of state rare species. |
| B4 | <u>Moderate or Regional Significance</u> : good example of a community type, excellent or good occurrence of state-rare species. |
| B5 | <u>General or State-wide Biodiversity Significance</u> : good or marginal occurrence of a community type, S1, or S2 species. |

Results

Table 4. Ranks and Status of the Rare and Imperiled Elements of Eagle County

| Scientific Name | Common Name | Global Rank | State Rank | Federal/ State Status |
|--|--------------------------------|-------------|------------|-----------------------|
| AMPHIBIANS | | | | |
| <i>Bufo boreas boreas</i> | boreal toad | G4T1Q | S1 | FS/ C/ E |
| BIRDS | | | | |
| <i>Accipiter gentilis</i> | northern goshawk | G5 | S3B, SZN | FS/ BLM |
| <i>Aegolius funereus</i> | boreal owl | G5 | S2 | FS |
| <i>Amphispiza belli</i> | sage sparrow | G5 | S3B, SZN | |
| <i>Asio flammeus</i> | short-eared owl | G5 | S2B, SZN | |
| <i>Bucephala islandica</i> | Barrow's goldeneye | G5 | S2B, SZN | BLM/ SC |
| <i>Centrocercus urophasianus</i> | sage grouse | G5 | S4 | BLM/ SC |
| <i>Cypseloides niger</i> | black swift | G4 | S3B | FS |
| <i>Falco peregrinus anatum</i> | American peregrine falcon | G4T3 | S2B, SZN | LE |
| <i>Grus canadensis tabida</i> | greater sandhill crane | G5T4 | S2B, S4N | FS/ T |
| <i>Haliaeetus leucocephalus</i> | bald eagle | G4T?Q | S1B, S3N | LT/ T |
| <i>Plegadis chihi</i> | white-faced ibis | G5 | S2B, SZN | FS/ BLM |
| FISH | | | | |
| <i>Gila robusta</i> | roundtail chub | G2G3 | S2 | BLM/ SC |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | FS/ BLM/ SC |
| MAMMALS | | | | |
| <i>Corynorhinus townsendii pallascens</i> | pale lump-nosed bat | G4T4 | S2 | |
| <i>Euderma maculatum</i> | spotted bat | G4 | S2 | FS/BLM |
| <i>Gulo gulo</i> | wolverine | G4 | S1 | FS/ E |
| <i>Lynx canadensis</i> | lynx | G5 | S1 | FS/ E |
| COMMUNITIES | | | | |
| <i>Abies lasiocarpa- Picea engelmannii/ Alnus incana</i> | | G5 | S5 | |
| <i>Abies lasiocarpa- Picea engelmannii/ Mertensia ciliata</i> | | G5 | S5 | |
| <i>Abies lasiocarpa- Picea engelmannii/ Salix drummondiana</i> | | G5 | S4 | |
| <i>Abies lasiocarpa/ Vaccinium myrtillus</i> | | G5 | S5 | |
| <i>Alnus incana- Cornus sericea</i> | | G3G4 | S3 | |
| <i>Alnus incana- mixed Salix species</i> | | G3 | S3 | |
| <i>Alnus incana/ mesic forb</i> | | G3G4Q | S3 | |
| <i>Artemisia tridentata ssp. tridentata/ leymus cinereus</i> | | G2G3 | S1 | |
| <i>Artemisia tridentata ssp. vaseyana/ Pseudoroegneria spicata</i> | | G5 | S2 | |
| <i>Betula occidentalis/ mesic forb</i> | | G3 | S2 | |
| <i>Betula occidentalis/ mesic graminoid</i> | | G3 | S2 | |

| | | | |
|--|------|------|--|
| <i>Cardamine cordifolia</i> - <i>Mertensia ciliata</i> - <i>Senecio triangularis</i> | G4 | S4 | |
| <i>Carex aquatilis</i> | G5 | S4 | |
| <i>Carex scopulorum</i> - <i>Caltha leptospala</i> | G4 | S4 | |
| <i>Carex utriculata</i> | G5 | S4 | |
| <i>Cercocarpus montanus</i> / <i>Pseudoroegneria spicata</i> | G4 | S3 | |
| <i>Cornus sericea</i> | G4 | S3 | |
| <i>Danthonia intermedia</i> | GU | S3S4 | |
| <i>Deschampsia cespitosa</i> - <i>Ligusticum tenuifolium</i> | GU | SU | |
| <i>Eleocharis quinqueflora</i> | G4 | S3S4 | |
| <i>Juniperus osteosperma</i> / <i>Artemisia tridentata</i> | G5 | SU | |
| <i>Juniperus scopulorum</i> / <i>Cercocarpus montanus</i> | G2 | S2 | |
| <i>Juniperus scopulorum</i> / <i>Cornus sericea</i> | G4 | S2 | |
| <i>Nuphar leteum</i> ssp. <i>Polysepalum</i> | G5 | S3 | |
| <i>Phragmites australis</i> | G4 | S3 | |
| <i>Picea pungens</i> / <i>Alnus incana</i> | G3 | S3 | |
| <i>Pinus edulis</i> / <i>Stipa comata</i> | G2 | S2 | |
| <i>Populus angustifolia</i> - <i>Juniperus scopulorum</i> | G2G3 | S2 | |
| <i>Populus angustifolia</i> - <i>Picea pungens</i> / <i>Alnus incana</i> | G4 | S4 | |
| <i>Populus angustifolia</i> / <i>Alnus incana</i> | G3? | S3 | |
| <i>Populus angustifolia</i> / <i>Cornus sericea</i> | G4 | S3 | |
| <i>Populus angustifolia</i> / <i>Salix eriocephala</i> var. <i>ligulifolia</i> - <i>Shepherdia argentea</i> | G2 | S2 | |
| <i>Populus balsamifera</i> | GU | SU | |
| <i>Populus tremuloides</i> / <i>Acer glabrum</i> | G2 | S1S2 | |
| <i>Populus tremuloides</i> / <i>Alnus incana</i> | G3 | S3 | |
| <i>Populus tremuloides</i> / tall forbs | G5 | S5 | |
| <i>Quercus gambelii</i> - <i>Amelanchier utahensis</i> | G4G5 | SU | |
| <i>Quercus gambelii</i> - <i>Cercocarpus montanus</i> / <i>Carex geyeri</i> | G3 | S3 | |
| <i>Salix boothii</i> / <i>Carex utriculata</i> | G4 | S3 | |
| <i>Salix boothii</i> / mesic forb | G3 | S3 | |
| <i>Salix drummondiana</i> / <i>Calamagrostis canadensis</i> | G3 | S3 | |
| <i>Salix drummondiana</i> / mesic forb | G4 | S4 | |
| <i>Salix exigua</i> / bare ground | G5 | S5 | |
| <i>Salix monticola</i> / <i>Calamagrostis canadensis</i> | G3 | S3 | |
| <i>Salix monticola</i> / <i>Carex utriculata</i> | G3 | S3 | |
| <i>Salix monticola</i> / mesic forb | G3 | S3 | |

| | | | | |
|--|----------------------------|---------|------|---------|
| <i>Salix planifolia/ Calamagrostis canadensis</i> | | G3 | S3 | |
| <i>Salix planifolia/ Caltha leptosepala</i> | | G4 | S4 | |
| <i>Salix planifolia/ Carex aquatilis</i> | | G5 | S4 | |
| <i>Salix wolfii/ Carex rostrata</i> | | G4 | S3 | |
| <i>Shepherdia argentea</i> | | G3G4 | S1 | |
| <i>Sparganium angustifolium</i> | | GU | SU | |
| INVERTEBRATES | | | | |
| <i>Lymnaea stagnalis</i> | swamp lymnaea | G5 | S2 | |
| PLANTS | | | | |
| <i>Botrychium lunaria</i> | moonwort grape-fern | G5 | S2S3 | |
| <i>Crataegus saligna</i> | willow hawthorn | G2 | S2 | |
| <i>Crypripedium fasciculatum</i> | purple lady's slipper | G4 | S3 | FS |
| <i>Draba crassa</i> | thickleaf whitlow grass | G3 | S3 | |
| <i>Draba oligosperma</i> | few seeded whitlow grass | G5 | S2 | |
| <i>Draba rectifruca</i> | mountain whitlow grass | G3? | S2 | |
| <i>Eriophorum altaicum</i> var. <i>neogaeum</i> | Altai cottongrass | G4T3? | S3 | FS |
| <i>Gymnocarpium dryopteris</i> | oak fern | G5 | S2S3 | |
| <i>Listera borealis</i> | northern twayblade | G4 | S2 | BLM |
| <i>Lycopodium annotinum</i> var. <i>pungens</i> | | G5TU | SU | |
| <i>Mentzelia multicaulis</i> | manystem stickleaf | G3 | S3 | |
| <i>Penstemon cyathophorus</i> | Rocky Mountain beardtongue | G3G4 | S3S4 | |
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | BLM/ FS |
| <i>Platanthera sparsiflora</i> var. <i>ensifolia</i> | canyon bog orchid | G4G5T3? | S3 | |

Natural History Information

Plants

Cypripedium fasciculatum (purple lady's-slipper)

Taxonomy:

Class: Monocotyledoneae

Order: Orchidales

Family: Orchidaceae

Genus: *Cypripedium*

Taxonomic Comments: There is some question as to whether the Colorado populations are a different species than the northwestern U.S. populations.

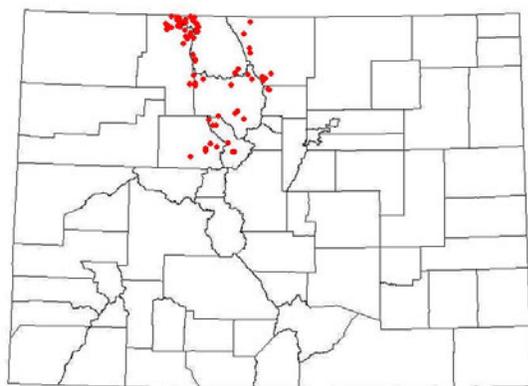
CNHP Ranking: G4S3

State/Federal Status: Forest Service Sensitive



Phenology: The large purple flowers are seen in mid-June through mid-July (Spackman et al. 1997).

Habitat Comments: Known from many geology and soil types within coniferous forests, the purple lady's-slipper is apparently not limited by potential habitat. Although habitat seems plentiful this species is usually found in low numbers. In Colorado, the elevation range is approximately 8000-10,500 feet.



Colorado Distribution

Global Range: The purple lady's-slipper is found in California, Oregon, Washington, Idaho, Montana, Wyoming, Utah and Colorado (Brownell and Catling 1987). It is reported to occur in southern British Columbia but apparently no longer occurs there, or was incorrectly reported (Brownell and Catling 1987).

State Range: It is known from Routt, Summit, Jackson, Larimer, Grand, Boulder and Eagle counties.

Distribution/Abundance: There are approximately 13,000 individuals documented in Colorado from around 60 locations.

Known Threats and Management Issues: In Colorado, this species is known only from National Forest Service properties (including several locations in wilderness areas), and the

species is a Forest Service Sensitive Species, protected by the Forest Management Act. The threats may not as high as those species occurring on private property. However, recreation impacts, logging, and fire suppression are threats to the purple lady's-slipper.

Potential Conservation Areas which support *Cypripedium fasciculatum*:

Grouse Creek

Two Elk Trail

***Cystopteris montana* (mountain bladder fern)**

Taxonomy:

Class: Filicopsida
Order: Filicales
Family: Dryopteridaceae
Genus: *Cystopteris*

Taxonomic Comments: none

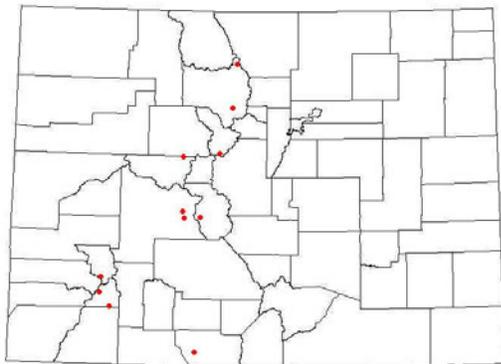
CNHP Ranking: G5 S1

Federal/State Status: none

Phenology: Spores are produced from summer through fall (Flora of North America Editorial Committee 1993).



Habitat: This species is found in moist, rich soils in spruce-fir forests between 9000-11,000 feet (Spackman et al. 1997).



Colorado Distribution

Global Distribution: *Cystopteris montana* is known from Alaska, Canada, northwestern Montana and as a disjunct in Colorado (Flora of North America Editorial Committee 1993).

State Distribution: In Colorado, it is known from eleven locations in Summit, San Juan, Ouray, Grand, Gunnison, Conejos, Chaffee, and Pitkin counties.

Distribution/Abundance: Specific counts of individuals are needed. Two locations include at least 200 individuals each.

Known Threats and Management Issues: Development, recreation, and logging may threaten this species.

Potential Conservation Areas which support *Cystopteris montana*:

North Fork Fryingpan

***Draba crassa* (thick-leaf whitlow-grass)**

Taxonomy:

Class: Dicotyledoneae

Order: Capparales

Family: Brassicaceae

Genus: *Draba*

Taxonomic Comments: none

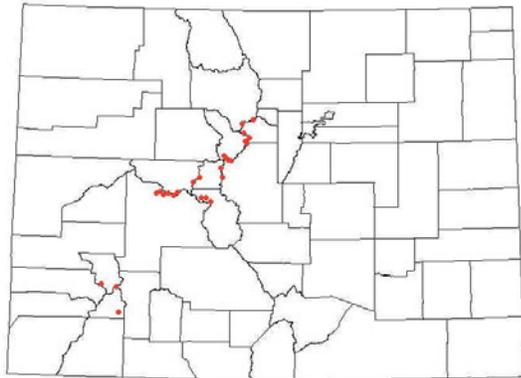
CNHP Ranking: G3S3

State/Federal Status: none



Phenology: It can be found in flower in late June through early July, fruits in mid-to-late July and early August.

Habitat Comments: In Colorado, this species is found at high elevations between 12,000-14,000 feet. It usually occurs in talus, fellfields or rock outcrops, growing between rocks with few associated species. Alpine besseya (*Besseya alpina*), arctic bluegrass (*Poa arctica*), bog sedge (*Kobresia* spp.), alpine springbeauty (*Claytonia megarhiza*), dwarf clover (*Trifolium nanum*), phlox species (*Phlox* spp.), willow species (*Salix* sp.), whitlowgrass species (*Draba* spp.), Ross' avens (*Geum rossii*) and sticky polemonium (*Polemonium viscosum*) can be found in this same habitat with the thick-leaf whitlow-grass.



Colorado Distribution

mining activities (including the associated roads) may threaten these plants. Recreation is becoming more of an issue as climbing "14'ers" increases in popularity. Trampling and unnatural erosion may threaten this species.

Potential Conservation Areas which support *Draba crassa*:

Elk Ridge

Global Distribution: This species is known from Colorado, Montana, Utah and Wyoming.

State Distribution: This species is known from 26 locations on high peaks in Eagle, Summit, Pitkin, Chaffee, Lake, Gunnison, Ouray, Hinsdale, Grand, Clear Creek, San Juan and Park counties.

Distribution/Abundance: There are 28 occurrences documented including at a minimum of 2700 individuals.

Known Threats and Management Issues: Alpine species, such as this, are known primarily from National Forest lands and wilderness areas. These sites may receive protection from their high elevations and remote locations. Historical private mining claims often fragment these types of areas and renewed

Draba lonchocarpa* var. *lonchocarpa
(lancepod whitlowgrass)

Taxonomy:

Class: Dicotyledoneae
Order: Capparales
Family: Brassicaceae
Genus: *Draba*

Taxonomic Comments: none

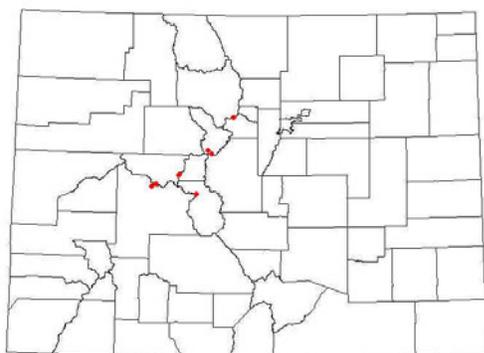
CNHP ranking: G4T4 S2

State/Federal Status: none



Phenology: The lancepod whitlowgrass is found in flower in June and July (Rollins 1993).

Habitat Comments: This species can be found in alpine habitats between 11,500-13,500 feet in Colorado.



Colorado Distribution

Global distribution: Colorado to Nevada and north to Alaska make up the range for this species.

State Distribution: It is known from Eagle, Summit, Pitkin, Gunnison, Lake, Chaffee, and Grand counties.

Distribution/Abundance: A minimum estimate of numbers of individuals is 600 from nine occurrences.

Known Threats and Management Comments: Alpine species, such as this, are known primarily from National Forest lands and wilderness areas. These sites may receive protection from their high elevations and remote locations. Historical private mining claims often fragment these types of areas and renewed mining activities (including the associated roads) may threaten these plants. Recreation is becoming

more of an issue as climbing "14'ers" increases in popularity. Trampling and unnatural erosion may threaten this species.

Potential Conservation Areas which support *Draba lonchocarpa* var. *lonchocarpa*:

Elk Ridge

***Draba oligosperma* (fewseed whitlowgrass)**

Taxonomy:

Class: Dicotyledoneae
Order: Capparales
Family: Brassicaceae
Genus: *Draba*



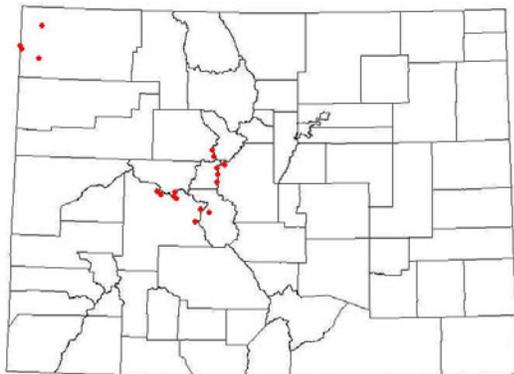
Taxonomic Comments: There is some confusion as to the distinctness of *Draba juniperina*, a related species of *Draba oligosperma*. In contrast to *D. oligosperma*, which occurs in alpine habitat of the central Colorado mountains, *Draba juniperina* occurs in pinyon-juniper habitat in Moffat County which is disjunct from the other *D. oligosperma* records. Colorado Natural Heritage Program considers these synonyms.

CNHP Ranking: G5 S2

Federal/State Status: none

Phenology: Flowers can be seen on this species from mid-to-late May into early June, and fruits from late June through early August.

Habitat: Fewseed whitlowgrass occurs in alpine habitats between 11,000-13,800 feet, and also in pinyon-juniper habitat between 6000-8300 feet.



Colorado Distribution

Global Distribution: This species is found in Alaska, Montana, Washington, California, Nevada, Wyoming, Colorado, Oregon, Idaho, and Utah.

State Distribution: Fewseed whitlowgrass occurs in Summit, Gunnison, Lake, Park, Chaffee, Pitkin, Eagle and Moffat counties.

Distribution/Abundance: This species is known from less than twenty locations. There is little information documented regarding number of individuals.

Known Threats and Management Issues: Alpine species, such as this, are known primarily from National Forest lands and wilderness areas. These sites may receive protection from their high elevations and remote locations. Historical private

mining claims often fragment these types of areas and renewed mining activities (including the associated roads) may threaten these plants. Recreation is becoming more of an issue as climbing "14'ers" increases in popularity. Trampling and unnatural erosion may threaten this species. The lower elevation sites are occur primarily in Dinosaur National Monument. Trampling from park visitors is the only threat at this time.

Potential Conservation Areas which support *Draba oligosperma*:

Elk Ridge

***Draba spectabilis* var. *oxyloba* (showy draba)**

Taxonomy:

Class: Dicotyledoneae

Order: Capparales

Family: Brassicaceae

Genus: *Draba*

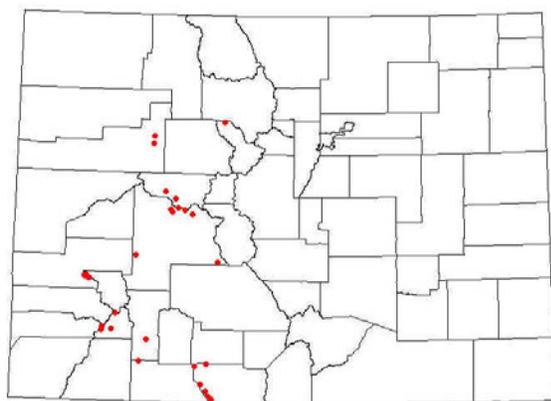
Taxonomic Comments: The validity of this variety is unclear. Weber and Wittmann (1996) do not recognize the varietal level of this species. The USDA (1999) recognize two varieties and report them both from Colorado. Due to this confusion, it is difficult to separate much of the current data regarding these varieties.

CNHP Ranking: G3?T3Q S3

Federal/State Status: none

Phenology: This species is found in flower in late June through July and fruits in August.

Habitat: Showy draba is found in montane to alpine areas in Colorado (Weber and Wittmann 1996) from elevations between 8200-13,000 feet. Specific habitats vary from open grasslands to coniferous forests.



Colorado Distribution

Global Distribution: According to the USDA (1999), this variety is found in Utah, Wyoming and Colorado.

State Distribution: In Colorado, this species is found in Conejos, San Juan, Gunnison, Archuleta, Hinsdale, Summit, Dolores, Montrose, Ouray, Pitkin, and Garfield counties.

Distribution/Abundance: There are at least 1000 individuals reported in Colorado, but there are likely more. Specific counts are needed at each location.

Known Threats and Management Issues: Specific threats are currently unknown. Many occurrences are within the National Forest and include grazing, recreation and logging activities.

Potential Conservation Areas which support *Draba spectabilis* var. *oxyloba*:
Deep Creek

***Eriophorum altaicum* var. *neogaeum* (Altai cottongrass)**

Taxonomy:

Class: Monocotyledoneae

Order: Cyperales

Family: Cyperaceae

Genus: *Eriophorum*

Taxonomic Comments: None.

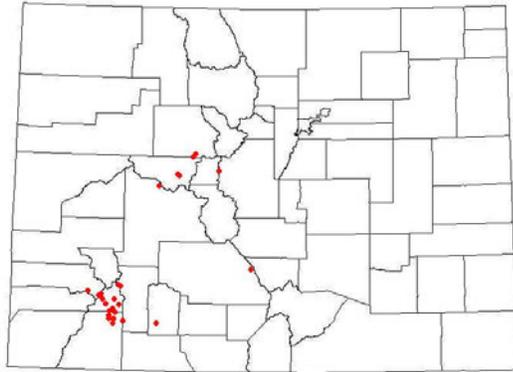
CNHP Ranking: G4T3?S3

State/Federal Status: Forest Service Sensitive Species



Phenology: This species is noticeable in fruit when it shows the white cottonlike fruit. This occurs in late-July through August (Kettler et al. 1993).

Habitat Comments: The Altai cottongrass can be found in wet boggy areas at altitudes of 9500-14,000 feet (Ryke et al. 1994).



Colorado Distribution

Global Distribution: Alaska, British Columbia, Utah, and Colorado (Kettler et al. 1993) is the known distribution.

State Distribution: This species occurs in 10 counties in the mountains of Colorado.

Distribution/Abundance: Approximately 7500 individuals are documented from 22 occurrences in the mountains of Colorado.

Known Threats and Management Issues: Most Colorado occurrences are within National Forest Service boundaries and are mainly threatened by water diversions, or a change in the water quality. Upstream logging or mining would be possible threats.

Potential Conservation Areas which support *Eriophorum altaicum* var. *neogaeum*:

Holy Cross City

***Platanthera sparsiflora* var. *ensifolia* (canyon bog-orchid)**

Taxonomy:

Class: Monocotyledoneae

Order: Orchidales

Family: Orchidaceae

Genus: *Limnorchis*

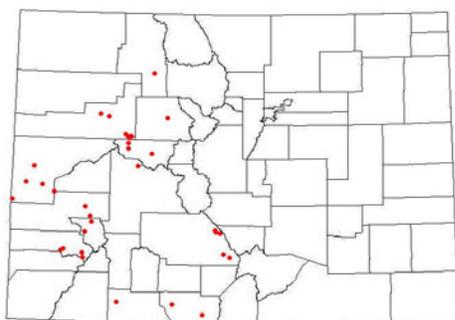
Taxonomic Comments: It is also known as *Limnorchis ensifolia*.

CNHP Ranking: G4G5T3? S3

State/Federal Status: no special status

Phenology: The canyon bog-orchid has been reported in flower from mid-June to mid-September and may fruit as early as late July and continue through mid-September.

Habitat Comments: This orchid can be found in wet, marshy areas in the mountains between 6000-10,000 feet.



Colorado Distribution

Global Distribution: This species is known from Arizona, Colorado and Nevada.

State Distribution: This species is found in 12 Colorado counties (Gunnison, Conejos, Montrose, Saguache, Eagle, Mesa, Ouray, Routt, Pitkin, Garfield, Arhuleta, and San Miguel).

Distribution/Abundance: A minimum number of individuals is estimated at 5000. Thirty-five locations are known at this time.

Known Threats and Management Issues: Grazing, recreation, and hydrological modifications are the main threats to this species. The canyon bog-orchid has been found on BLM, FS and private properties.

Potential Conservation Areas which support *Limnorchis ensifolia*:

Edwards

***Listera borealis* (northern twayblade)**

Taxonomy:

Class: Monocotyledoneae

Order: Orchidales

Family: Orchidaceae

Genus: *Listera*

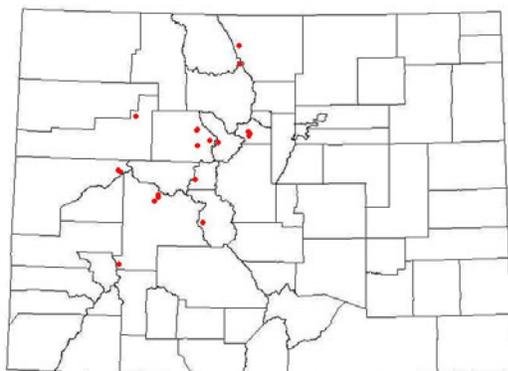
Taxonomic Comments: None.

CNHP Ranking: G4S2

State/Federal Status: BLM sensitive species

Phenology: The northern twayblade flowers from late June through July.

Habitat Comments: It is known from elevations of 8700-10,800 feet in moist woods and mossy places along small streams (Cronquist et al. 1977).



Colorado Distribution

Global Distribution: Alaska, Yukon, east to Labrador and Hudson Bay, south to Montana, Idaho, Wyoming, Utah, and Colorado makes up its current distribution.

State Distribution: It is known from Chaffee, Clear Creek, Eagle, Garfield, Grand, Gunnison, Lake, Larimer, and Mesa counties.

Distribution/Abundance: Approximately 360 individuals have been documented from twelve locations. A total of 19 locations are known.

Known Threats and Management Issues: Most Colorado populations occur on National Forest Service property and are mainly threatened by recreation (trampling and habitat disturbance).

Potential Conservation Areas which support *Listera borealis*:

Two Elk Trail

***Mentzelia multicaulis* (manystem blazingstar)**

Taxonomy:

Class: Dicotyledoneae

Order: Violales

Family: Loasaceae

Genus: *Mentzelia*

Taxonomic Comments: It is also known as *Nuttallia multicaulis*.

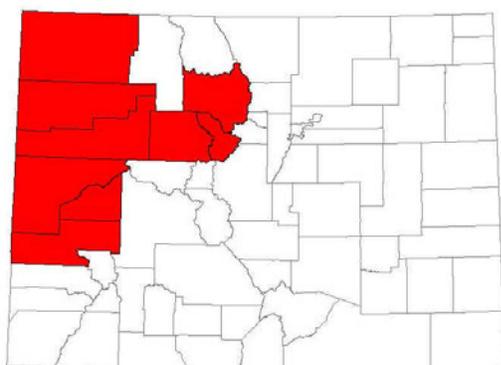
CNHP Ranking: G3S3

State/Federal Status: No special status.

Phenology: The manystem blazingstar flowers in July and early August. Fruit begin to form in late July while flowers are still present.

Habitat: This species is found on dark grey to black shale derived soils. These soils are usually sparsely vegetated with this rare species, rabbitbrush (*Chrysothamnus* spp.), Indian rice grass (*Oryzopsis hymenoides*), and buckwheat species (*Eriogonum* spp). It occurs on steep slopes, flats or gullies. It may be a poor competitor and is therefore limited to these barren slopes. It has been found on several roadcuts which do not fit the above description but has not been found in the surrounding areas. The roadcuts may be acting as similar barren habitat. Known elevation ranges from 6300-8500 feet.

Global Distribution: The manystem blazingstar is known from northeastern Utah and the western slope of Colorado.



Colorado Distribution

State Distribution: In Colorado, it is known from nine counties (Eagle, Mesa, Montrose, Moffat, Garfield, Grand, Summit, Delta, and Rio Blanco).

Distribution/Abundance: There are approximately 30 locations known, number of individuals is not known at this time.

Known Threats and Management Issues: The steep habitat known for this species is not often impacted due to its unstable and steep nature. The flats and gullies where it is found is threatened by grazing and off-road motor vehicle use. Trampling and the increase of erosion are associated with both of these threats. Exotic plant species were noted in many of the areas supporting the manystem blazingstar, however the weeds

do not appear to become established on these barren outcrops of shale. Most of the known occurrences occur on BLM property, however there are a few on private land. Development pressures in the mountains of Colorado are high and may threaten this species in the future.

Potential Conservation Areas which support *Mentzelia multicaulis*:

Blue Hill

Norman Creek

Sweetwater Creek Uplands

Milk Creek

***Penstemon harringtonii* (Harrington's beardtongue)**

Taxonomy:

Class: Dicotyledoneae
Order: Scrophulariales
Family: Scrophulariaceae
Genus: *Penstemon*

Taxonomic Comments: None.

CNHP ranking: G3S3

State/Federal Status: BLM and FS sensitive.

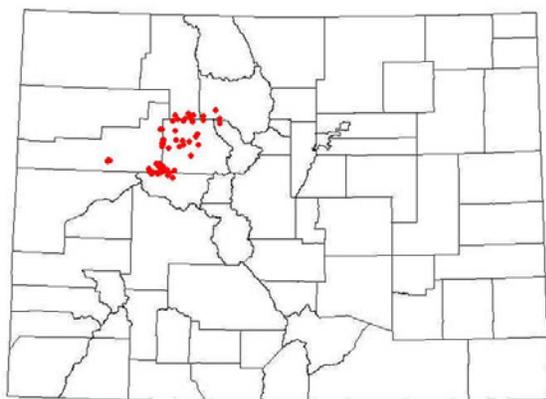
Look Alikes: Harrington's beardtongue is most similar in appearance to Osterhout's beardtongue (*P. osterhoutii*) and sagebrush beardtongue (*P. cyathophorus*). Harrington's beardtongue has two stamens exerted, stamens are not or scarcely exerted in Osterhout's beardtongue (Penland 1958), and sagebrush beardtongue has four stamens exerted. The species is difficult to identify with certainty unless in full bloom as the rosettes are virtually identical to the above mentioned species of *Penstemon* (pers. comm. Coles).



Phenology: Harrington's beardtongue begins flowering in early June of most years and continues until late June at higher elevation sites. The development of fruit proceeds through late August; capsules dehisce beginning at that time, and much seed seems to have been dispersed by September, but the capsules remain on the plant indefinitely (Buckner and Bunin 1992).

Reproduction: It is assumed that sexual reproduction is the only functional mode for Harrington's beardtongue. It is insect pollinated and the most likely agents of seed dispersal are overland flow of water and rodents (Buckner and Bunin 1992).

Habitat Comments: Harrington's beardtongue is most often found in open sagebrush stands on moderate slopes between 6700-9200 feet elevation. Soils are typically loams and clay loams derived from coarse calcareous parent materials, especially Pleistocene gravels, but also limey shales, limestones, and other parent rocks. It is found on all aspects, but primarily on gentle slopes. Most commonly associated species are mountain big sagebrush (*Artemisia tridentata* var. *vaseyana*), yellow rabbitbrush (*Chrysothamum viscidiflorum*), spiny phlox (*Phlox hoodii*), muttongrass (*Poa fendleriana*), Indian ricegrass (*Oryzopsis hymenoides*), squirreltail (*Sitanion hystrix*), bluebunch wheatgrass (*Pseudoroegneria spicata*), junegrass (*Koeleria macrantha*), and needle and thread grass (*Stipa comata*) (Buckner and Bunin 1992). Microbiotic crust or lichen is also common. The total bare ground/rock/lichen cover is often high (20-30%).



Colorado Distribution

Global Distribution: This species is only found in Colorado.

State Distribution: This species is a Colorado endemic known from 6 counties: Eagle, Grand, Pitkin, Garfield, Routt, and historically from Summit.

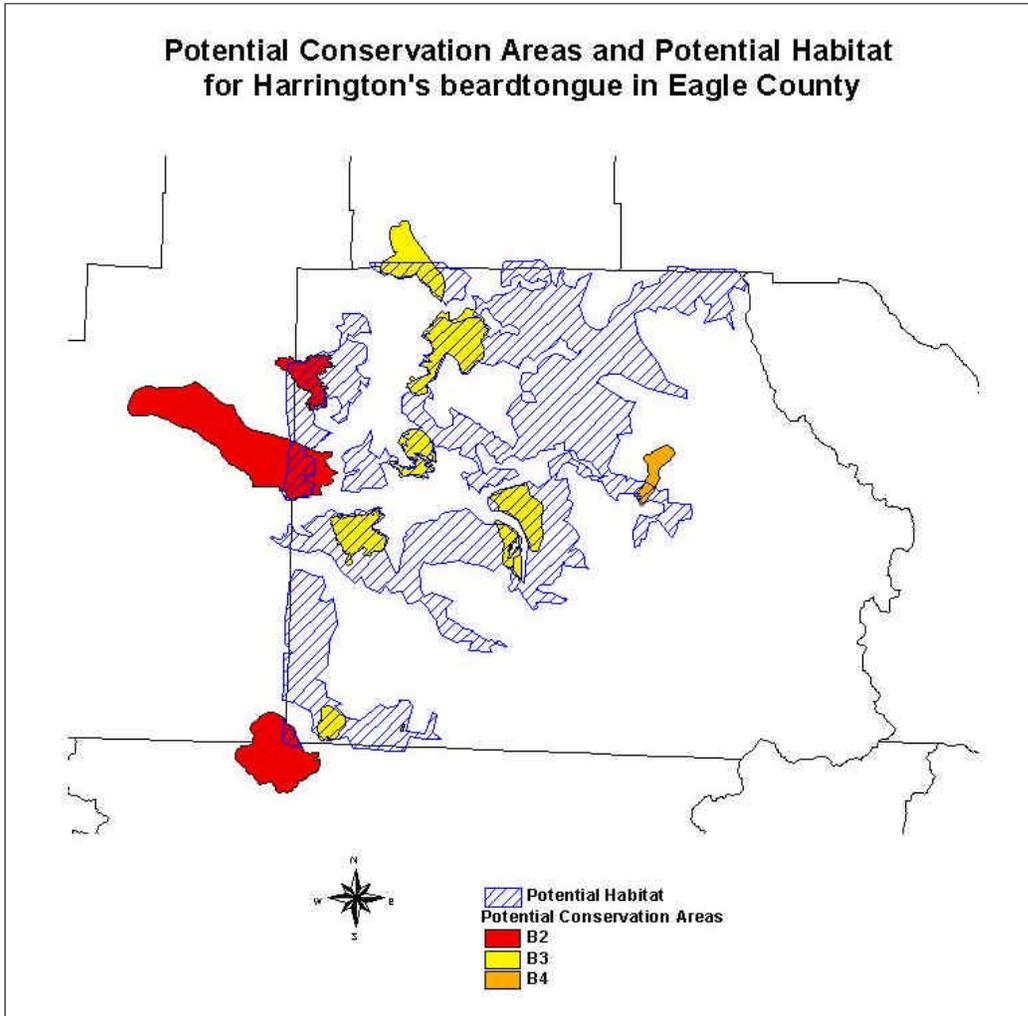
Distribution/Abundance: Sagebrush is found on the west slope of Colorado only, covering only 1/3 of the state (Barbour and Billings 1988). A large portion of this is found in Eagle County. It is not surprising that the center of a sagebrush endemic, such as Harrington's beardtongue is found here. Half of the known occurrences of Harrington's beardtongue are found in Eagle County. There are a total of

approximately 40 occurrences including around 8000 individuals.

Known Threats and Management Issues: Harrington's beardtongue is restricted to sagebrush habitat in the Rocky Mountains on the west slope of Colorado. In the past, this habitat type has been used primarily for grazing and, on a more limited basis, for agricultural fields, in which case the sagebrush is completely removed. It is likely that the community type in this area was dominated by sagebrush with bunchgrasses, such as *Pseudoroegneria spicata*. At the center of Harrington's beardtongue's distribution, in Eagle County, overgrazing appears to modify the sagebrush community in two ways: 1) arrowleaf balsamroot (*Balsamorhiza sagittata*) and mule ears (*Wyethia amplexicaulis*) increase and the overall forb cover increases; 2) the graminoid and forb cover decreases and the sagebrush cover increases, leaving sagebrush and bare ground. Harrington's beardtongue is rarely found in the first scenario but appears to tolerate the second. Development pressures are high in these mountain ski towns and many of the sagebrush areas historically used for ranching are now being converted to housing developments.

Fire suppression has also affected this system, and may effect Harrington's beardtongue specifically, by increasing the chance for catastrophic fire. Since sagebrush does not reestablish by sprouting, but rather must re-seed, it suffers a distinct disadvantage in the event of catastrophic fire (Barbour and Billings 1988). Thus, catastrophic fire would decrease sagebrush and increase the number of perennial herbaceous plants and graminoids. This sudden increase in herbaceous understory may represent a competitive disadvantage for Harrington's beardtongue. Another aspect of fire suppression in this community is that it tends to allow for higher densities of sagebrush. Increased shrub density may promote a decline in the number of species and their abundance within the herbaceous understory (C. Scheck pers. comm.) Further, sagebrush tends to be more efficient at extracting water from the soil than is Harrington's beardtongue. An increase in sagebrush density, therefore, may promote a decline in Harrington's beardtongue (C. Scheck, pers. comm. with P. Lyon). For these reasons, the reintroduction of low-intensity fire (via prescribed burns) to sagebrush communities in which the native understory is still intact might benefit the system. However, in areas where the understory is now predominantly composed of exotic species, especially cheatgrass, the use of fire as a restoration tool may worsen the range condition. It is not understood how fire affects a community such as the sagebrush/mules ear/arrowleaf balsamroot. Arrowleaf balsamroot and mules-ear are native increasers. Although the community is composed largely of natives, the composition itself is not natural. Fire may not rectify this unnatural composition.

Potential Habitat: Eagle County includes the heart of Harrington's beardtongue distribution and a much larger area of potential habitat is available. If this species is not preserved in this county it may become extinct. Since the majority of Harrington's beardtongue populations occur in Eagle County it becomes extremely important to protect a network of Eagle County sites in order to ensure the survival of this species. A network of top priority sites including Sheep Creek, and the Crown would be an ideal conservation strategy. The potential habitat boundary includes sagebrush between 6700-9200 feet, documented in Eagle County based on 7.5" topo maps, GAP vegetation maps, DEM, and field work. Some areas are not considered potential habitat at this time due to degraded understory conditions, but may be restorable or recoverable. Housing developments within this potential habitat, which are known to include Harrington's beardtongue, are excluded because they are not thought to support high quality populations. This boundary is designed for large areas of intact potential and occupied habitat. Surveys were not possible for every section of potential habitat and should be accessed before land management changes occur.



Potential Conservation Areas which support *Penstemon harringtonii*:

- Black Mountain
- Cabin Creek
- Christine State Wildlife Area
- Crown
- Deep Creek
- Dry Lake
- Red Hill
- Seven Hermits
- Sheep Creek
- Taylor Creek

***Sullivantia hapemanii* var. *purpusii* (hanging garden sullivantia)**

Taxonomy:

Class: Dicotyledoneae
Order: Rosales
Family: Saxifragaceae
Genus: *Sullivantia*

Taxonomic Comments: none

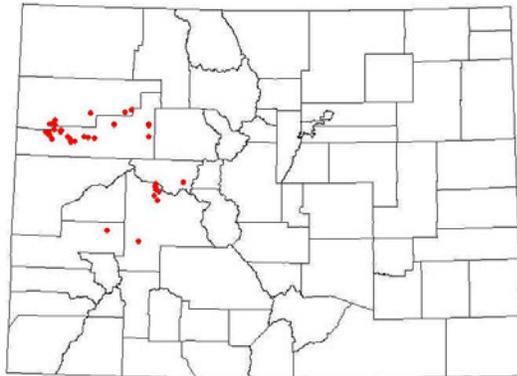
CNHP Ranking: G3T3 S3

Federal/State Status: Forest Service sensitive species

Phenology: This plant flowers from mid-June to late July and fruits July-August (Spackman et al. 1997).



Habitat: This species can be found in hanging gardens, wet cliffs and boulders of various geology between (7000-10,000 feet).



Colorado Distribution

Global Distribution: This variety is only known from Colorado (USDA 1999).

State Distribution: There are 45 locations known from Rio Blanco, Gunnison, Garfield, Pitkin, and Montrose counties.

Distribution/Abundance: It is estimated that there are approximately 40,000 individuals worldwide.

Known Threats and Management Issues: This species is somewhat naturally protected by its inaccessible hanging garden habitat. Although, rock climbing may disturb or destroy individuals, while alteration of hydrology is needed for the survival of these locations. Most occurrences occur on

Forest Service, Bureau of Land Management or Naval Oil Shale properties.

Potential Conservation Areas which support *Sullivantia hapemanii* var. *purpusii*:

Deep Creek

Animals

American Peregrine Falcon (*Falco peregrinus anatum*)

Taxonomy:

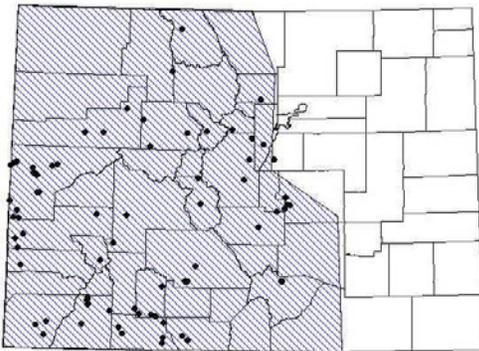
Class: Aves
Order: Falconiformes
Family: Falconidae
Genus: *Falco*

Taxonomic Comments: *Falco peregrinus anatum* refers to the populations of *F. peregrinus* that once ranged the continent and now occur across the western and interior portions of North America, while *F. p. pealei* and *F. p. tundrinus* refer to the northwest coastal and northern North American populations respectively.

CNHP Ranking: G4T3 S3B,SZN

State/Federal Status: CO species of special concern

Habitat Comments: Peregrine falcons nest on foothill and mountain cliffs from 4,500 to over 9,000 feet in elevation (Rocky Mtn./SW Peregrine Recovery Team 1977). Pinyon/Juniper occurs in the vicinity of about half of all nest sites, and ponderosa pine at about one-quarter of the sites (CBBA 1998).



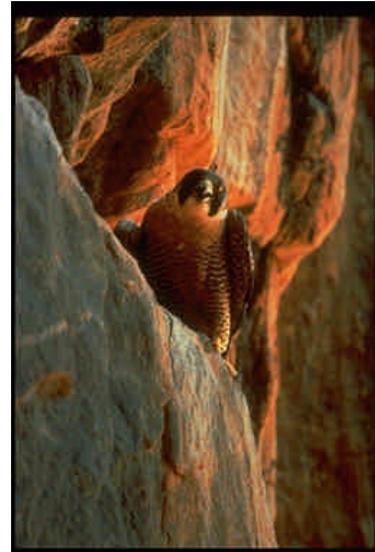
Distribution: *Falco peregrinus anatum* once ranged the entire continent, but is now restricted to the western part of the U.S. where it is a full-time resident (NGS 1987). The peregrine falcon breeds in several locations along Colorado's Front Range, but higher concentrations nest in the river valleys and canyons of the Western Slope, including the Dolores and Colorado River drainages and Dinosaur National Monument (CBBA 1998).

Important Life History Characteristics: Pairs defend a small area around the nest of about 100 yards. Females lay 3-4 eggs and the young remain in the nest for about 39-46 days after hatching (CBBA 1998).

Known Threats and Management Issues: Though breeding occurrence numbers appear stable to increasing, human disturbance of nests by recreational rock climbers, illegal capture by falconers, and uncertain breeding status across the state are factors considered important in the conservation of this species (CNHP 1997).

Potential Conservation Areas that support *Falco peregrinus anatum*:

Deep Creek



Bald Eagle (*Haliaeetus leucocephalus*)

Taxonomy:

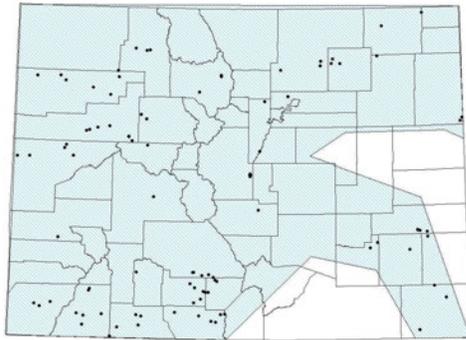
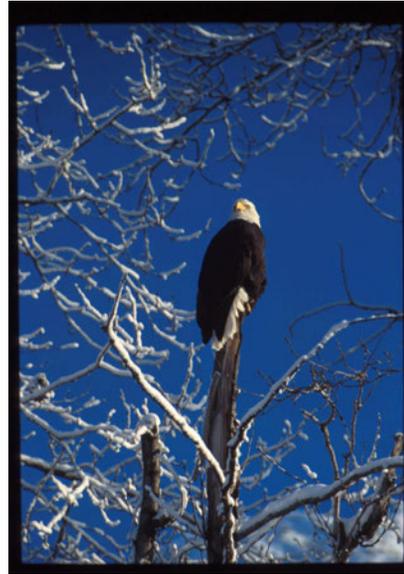
Class: Aves
Order: Falconiformes
Family: Accipitridae
Genus: *Haliaeetus*

Taxonomic Comments: none.

CNHP Ranking: G4 S1B,S3N

State/Federal Status: Federally threatened

Habitat Comments: Bald Eagles that nest in Colorado use large, mature cottonwoods or pines, often along rivers, to hold their heavy nests (CBBA 1998). Wintering populations will use major rivers, reservoirs, and prairie dog towns (MBW).



Distribution: Bald Eagles live throughout North America - from Alaska to Newfoundland, and from the tip of Florida to southern California, and nest across Colorado (CBBA 1998).

Important Life History Characteristics: Bald Eagles begin nesting in late February, and can often be observed feeding their young into late June (CBBA 1998).

Known Threats and Management Issues: Continued threats to this species include high pesticide use, poisoning, poaching, and loss of nesting habitat due to the enduring popularity of waterfront development (CNHP 1997).

Potential Conservation Areas supporting *Haliaeetus leucocephalus*:

Deep Creek

Barrow's Goldeneye (*Bucephala islandica*)

Taxonomy:

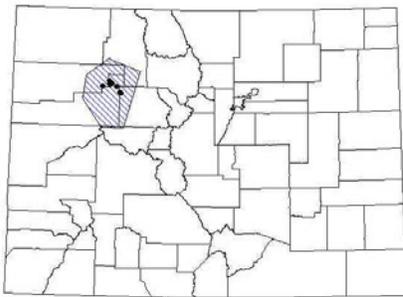
Class: Aves
Order: Anseriformes
Family: Anatidae
Genus: *Bucephala*

Taxonomic Comments: Subfamily Anatinae

CNHP Ranking: G5 S2B,SZN

State/Federal Status: BLM Sensitive, State special concern

Habitat Comments: Barrow's Goldeneyes are cavity nesters, and find nest holes among beetle-killed trees in the vicinity of montane lakes (CBBA 1998).



Distribution: Colorado is at the southern margin of this bird's range, and the state's occurrences may be disjunct (CNHP 1997). Taxonomists recognize no subspecies, but Barrow's goldeneye in Colorado belong to a unique population that breeds and winters inland on freshwater lakes, reservoirs, and rivers in Idaho, Montana, Wyoming, and Colorado (CBBA 1998).

Important Life History Characteristics: Courtship begins in late May and fledged young are observed into late July (CBBA 1998) Barrow's goldeneye is a secondary cavity nester, and relies upon primary cavity nesters to excavate nest sites. This bird competes with

fish for the aquatic invertebrate foods upon which it relies. Lakes that are unsuitable or unoccupied by fish are preferred by this species. In more northern parts of the range, this species breed in alkaline lakes that cannot support fish. In Colorado, we find them on lakes that lack continuous oxygen replenishment from mountain streams or freeze through during winter. Under these circumstances, insect populations during the summer are found along the shorelines, but there are no fish with which to compete (CBBA 1998).

Known Threats and Management Issues: This species is threatened by the small number of breeding localities, uncertain population status, and the small number of protected occurrences within Colorado (CNHP 1998). A high degree of sensitivity to alterations in breeding habitat also renders this species vulnerable to logging impacts (CBBA 1998).

Potential Conservation Areas supporting *Bucephala islandica*:

Red Dirt Creek

Black Swift (*Cypseloides niger*)

Taxonomy:

Class: Aves
Order: Apodiformes
Family: Apodidae
Genus: *Cypseloides*

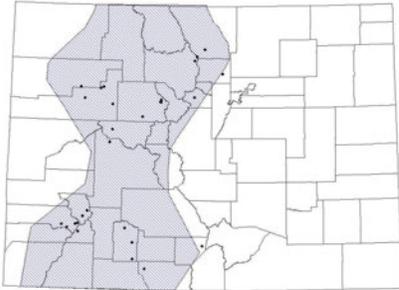
Taxonomic Comments: Subfamily Cypseloidinae

CNHP Ranking: G4 S3B

State/Federal Status: USFS Sensitive



Habitat Comments: Black Swifts nest on vertical rock faces, near waterfalls or in dripping caves (Lack 1956). Beyond that requirement, they inhabit a variety of landscapes, from seacoasts to the high elevations of the Rocky Mountains (CBBA 1998).



Distribution: Black swifts breed in scattered colonies in western North America, from southeast Alaska to central Mexico, and migrate to the Neotropics in the winter (Stiles and Negret 1994). In Colorado, black swifts breed most commonly in the San Juan mountains, with scattered colonies in four other mountain ranges -- Sangre de Cristo, Flat Tops, Gore, and Front (CBBA 1998).

Important Life History Characteristics: After arriving in Colorado in June, black swifts take all summer to raise a single nestling (CBBA 1998). The cool microclimates they select for nesting presumably slows the developmental metabolism of the nestlings. Since nestlings

are typically fed only once per day after the adults return from a day of foraging, slower development rates would help the survival.

Known Threats and Management Issues: There are few obvious threats to this species, except where development alters nesting habitat. The Colorado Breeding Bird Atlas (1998) hypothesizes that at least 20% of all black swifts breed in Colorado.

Potential Conservation Areas supporting *Cypseloides niger*:

Pitkin/Booth Creeks

Boreal Toad (*Bufo boreas boreas*)

Taxonomy:

Class: Amphibia
Order: Anura
Family: Bufonidae
Genus: *Bufo*

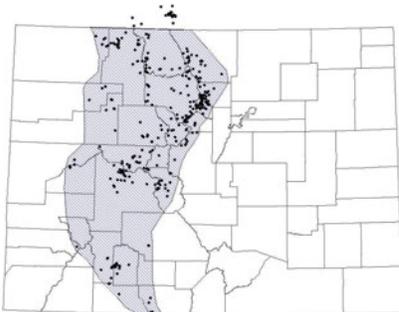


Taxonomic Comments: Prior to the 1990s, morphological, biogeochemical, and vocal differences were noted between toads of the *Bufo boreas* complex in the southern Rocky Mountains and those in the Pacific Northwest (Burger and Bragg 1947, Hubbard 1972). Goebel (1996) described *Bufo boreas* in the southern Rocky Mountains as genetically distinct from those in the Pacific Northwest. These differences may warrant recognition as one or more distinct species. Until this change is formally accepted, Hammerson (1999) has offered the common name of Mountain Toad for the interim, and suggests that the Latin name may become *Bufo pictus*. For the purposes of this report, we are referring all naming to boreal toad (*Bufo boreas boreas*).

CNHP Ranking: G4T1Q S1

State/Federal Status: USFWS candidate for listing (warranted but precluded), USFS Sensitive, State endangered

Habitat Comments: The boreal toad breeds in still or slowly-moving water such as can be found in marshes, ponds, and lakes. Successful breeding generally requires permanent or semipermanent water sources. Post breeding, one may find the boreal toad in more terrestrial environments. Though they still tend to linger near water in damp environments, some females will use drier, more densely vegetated areas. Rocks, logs and rodent burrows provide cover while away from water during periods of inactivity (Hammerson 1999).



Distribution: The southern Rocky Mountain population of boreal toads is likely distinct from other populations (A. Geobel, unpubl. data). Although relationships among populations of this toad are not resolved, recent genetic evaluations suggest that the southern Rocky Mountain population ranges from southern Idaho to New Mexico (Goettl 1997; Steve Corn pers. comm.; A. Geobel unpubl. data). In Colorado, this species occurs throughout the mountains above approximately 8,000 feet in elevation. There are approximately 206 historical localities for the boreal toad in Colorado, while currently there are just 35 known active breeding sites.

Important Life History Characteristics: Boreal toads are long-lived, reaching ages of nine years or more (Campbell 1976). Reproductive maturity does not occur until age four in males and six in females (Carey 1976). Other important considerations include sensitivity to toxicants, relatively short breeding season (starting as the winter snowpack begins to thaw), and slow metabolic rates of the larvae (Hammerson 1999).

Known Threats and Management Issues: Presently, only three to four healthy populations remain across the entire range, comprised of less than 40 high priority breeding sites (Steve Corn, pers. comm.; Lauren Livo, pers. comm.). Based on the small numbers of egg masses, it is estimated that there are currently fewer than 1,000 breeding adults. Although there is an abundance of “protected” habitat, populations have declined precipitously or disappeared over the past 20 years, and continue to do so (Goettl 1997). The reasons for this decline are varied and largely unknown and the factors important to the persistence of this species are not well understood.

Potential Conservation Areas supporting *Bufo boreas boreas*:

East Lake Creek
Holy Cross City
Pitkin/Booth Creeks

Colorado River Cutthroat Trout (*Oncorhynchus clarki pleuriticus*)

Taxonomy:

Class: Actinopterygii
Order: Salmoniformes
Family: Salmonidae
Genus: *Oncorhynchus*

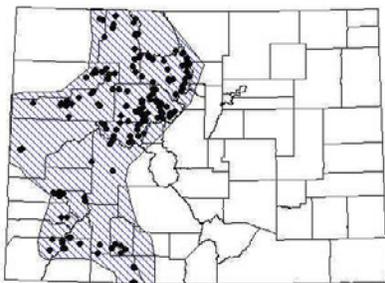


Taxonomic Comments: Subclass - Neopterygii

CNHP Ranking: G4T3 S3

State/Federal Status: USFS sensitive, BLM sensitive, State species of special concern

Habitat Comments: The historical habitat included most clearwater streams and rivers of western Colorado (Behnke 1992). The trout remains only in smaller order streams and a few high elevation lakes of the mountainous country.



Distribution: 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, and San Juan river systems (CDOW 1986, CDOW 1987, Proebstel 1994, Young et al. 1996). Currently, remnant populations remain in Colorado, Wyoming, and Utah.

Important Life History Characteristics: Competition and hybridization with non-native salmonids occurs. This trait has contributed to the current preferences of this native trout for lakes, beaver ponds, and small streams.

Clean, cold water running over a boulder-cobble substrate marks the preferred habitat of this trout (Trotter 1987).

Known Threats and Management Issues: The Colorado River cutthroat trout is heavily managed and studied. Presently, there are 42 populations in Colorado judged to be genetically pure (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); hybridization between this species and non-native trout species (Rainbow trout *Oncorhynchus mykiss*) poses the greatest threat to the elimination of pure populations. Competition with non-native trout species and exotic fish diseases also pose threats, and declines have been hastened by loss of habitat to grazing, clearcutting, water diversions, and stream channelization (Trotter 1987).

Potential Conservation Areas supporting *Oncorhynchus clarki pleuriticus*:

- Berry Creek
- Black Mountain
- Castle Peak
- Cattle Creek
- Cross Creek
- East Lake Creek
- East Meadow Creek
- Hardscrabble
- Hat Creek
- Holy Cross City
- North Fork Fryingpan
- Pitkin/Booth Creeks
- Polk Creek
- Red Dirt Creek
- West Lake Creek

Northern Goshawk (*Accipiter gentilis*)

Taxonomy:

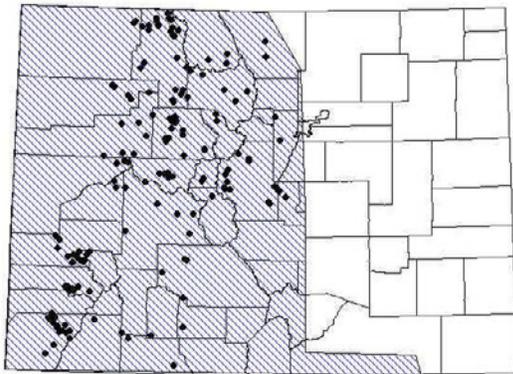
Class: Aves
Order: Falconiformes
Family: Accipitridae
Genus: *Accipiter*

Taxonomic Comments: none

CNHP Ranking: G5 S3B,SZN

State/Federal Status: USFS sensitive, BLM sensitive

Habitat Comments: In northwestern Colorado, northern goshawks typically nest in aspen, sometimes in conifer stands less than 100 years old, and up to 10,000 feet in elevation (CBBA 1998). Goshawks tend to choose nest trees on shallow slopes, flat benches in steep country, and fluvial pans on small stream junctions (CBBA 1998).



Distribution: The northern goshawk is found throughout the state of Colorado above 7500 feet in elevation (Andrews and Righter 1992). The Colorado Breeding Bird Atlas (1998) shows them to be well distributed in the San Juan Mountains and across the northern mountain ranges.

Important Life History Characteristics: This species requires large blocks of forest for nesting and foraging (CBBA 1998). Goshawks reuse the same territory year after year and sometimes reuse the same nest. Pairs typically have one or more alternate nests within the same territory and may desert one nest and then return to it in a later year (CBBA 1998).

Known Threats and Management Issues: This species apparently responds negatively to some form of forest fragmentation (Reynolds 1983). Stokes and Stokes (1996) indicated that populations are declining in the western U.S. due to fragmentation and development, small estimated population sizes, and lack of detailed knowledge about this species. Human disturbances around nesting sites may also upset breeding goshawks (CBBA 1998).

Potential Conservation Areas supporting *Accipiter gentilis*:

- Castle Peak
- Deep Creek
- Hardscrabble
- Red Dirt Creek

Roundtail Chub (*Gila robusta*)

Taxonomy:

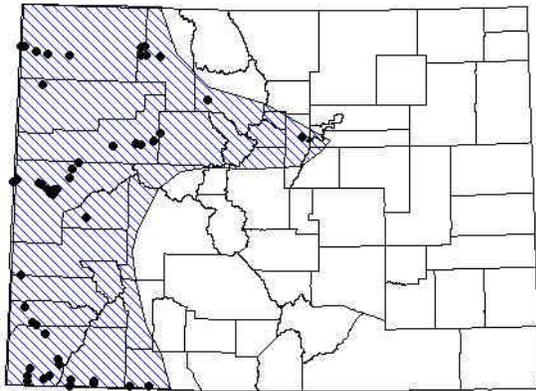
Class: Actinopterygii
Order: Cypriniformes
Family: Cyprinidae
Genus: *Gila*

Taxonomic Comments: Subclass Neopterygii

CNHP Ranking: G2G3 S2

State/Federal Status: BLM sensitive, State species of special concern

Habitat Comments: The Roundtail chub occurs in large streams and intermediate sized rivers (Page and Burr 1991).



Distribution: The Roundtail Chub is endemic to the Colorado River basin (Page and Burr 1991). In Colorado, this species occurs in the Colorado River mainstem and its larger tributaries, including the White, Yampa, Dolores, San Juan, and Gunnison rivers (CNHP 1997).

Important Life History Characteristics: Roundtail chub occupies slow moving water adjacent to areas of faster water. Gravel substrates are required for spawning (Woodling 1985).

Known Threats and Management Issues: The main threats to this species are habitat degradation and its restricted range (CNHP 1997). Warm water temperatures are

required during the summer for breeding, and the release of cold water from dam facilities during the summer may contribute to the decline of this species (Woodling 1985).

Potential Conservation Areas supporting *Gila robusta*:

Deep Creek

Spotted Bat (*Euderma maculatum*)

Taxonomy:

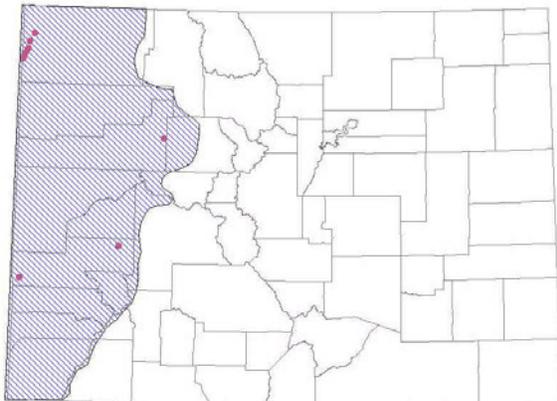
Class: Mammalia
Order: Chiroptera
Family: Vespertilionidae
Genus: *Euderma*

Taxonomic Comments: none

CNHP Ranking: G4 S2

State/Federal Status: USFS sensitive, BLM sensitive

Habitat Comments: The spotted bat is a crevice roosting bat, preferring the shelter of cracks in cliffs for day roosts. Foraging habitat is characterized by dry coniferous forests. In Colorado, spotted bats forage over ponderosa pine (*Pinus ponderosa*) and pinyon-juniper (*Pinus edulis-Juniperus* spp.) woodlands (Armstrong et al. 1994).



Distribution: The spotted bat is distributed across western North America from southern British Columbia south into central Mexico (Kunz and Racey 1998). Western Colorado marks the eastern boundary of the distribution at local latitudes (Fitzgerald et al. 1994). While the distribution is relatively broad, this species is generally rare in all parts of the range, perhaps limited by the need for significant rock features that support day roosting (Kunz and Racey 1998). Conventional methods of monitoring bats have yielded few records of this species in Colorado, but reports based on echolocation suggest that with increased effort, additional locations will be documented with increased sampling effort (Navo et al. 1992).

Important Life History Characteristics: As with many bat species, evidence suggests that just a single young is produced each year (Armstrong et al. 1994). Reported flight distances to foraging locales are unusually large for the size of this animal. Individuals have been observed to fly 10 km or more from day roosts to get to preferred foraging areas (Kunz and Racey 1998).

Known Threats and Management Issues: Very little is known about spotted bats in this regard. Its overall rarity alone may pose a substantial threat to the species survival. This species would benefit from reduced disturbance at known day roosts. Disturbance to day roosts may occur if the area is heavily used by recreational climbers.

Potential Conservation Areas supporting *Euderma maculatum*:
Deep Creek

Townsend's Big-eared Bat (*Corynorhinus townsendii pallescens*)

Taxonomy:

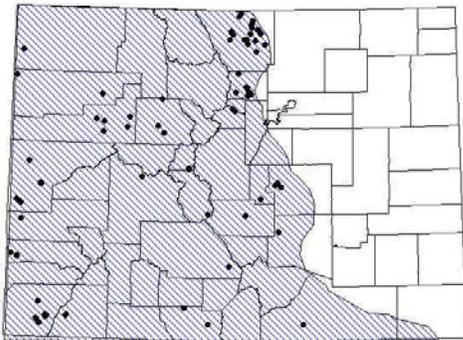
Class: Mammalia
Order: Chiroptera
Family: Vespertilionidae
Genus: *Corynorhinus*

Taxonomic Comments: Also referred to as *Plecotus townsendii*.

CNHP Ranking: G4T4 S2

State/Federal Status: BLM sensitive

Habitat Comments: The occurrence of Townsend's big-eared bat is strongly correlated with the availability of caves or cave-like roosting habitat and population concentrations occur in areas with substantial surface exposures of cavity forming rock (e.g., limestone, sandstone, gypsum, or volcanic), and in old mining districts (Pierson et al. 1999). Hibernacula are generally selected based upon stable low temperatures and moderate airflow (CDOW 1984).



Distribution: Townsend's big-eared bat ranges throughout Colorado except on the eastern plains, and is found in mines, caves, and man-made structures up to 9,500 feet in elevation (CDOW 1984). It occurs in lower elevation, pinyon-juniper woodlands, semi-desert shrublands, and montane forests of the western U.S. south into Mexico (Fitzgerald et al. 1994). The distribution of this species also appears to be geomorphically determined (Pierson et al. 1999) and limited by the temperatures at roost sites (CDOW 1984). Currently only 11 maternity roosts and 30 hibernacula have been documented from Colorado (Pierson et al. 1999). Historical occurrences number about 350.

Important Life History Characteristics: This species is sedentary and no known long-distance migrations have been reported (Pierson et al. 1999). One study observed greater than 80% of individuals of this species returning to the same site in subsequent winters suggesting a high degree of site fidelity (Humphrey and Kunz 1976).

Known Threats and Management Issues: Abandoned mine closures, recreational caving, renewed mining at historic sites, toxic material impoundments, pesticide spraying, vegetation conversion, livestock grazing, and timber harvesting threaten this species (Pierson et al 1999).

Potential Conservation Areas supporting *Corynorhinus townsendii pallescens*:

Deep Creek
Horse Mountain

Plant Communities



Landscape view of montane communities in Eagle County. Photo by Cyndi Mosch.

Abies lasiocarpa /*Alnus incana*
subalpine fir /thinleaf alder

Global Rank: G5

Global Rank Comments: This is a common community on first- and second-order streams in the subalpine zone in all Rocky Mountain states.

State Rank: S5

State Rank Comments: This is a common community on first- and second-order streams above 9,000 feet in elevation. There are over 1000 miles of this type on Colorado's upper montane streams.

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) and *Salix drummondiana* (Drummond willow) grow in a thick band along the edge of the stream. At lower elevations, *Alnus incana* is more abundant than *Salix drummondiana*. At mid-elevations, the two shrubs can be codominant. At higher elevations, *Salix drummondiana* becomes dominant and *Alnus incana* drops out, forming the *Abies lasiocarpa*-*Picea engelmannii*/*Salix drummondiana* plant 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 1997).

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, Rio Grande and Routt National Forests (Richard *et al.* 1996, Kittel *et al.* 1999, Kettler and McMullen 1996), and Rocky Mountain National Park (Baker 1989).

Elevation Range in Colorado: 7200-10,300 ft (2200-3100 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).

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

Vegetation: *Picea engelmannii* (Engelmann spruce) and/or *Abies lasiocarpa* (subalpine fir) dominates the upper canopy with up to 80% cover, with *Picea engelmannii* present more often than *Abies lasiocarpa*. Other tree species occasionally present are up to 15% cover of *Populus angustifolia* (narrowleaf cottonwood), up to 20% cover each of *Picea pungens* (Colorado blue spruce) and *Pinus contorta* (lodgepole pine), and up to 1% cover of *Populus tremuloides* (aspen). *Abies concolor* (white fir) is present with up to 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 up to 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 franciscana* (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 include up to 25% cover of *Calamagrostis canadensis* (bluejoint reedgrass), 5-10% cover of *Carex disperma* (softleaf sedge), and up to 15% cover of *Glyceria* spp. (mannagrass). One plot had 43% cover of *Equisetum arvense* (field horsetail).

Successional and Ecological Processes: 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 at lower elevations (Padgett *et al.* 1989). This successional shift may be attributed to a lack of fire in the association (Manning and Padgett 1995).

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

The successional process of the spruce-fir forest is slow (200 + years). Some ecologists suggest that *Abies lasiocarpa* and *Picea engelmannii* are in equilibrium and form a stable climax community (Peet 1988). Others suggest that the two species coexist in non-equilibrium and that given enough time, either *Abies lasiocarpa* or *Picea engelmannii* will dominate the overstory (Aplet *et al.* 1988). Current literature suggests that the spruce-fir forest will never become a single-species dominated “climax” forest, but rather it is a perpetually changing mosaic of patches that are of different ages and composition. In addition, the successional dynamics of the forest is a complex interaction of the life history traits of spruce and fir, local site physical characteristics, and disturbance from fire, wind-throw or insect outbreak at both large (entire stand) and small (individual trees) scales.

Picea engelmannii has the potential to outlive *Abies lasiocarpa* by as much as 200 years (Aplet *et al.* 1988), but it has a much lower rate of establishment on the forest floor (Peet 1981). As the shorter-lived *Abies lasiocarpa* begin to die, a new generation of mostly *Abies lasiocarpa* seedlings establish, perpetuating a mixed stand (Peet 1981). On mesic sites, *Picea engelmannii* is faster-growing and will overtop *Abies lasiocarpa*. However, *Abies lasiocarpa* is more successful at establishing in the shade and on organic substrates (Peet 1988).

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).

Wind-throw 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. During population surges, the beetle infests larger areas of live trees, selectively attacking and killing individuals with diameters greater than 4 inches (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).

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 sensitivity to timber harvesting activities is due to high soil moisture content. Timber activity should be restricted to the driest sites. 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).

Potential Conservation Areas which support this community:

North Fork Fryingpan

Abies lasiocarpa/Mertensia ciliata
subalpine fir/mountain bluebells

Global Rank: G5

Global Rank Comments: This is a very common community on first- and second-order streams in the subalpine zone of all Rocky Mountain States.

State Rank: S5

State Rank Comments: This community occurs in all mountain ranges and national forests in Colorado, comprising approximately 2000+ miles in Colorado alone.

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* is nearly always present. Other forbs consistently present include *Cardamine cordifolia* (heartleaf bittercress), *Micranthes odontoloma* (brook saxafrage) 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 upslope species, can intergrade with this riparian plant association on the stream banks.

Regional Distribution: This association occurs in Montana, Utah (Padgett *et al.* 1989), New Mexico (Johnston 1987), and Colorado (Colorado Natural Heritage Program 1997).

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.* 1985, 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).

Elevation Range in Colorado: 8200-11,500 ft (2500-3500 m).

Site Geomorphology: This plant association occurs in narrow to wide valleys, 35-350 feet (10-100 m) wide, and is limited to the immediate stream channel edge and overflow areas. It usually establishes within 15 feet (5 m) of the channel and within 2 feet (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, G3), but can also be found along moderate gradient stretches (Rosgen's Channel Type: B2-B6).

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 feet (2 m), and is typically less than 3 feet (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: Either *Picea engelmannii* (Engelmann spruce) or *Abies lasiocarpa* (subalpine fir) is present, although they are not always present together. The tree canopy can be very thick, completely overhanging the stream, or it can be quite open, with a wide gap over the stream. Cover values range from 1-70% cover. There is generally very little shrub cover. *Vaccinium myrtillus* (Rocky Mountain whortleberry), can be abundant with 1-50% cover, however it was present in only 40% of the stands sampled. Other shrub species may be present (<30% frequency) include: *Salix drummondiana* (Drummond willow) (3-10% cover), *S. planifolia* (plane-leaf willow) (1-20% cover), *S. monticola* (yellow willow) (1-20% cover), *Alnus incana* ssp. *tenuifolia* (thinleaf alder) (2-24% cover), *Lonicera involucrata* (honeysuckle) (1-10%), and several *Ribes* species (currant)(1-10% cover).

The dense, mossy forb layer is the diagnostic part of this vegetation type. The forb layer is usually very narrow, often well under a meter wide (3 feet), clinging to, and undulating with, the side of the narrow stream channel. It is species rich with 20-80% total combined forb cover. No single forb species is consistently present in every stand, however a distinct suite of species are present in varying combinations. This suite of forb species include *Cardamine cordifolia* (bittercress) (present in 93% of stands with 1-50% cover), *Mertensia ciliata* (mountain

bluebells) (present in 86% of stands with 1-40% cover), *Senecio triangularis* (arrowleaf groundsel) (present in 81% of stands with 1-22% cover), *Oxypolis fendleri* (cowbane) (present in 79% of stands with 1-20%), *Micranthes odontoloma* (brook saxifrage) (present in 72% of stands with 1-20%), *Mitella pentandra* (bishops cap) (present in 57% of stands with 1-10% cover), *Streptopus amplexifolius* (twisted-stalk) (present in 53% of stands with 1-10%), and *Arnica cordifolia* (heartleaf arnica) (present in 45% of stands with 1-15%). A large variety of other forb and graminoid species are often present as well, with individual cover ranging from 1-10%.

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 a number of riparian *Abies lasiocarpa*-*Picea engelmannii* plant associations. Although *Abies lasiocarpa* and *Picea engelmannii* are not obligate riparian species, the two species strongly influence subalpine riparian ecosystems.

The successional process of the spruce-fir forest is slow (200 + years). Some ecologists suggest that *Abies lasiocarpa* and *Picea engelmannii* are in equilibrium and form a stable climax community (Peet 1988). Others suggest that the two species coexist in non-equilibrium and that given enough time, either *Abies lasiocarpa* or *Picea engelmannii* will dominate the overstory (Aplet *et al.* 1988). Current literature suggests that the spruce-fir forest will never become a single-species dominated “climax” forest, but rather it is a perpetually changing mosaic of patches that are of different ages and composition. In addition, the successional dynamics of the forest is a complex interaction of the life history traits of spruce and fir, local site physical characteristics, and disturbance from fire, wind-throw or insect outbreak at both large (entire stand) and small (individual trees) scales.

Picea engelmannii has the potential to outlive *Abies lasiocarpa* by as much as 200 years (Aplet *et al.* 1988), but it has a much lower rate of establishment on the forest floor (Peet 1981). As the shorter-lived *Abies lasiocarpa* begin to die, a new generation of mostly *Abies lasiocarpa* seedlings establish, perpetuating a mixed stand (Peet 1981). On mesic sites, *Picea engelmannii* is faster-growing and will overtop *Abies lasiocarpa*. However, *Abies lasiocarpa* is more successful at establishing in the shade and on organic substrates (Peet 1988).

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).

Wind-throw 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*). During population surges, the beetle infests larger areas of live trees, selectively attacking and killing individuals with diameters greater than 4 inches (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).

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).

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)

Potential Conservation Areas which support this community:

Cross Creek

Red Dirt Creek

Alnus incana* ssp. *tenuifolia*-*Cornus sericea
thinleaf alder-red-osier dogwood

Global Rank: G3G4

Global Rank Comments: This plant association is widespread throughout the Rocky Mountains. However, all of the occurrences are small and threatened by improper grazing and stream impoundments. The double rank indicates the total number of estimated occurrences is thought to be between 20 and 100.

State Rank: S3

State Rank Comments: There are less than 100 stands of this plant association in Colorado. This association is threatened by improper livestock grazing, stream impoundments, and heavy recreational use.

General Description and Comments: The *Alnus incana* ssp. *tenuifolia*-*Cornus sericea* (thinleaf alder-red-osier dogwood) plant association is a narrow thicket of medium-to-tall shrubs lining the stream bank. It is an uncommon association restricted to small tributaries and narrow, constricted reaches of larger rivers. Due to heavy shading, there is usually a limited herbaceous understory.

Regional Distribution: This plant association occurs in Nevada, Utah (Padgett *et al.* 1989, Manning and Padgett 1995), and Colorado (Johnston 1987, Colorado Natural Heritage Program 1997).

Distribution in Colorado: This plant association occurs in the Yampa, Colorado, Gunnison, San Juan, Arkansas and Rio Grande River Basins (Johnston 1987, Kittel and Lederer 1993, Kittel *et al.* 1994, Kittel *et al.* 1995, Kittel *et al.* 1996, Richard *et al.* 1996, Kittel *et al.* 1999).

Elevation Range in Colorado: 6400-8600 ft. (2000-2600 m).

Site Geomorphology: This plant association occurs on narrow, rocky banks and benches of small channels as well as narrow, constricted reaches of larger rivers. It can also occur along overflow channels and narrow tributaries. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Stream channels are steep and narrow (Rosgen's Channel Type: A2, A3, A4), wider and moderately sinuous (Rosgen's Channel Type: B3, B4), or wider and highly sinuous (Rosgen's Channel Type: C2, C3).

Soils: Soils range from loamy sand to sandy clay loam. Mottling is evident at approximately 12 inches (30 cm) and gravel or cobble layers appear at 20-40 inches (50-100 cm) beneath the surface. In the Colorado River Basin, the soils classify as recently buried typic Cryaquolls, sandy typic Cryoborolls, Histisols, typic Cryaquents, loamy to clayey Cryofluvents and fragmental Cryaquents

Vegetation: This plant association is characterized by a dense thicket of shrubs dominated by 10-80% cover each of *Alnus incana* ssp. *tenuifolia* (thinleaf alder) and *Cornus sericea* (red-osier dogwood). *Salix exigua* is often present (42% frequency) with 1-10% cover. A wide variety of other shrub species may be present, but with < 37% frequency, including *Salix eriocephala* var. *ligulifolia* (strapleaf willow) (3-30%) and *Salix lasiandra* var. *caudata* (whiplash willow) (3-30%), *Salix monticola* (mountain willow) (1-20%), *Lonicera involucrata* (honeysuckle) (1-20%), *Rosa woodsii* (woods rose) (1-20%), *Betula occidentalis* (river birch) (3-20%), *Salix bebbiana* (Bebb willow) (8-70%), and *Rubus idaeus* (raspberry) (3-9%). One stand in the Yampa River Basin had 70% cover of *Salix bebbiana*. Tree species are scattered and not consistently present.

Forb cover is highly variable depending on the amount of light that penetrates through the canopy. Forb species include *Rudbeckia laciniata* (cutleaf coneflower) (1-20%) *Heracleum maximum* (cow parsnip) (1-17%), *Maianthemum stellatum* (false Solomon seal) (1-10%) and *Ozmorhiza depauperata* (blunt-fruit sweet cicely) (1-10%), *Ligusticum porteri* (southern ligusticum) (1-3%). Graminoid cover is usually low, but can include *Poa pratensis* (Kentucky bluegrass) (1-45%) and *Equisetum arvense* (meadow horsetail) (1-10%).

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* sp. 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 10 to 150 times that 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.

In Colorado, the *Alnus incana* ssp. *tenuifolia*-*Cornus sericea* (thinleaf alder-red-osier dogwood) plant association is tolerant of flooding and requires a high water table each spring. It appears to be a stable, long-lived association where succession to other types can be very slow (Manning and Padgett 1995).

Management: *Alnus incana* ssp. *tenuifolia* (thinleaf alder) is not particularly palatable to livestock, but can be trampled as animals search for more palatable forb species (Hansen *et al.* 1995). *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. However, dense stands of *Alnus incana* ssp. *tenuifolia* and *Cornus sericea* hinder livestock access. Season-long grazing reduces the native forb cover and allows non-native grasses to increase (Padgett *et al.* 1989, Hansen *et al.* 1995).

According to Hansen *et al.* (1995), most fires kill *Alnus incana* (thinleaf alder) dominated stands, resulting in a sparse herbaceous understory and bank destabilization due to root death. *Cornus sericea* can survive all but the hottest fires. After fire, new shoots sprout from the surviving rhizomes (Hansen *et al.* 1995). Frequent fire may shift this community to *Cornus sericea* dominated types.

Both *Alnus incana* ssp. *tenuifolia* and *Cornus sericea* are capable of sprouting and have rhizomatous roots which provide good stream bank stabilization. *Alnus incana* ssp. *tenuifolia* sprouts quickly when cut at 4-5 year intervals. Cutting in spring and winter results in rapid sprouts. Cutting in the summer results in fewer, slow-growing sprouts. The rapid growth following direct seeding or transplanting allows this shrub to quickly establish on streambanks (Hansen *et al.* 1995). *Alnus incana* ssp. *tenuifolia* and *Cornus sericea* may be useful for revegetating higher gradient streams where seasonal, scouring floods occur (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

Colorado River

***Alnus incana* /Mesic Forbs**
thinleaf alder/Mesic Forbs

Global Rank: G3G4Q

Global Rank Comments: This plant association was once common and widespread, but is now declining. This association is rarely found in good condition without non-native species in the undergrowth. Because this community can change significantly with improper grazing, this plant association may not be recognized as the same type across state lines, and thus the taxonomy is in question (a Q in the rank).

State Rank: S3

State Rank Comments: There are over 30 documented occurrences of this plant association in Colorado. However, non are very large and only one or two are in pristine condition. All stands are highly threatened by improper livestock grazing, stream flow alterations, road and railroad improvements and maintenance, and heavy recreational use.

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 m²), stands with the native herbaceous undergrowth intact are uncommon.

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 Cottrell 1990, Johnston 1987, Colorado Natural Heritage Program 1997).

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, Kittel *et al.* 1999, Colorado Natural Heritage Program 1997).

Elevation Range in Colorado: 6400-9600 ft (2000-2900 m).

Site Geomorphology: This plant association occurs along narrow, 130-230 feet (40-70 m) wide, alluvial benches and terraces of canyons and valleys. It also occurs as narrow bands in wider valleys, greater than 400 feet (>120 m), and occasionally forms a wide band on the floodplain. Stream channels 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, G4) 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).

Soil: Soils are well drained silt loams, loams, sandy clay loams, sandy loams, or sand. 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 feet) shrub canopy with 20-95% cover. Other shrubs can be present, although no single species is consistently so. Shrub species include: *Salix drummondiana* (Drummond willow) (1-20%), *Rosa woodsia* (woods rose) (1-70%), *Salix monticola* (mountain willow) (1-10%), *Salix lasiandra* var. *caudata* (whiplash willow) (1-32%), *Lonicera involucrata* (honeysuckle) (1-30%), *Ribes inerme* (current) (1-30%), *Salix geyeriana* (Geyer willow) (1-30%), *Salix bebbiana* (Bebb willow) (1-11%), and *Ribes montegeum* (gooseberry currant) (2-31%). A few trees may be present along the edges of the stand including *Picea engelmannii* (Engelmann spruce) (1-13%), *Populus tremuloides* (quaking aspen) (1-20%), and *Populus angustifolia* (narrowleaf cottonwood) (8-21%).

The ground is generally very wet and covered with tall, 3-7 feet (1-2 m), forbs and graminoids. Forb cover is high in undisturbed stands, with total cover often exceeding 60%. Dominant forb species include *Heracleum maximum* (cow parsnip) (1-70%), *Angelica ampla* (giant angelica) (3-45% cover), *Aconitum columbianum* (monk's hood) (1-14% cover), *Mertensia ciliata* (mountain bluebells) (1-19% cover) and *Rudbeckia laciniata* (cutleaf coneflower) (3-20% cover), *Viola canadensis* (Canada violet) (1-7%), and *Streptopus amplexifolius* (twisted stalk) (1-10%). Graminoid species include *Glyceria striata* (mannagrass) (1-11%), *Calamagrostis canadensis* (bluejoint reedgrass) (1-20%), *Carex utriculata* (beaked sedge) (1-6%), and *Carex microptera* (small-wing sedge) (1-10%). A dense cover of up to 30% *Equisetum arvense* (field horsetail) and up to 10% cover each of *Equisetum pratense* (meadow horsetail) and *Hippochaete hyemalis* (scouring rush) may also 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* sp. 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 10 to 150 times the amount 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.

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).

Potential Conservation Areas which support this community:

Castle Peak
Colorado River

Artemisia tridentata/Leymus cinereus
big sagebrush/Great Basin wild rye

Global Rank: G2G3

Global Rank Comments: This association is known from eastern Oregon to northwestern Colorado. It is highly threatened by improper livestock grazing and fire suppression/prevention practices.

State Rank: S1

State Rank Comments: This association is known only to occur in northwestern Colorado. It is documented on two streams, but is expected to occur in at least two or three more locations. It is highly threatened by improper livestock grazing and fire suppression/ prevention practices.

General Description and Comments: The *Artemisia tridentata/Leymus cinereus* (big sagebrush/Great Basin wild rye) plant association is a transitional community found along the edges of washes and gullies of the high desert steppe. It is generally narrow and confined to stream benches of low flood plain areas. Fire and the seasonally high water tables play important roles in maintaining a high cover of *Leymus cinereus*.

Regional Distribution: This plant association occurs in Oregon, Idaho, southwestern Wyoming (Johnston 1987) and Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: This plant association is found in northwestern Colorado and Arapaho National Forest (Kittel *et al.* 1994, Hess 1981).

Elevation Range in Colorado: 6200-8375 ft. (1860-2513 m).

Site Geomorphology: The *Artemisia tridentata/Leymus cinereus* (big sagebrush/Great Basin wild rye) plant association occurs on upper terraces and side slopes of narrower valleys. It occupies more mesic sites than adjacent *Artemisia* spp. (sagebrush) shrublands. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Streams are narrow, incised and steep (Rosgen's Channel Type: G4). **Soil:** The soils are relatively deep sandy clay loams.

Vegetation: This plant association is dominated by 15-90% cover of *Leymus cinereus* (Great Basin wild rye) while *Artemisia tridentata* (big sagebrush) occurs at the edges of the stands with 5-30% cover. If the stand has been burned recently, the shrubs are few and far between. Without burning, the shrub cover will become higher, and the shrubs invade the grassland, making the association a shrubland. A few other forb and graminoid species that may be present include: *Pascopyron smithii* (western wheat grass) (10%), *Bromus inermis* (smooth brome) (10%), *Hordeum jubatum* (foxtail barely) (3%), *Mentha arvensis* (field mint) (3%), and *Ipomopsis aggregata* (scarlet gilia) (1%).

Succession and Ecological Processes: The maintenance of high cover of *Leymus cinereus* depends on seasonally high water tables. Since this plant association occurs in low rainfall and low stream flow areas, if the water table drops, *Leymus cinereus* will not survive.

The natural fire frequency for the *Artemisia tridentata/Leymus cinereus* (big sagebrush/Great Basin wild rye) plant association is 20-30 years (Baker 1982). Fire appears to maintain pure stands of *Leymus cinereus* (Great Basin wild rye) because *Artemisia tridentata* (big sagebrush) does not sprout after burning. If a natural fire frequency is not maintained, stands will revert to an *Artemisia tridentata* dominated shrubland (Baker 1982).

Management: Livestock grazing of the *Artemisia tridentata/Leymus cinereus* (big sagebrush/Great Basin wild rye) plant association decreases the cover of palatable, native grasses and results in an increase of exotic species such as *Bromus tectorum* (cheatgrass) and *Poa pratensis* (Kentucky bluegrass) (Baker 1982). Although *Leymus cinereus* is coarse and unpalatable most of the year, its spring and fall growth is palatable and can be easily damaged by heavy grazing (Hansen *et al.* 1988). Overgrazing can cause an increase in the density of *Artemisia tridentata* which is considered undesirable for livestock and elk, but can be desirable for sheep and deer. In the winter, *Artemisia tridentata* can be an important winter browse species for sheep, cattle and big game due to its high fat content

(USDA 1976). However, *Leymus cinereus* needs summer and winter rest periods from grazing to replenish its root reserves.

Fire may be an effective management tool for increasing the cover of *Leymus cinereus* while decreasing the cover of *Artemisia tridentata*. Fire has been used for many years to control *Artemisia tridentata* since this species does not sprout after burning (Branson 1985). However, prescribed burning can increase the amount of annual exotic grasses if soils are dry or disturbed after burning. *Leymus cinereus*, which is generally resistant to fire, may be damaged when soils are dry (Hansen *et al.* 1988). Prescribed burning should be used when soil moisture is relatively high and at sites that have remnants of palatable grasses. Livestock should be excluded from burned areas to prevent premature utilization of palatable grasses and to allow root reserve build-up (USDA 1988).

Leymus cinereus can be an effective stream bank stabilizer with its well-developed, fibrous root system (Hansen *et al.* 1988). *Artemisia tridentata* is not particularly useful in stabilizing stream banks (Manning and Padgett 1995). This shrub has a prominent tap root and diffuse root system, a root structure not adapted for holding soil. Also, *Artemisia tridentata* is generally restricted to well-drained soils (Caldwell 1978) and is frequently killed by flooding or the rise of the water table above the subsoil horizon (USDA 1988).

Leymus cinereus is useful for seeding disturbed sites (Hansen *et al.* 1988). However, *Artemisia tridentata* is very effective in competing for water sources in relatively dry areas and may out compete newly seeded grasses (Caldwell 1978)

Potential Conservation Areas which support this community:
Colorado River Seeps

***Betula occidentalis*/Mesic Forbs**
river birch/Mesic Forbs

Global Rank: G3

Global Rank Comments: This association is well documented in the western states.

State Rank: S2

State Rank Comments: In Colorado, fewer than thirty stands are documented, and while more are estimated to occur, this association is highly threatened by development, including that of roads.

General Description and Comments: The *Betula occidentalis*/Mesic Forbs (river birch/Mesic Forbs) 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.

Regional Distribution: The *Betula occidentalis*/Mesic Forbs (river birch/Mesic Forbs) plant association occurs in Nevada (Manning and Padgett 1995), Utah (Padgett *et al.* 1989), and Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: This association occurs in the Gunnison River (Kittel *et al.* 1995), Colorado River (Kittel *et al.* 1994), and Rio Grande and Closed Basins (Colorado Natural Heritage Program 1997). It also occurs along the Colorado Front Range and in the Arkansas River Basin (Cooper and Cottrell 1990, Kittel *et al.* 1996).

Elevation Range in Colorado: 6400-8800 ft (2000-2700 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.

Soil: Soils are fairly shallow, ranging from 12 to greater than 25 inches (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 inches (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 that may be present (in order of decreasing frequency) include: *Alnus incana* spp. *tenuifolia* (thinleaf alder) (1-40%), *Cornus sericea*, (red-osier dogwood) (1-37%), *Salix exigua* (coyote willow) (1-16%), *Jamesia americana* (cliff jamesia) (5-21%), *Amelanchier utahensis* (Utah serviceberry) (20%), *Prunus virginiana* (chokecherry) (1-17%), and *Salix monticola* (Rocky Mountain willow) (1-14%). Along narrow valleys at higher elevations, conifers may overhang the stream edge, thus appearing (according to the stand table) to be within the *Betula* shrubland, when in reality they occur on adjacent, higher ground. Conifer species include: *Pseudotsuga menziesii* (Douglas-fir) (1-66%), *Abies lasiocarpa* (subalpine fir) (30%), *Picea pungens* (Colorado blue spruce) (8-20%), and *Pinus ponderosa* (ponderosa pine) (7-17%).

Due to the dense shrub canopy, herbaceous undergrowth is usually limited (<10% cover). However, some stands have considerable herbaceous cover. Forb cover can include species such as: *Maianthemum stellatum* (false Solomon seal) (1-40% cover), *Heracleum maximum* (cow parsnip) (1-34%), *Thalictrum fendleri* (Fendler meadowrue) (1-21%), and *Rudbeckia laciniata* (cutleaf coneflower) (1-10%). Graminoid cover is usually low, but can include: *Poa pratensis* (Kentucky bluegrass) (1-34%), *Equisetum arvense* (horsetail) (1-23%), *Carex utriculata* (beaked sedge) (1-23%), *Juncus balticus* (Baltic rush) (1-17%), *Calamagrostis canadensis* (Canadian reedgrass) (1-14%), *Agrostis stolonifera* (red-top) (4-13%), and *Phleum pratense* (timothy) (10%). An abundance of non-native grass species is considered an indication of past or current heavy grazing.

Successional and Ecological Processes: The *Betula occidentalis*/Mesic Forbs (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 Forbs plant association exist today.

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).

Potential Conservation Areas which support this community:

Colorado River

***Betula occidentalis*/Mesic Graminoids**
river birch/Mesic Graminoids

Global Rank: G3

Global Rank Comments: This association is well documented in several western states, however, it remains threatened by improper livestock grazing, stream flow alterations, and heavy recreational use.

State Rank: S2

State Rank Comments: In Colorado, fewer than ten stands have been documented, however twenty to thirty stands are estimated to occur. It is threatened by poor livestock management, stream flow alterations, and heavy recreational use.

General Description and Comments: The *Betula occidentalis*/Mesic Graminoids plant association is a tall (5-8 ft., 1.5-2.5 m), narrow band of shrubs lining a stream channel. The undergrowth is a sparse to thick carpet of grasses and grass-like plants with only a few forbs present. It occupies wetter sites than the *Betula occidentalis*/mesic forb plant association. In Colorado, large, near pristine stands are rare.

Regional Distribution: This plant association occurs in Nevada (Manning and Padgett 1995) and Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: This association occurs in the San Juan National Forest (Richard *et al.* 1996) and in the San Miguel River Basin (Colorado Natural Heritage Program 1997).

Elevation Range in Colorado: 7700 ft. (2300 m).

Site Geomorphology: This plant association generally occurs on moderately wide to wide floodplains in bands up to 115 feet (35 m) wide, that often extend well away from the channel edge (Manning and Padgett 1995). This association also occurs in small patches at higher elevations and around seeps and isolated springs on hillslopes away from the valley bottom. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Stream channels are wide, meandering, and cobble-bottomed (Rosgen's Channel Type: C3).

Soil: Soils are deep pockets of sandy loams with signs of mottling within the top 12 inches (30 cm).

Vegetation: *Betula occidentalis* (river birch) forms a dense canopy of 40-60% cover, often associated with 10% cover of *Ribes inerme* (whitestem gooseberry) and <5% cover of *Salix bebbiana* (Bebb willow). *Alnus incana* (thin-leaf alder) may be present with as much as equal abundance as that of the birch. *Picea pungens* (Colorado blue spruce) and *Juniperus scopulorum* (Rocky Mountain juniper) can be present, but usually with low cover. Stands with a dense shrub canopy, have an herbaceous undergrowth that is limited in cover (<10%), but contain a diversity of species. Forb cover includes 1% cover each of *Achellia millefolium* (yarrow), *Cardamine cordifolia* (bittercress), *Heracleum maximum* (cow parsnip), *Maianthemum stellatum* (false Solomon's seal), and *Vicia americana* (American vetch). Graminoid cover, especially *Carex* (sedge) species, is high. *Carex lanuginosa* (woolly sedge) dominates with 40% cover. Other *Carex* species include <5% cover each of *Carex deweyana* (Dewey sedge) and *Carex utriculata* (beaked sedge).

Successional and Ecological Processes: The *Betula occidentalis*/Mesic Graminoids (river birch/Mesic Graminoids) plant association occupies wetter habitats than the *Betula occidentalis*/mesic forb plant association. According to Manning and Padgett (1995), stands dominated by *Carex lanuginosa* (woolly sedge) or *Carex deweyana* (Dewey sedge) indicate undisturbed sites. Grazing pressure can convert the native sedges to non-native grasses, including *Agrostis stolonifera* (redtop) and *Poa pratensis* (Kentucky bluegrass). In Utah, the presence of scattered deciduous and coniferous trees in the canopy of *Betula occidentalis* stands may indicate that the stand will become a tree-dominated type (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*. Because *Betula occidentalis* communities occupy low elevation, foothill habitats in Colorado, they are more threatened by development and stream impoundments than *Alnus incana* (thinleaf alder) or *Cornus sericea* (red-osier dogwood) riparian communities. Consequently, few undisturbed and unaltered stands exist today.

Management: With season-long grazing, non-native grasses, such as *Poa pratensis* (Kentucky bluegrass) and *Agrostis stolonifera* (redtop), may begin to dominate the undergrowth of this plant association. Improper livestock grazing can also reduce stream bank stability and cause sloughing. *Betula occidentalis* (river birch) 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).

Potential Conservation Areas which support this community:
Colorado River Seeps

Cardamine cordifolia-Mertensia ciliata-Senecio triangularis
heartleaf bittercress-mountain bluebells-arrowleaf groundsel

Global Rank: G4

Global Rank Comments: This association is common in the upper subalpine and lower alpine of the Colorado Rocky Mountains. It has not been reported outside of Colorado, but is expected to occur in similar habitats in other western states.

State Rank: S4

State Rank Comments: This association is found throughout Colorado.

General Description and Comments: The generally small stands of the *Cardamine cordifolia-Mertensia ciliata-Senecio triangularis* (heartleaf bittercress-mountain bluebells-arrowleaf groundsel) plant association are found in and near running water of small streams, seeps, and springs. Associated taxa may vary greatly with this plant association, but the dominance of *Cardamine cordifolia*, *Mertensia ciliata* or *Senecio triangularis* is clear. All of these species may be present or only one of the three.

Regional Distribution: This association occurs in Colorado (Johnston 1987, Komarkova 1976, Cooper 1993, Colorado Natural Heritage Program 1997) and is expected to occur throughout the western states.

Distribution in Colorado: This association occurs throughout upper subalpine areas and lower alpine areas in central and south-central Colorado (Sanderson and Kettler 1996, Johnston 1987, Komarkova 1976, Cooper 1993, Kittel *et al.* 1999, Colorado Natural Heritage Program 1997).

Elevation Range in Colorado: 9,000-12,300 ft. (2700-3800 m)

Site Geomorphology: Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). This association typically occurs on moderately steep to very steep first order streams (Rosgen's Channel Type: A2, A3), but can occur on less steep stream reaches as well (Rosgen's Channel Type: B2, B4). In many cases this habitat probably experiences a long period of snow cover (Sanderson and Kettler 1996).

Soils: Soils can be moderately deep (40 cm) sandy clay loam and sand, but in general are quite thin and skeletal

Vegetation: This association is a narrow band of forbs and mosses with one or more of the following three forb species being abundantly present: *Cardamine cordifolia* (bittercress) (1-70%), *Mertensia ciliata* (chiming bells) (1-62%) and/or *Senecio triangularis* (arrowleaf groundsel) (1-50%). All of these species may be present or only one of them. In addition, this type is always rich in forbs. Stands generally have at least fifteen species, and often have as many as 45 forb species present. A wide variety of forb species comprise this diversity, some can be quite abundant.

Other forb species include: *Saxifraga odontoloma* (brook saxifrage) (1-9%), *Mitella pentandra* (fivestar miterwort) (2%), *Oxypolis fendleri* (fendler cowbane) (1-8%), *Delphinium barbeyi* (tall larkspur) (1-30%), *Epilobium* spp. (willowherb) (1-7%), *Caltha leptosepala* (marsh marigold) (1-30%), *Geranium richardsonii* (geranium) (1-8%), *Arnica cordifolia* (pathfinder) (1-7%), *Conioselinum scopulorum* (hemlock parsley) (1-2%), *Sedum integrifolium* (rose crown) (1-30%), *Primula parryi* (1-13%) (primula), *Corydalis caseana* ssp. *brandegei* (Corydalis) (55%), *Senecio taraxacoides* (groundsel) (19%) *Heracleum maximum* (Cow parsnip) (14%), and *Ligusticum porteri* (Ligusticum) (9%), among others.

Successional and Ecological Processes: The *Cardamine cordifolia-Mertensia ciliata-Senecio triangularis* plant association appears to be a stable community. However, with excessive grazing by sheep, it may be converted to communities dominated by various increaser species (Padgett *et al.* 1989). Hansen *et al.* (1995) suggest this type of habitat is early-seral and experiences frequent fluvial depositions, keeping any invading conifers from advancing beyond the sapling stage.

Management: Perennial wet soils, steep gradients and a short growing season make this association vulnerable to heavy disturbance. Forage value and productivity is low for this community. Excessive grazing by sheep may convert this association to one dominated by various increaser species (Padgett *et al.* 1989). Wet soils are

susceptible to compaction and churning. If possible, it is best to keep livestock out of these very wet areas (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

East Lake Creek

Carex aquatilis

Water sedge Montane Grassland

Global Rank: G5

Global Rank Comments: This is a common association that is well documented throughout the western states.

State Rank: S4

State Rank Comments: This is a common association in Colorado. It is well documented throughout its range. Many stands are protected within National Park and Wilderness Area boundaries. However, many acres are improperly grazed by livestock and remain in severely degraded condition.

General Description and Comments: The *Carex aquatilis* is a common, wide spread plant association that can occur as large meadows in high montane valleys or as narrow strips bordering ponds and streams at lower elevations. It occurs in a variety of environmental settings in the montane and subalpine zones. A clear dominance by *Carex aquatilis* and low cover of *Carex utriculata* or *Pedicularis groenlandica* sets this plant association apart from closely related types.

Regional Distribution: This common type is widespread throughout the Rocky Mountain region. It occurs in Montana (Hansen *et al.* 1988), eastern Idaho, western Wyoming (Youngblood *et al.* 1985.), Utah (Johnston 1987, Padgett *et al.* 1989) and Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: The *Carex aquatilis* plant association has been reported from Arapaho-Roosevelt, White River, Routt, Gunnison , and Rio Grande National Forests (Kettler and McMullen 1996, Sanderson and Kettler 1996, Kittel *et al.* 1995, Kittel *et al.* 1996, Colorado Natural Heritage Program 1998), and from Rocky Mountain National Park (Johnston 1987).

Elevation Range in Colorado: 8100-11,400 ft. (2460-3500 m).

Site Geomorphology: This plant association occurs in a variety of valley types, but the largest expanses occur in broad, low-gradient valleys where large snow-melt fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins on lakes and beaver ponds. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). The largest occurrences are found adjacent to narrow, deep, sinuous streams (Rosgen's Channel Type: E4, E5, E6). Some stands occur along steep streams (Rosgen's Channel Type: A3), others along wide, shallow streams (Rosgen's Channel Type: B3), as well as where beaver dams and ponds have altered the channel morphology.

Soils: Soils are mostly deep, dark colored heavy clays, silts or organic layers over more skeletal layers. Soils are often saturated to the surface, and if not, mottling is commonly present within 10 cm of the surface.

Vegetation: This plant association is characterized by a dense rhizomatous meadow of *Carex aquatilis* (water sedge) (10-80%), usually accompanied by a few other graminoids species such as *Calamagrostis canadensis* (Canadian reedgrass) (1-40%) or *Deschampsia cespitosa* (tufted hairgrass) (1-16%). *Eleocharis quinqueflora* (spikerush) can be abundant on organic substrates (1-49%). *Carex utriculata* (beaked sedge) was present in 38% of the stands sampled stands with 1-20% cover. When present, *Carex utriculata* is usually not more than one third the cover of *Carex aquatilis* (aquatic sedge) cover. If it is more than that, the stand may be a *Carex aquatilis*-*Carex utriculata* or *Carex utriculata* plant association. Forbs are often present, although sometimes inconspicuously. Species include: *Epilobium* spp. (willowherb) (1-3%), *Pedicularis groenlandica* (elephant head) (1-5%), *Caltha leptosepala* (marsh marigold) (1-48%), *Cardamine cordifolia* (bittercress) (1-3%), *Mertensia ciliata* (chiming bells) (1-39%),

Successional and Ecological Processes: Presence of *Carex utriculata* may indicate the site has progressed from the more wet *Carex utriculata* community to less mesic conditions, and may become dominated by *Salix planifolia* or *Salix wolfii* (Youngblood *et al.* 1985). Wilson (1969) reports that *Carex aquatilis* associations trap sediment from overbank flows which forms a clay pan, eventually raising the water table. This process drives retrogressive succession and a plant association dominated by *Carex utriculata* takes over on these sites (Wilson 1969).

Management: The *Carex aquatilis* plant association occurs on soils that are typically wet throughout the growing season, and livestock grazing can often cause compaction, pitting and hummocking of the soil (Padgett *et al.* 1989). *Carex aquatilis* is highly palatable to cattle and horses and provides valuable source of forage (Youngblood *et al.* 1985). Kovalchik and Elmore (1992) suggest early-spring grazing of sedge dominated systems, with later-season rest to allow for root reserve buildup.

Overgrazing by livestock can dry the site, increase non-native grass cover, and reduce the vigor of root structure. 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 if there are adjacent willows, they 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 damaging young, palatable regrowth and to allow for root reserve build up. Prescribed burning is also an effective method of rejuvenating decadent clumps 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).

Potential Conservation Areas which support this community:

Cross Creek

Carex aquatilis*–*Carex utriculata

water sedge-beaked sedge montane grassland

Global Rank: G3G4

Global Rank Comments: This is a common community, well documented throughout the western states.

State Rank: S4

State Rank Comments: In Colorado, over one hundred stands have been documented and many are protected within National Parks or Wilderness Areas.

General Description and Comments: This plant association is recognized by the presence of both *Carex aquatilis* and *Carex utriculata* in roughly equal proportions. This is 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.

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 1991, Hess and Wasser 1982, Colorado Natural Heritage Program 1997). 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 1991, Richard *et al.* 1996, Colorado Natural Heritage Program 1997).

Elevation Range in Colorado: 8200-11,100 ft. (2500-3400 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 often associated with beaver activity. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Stream channels are narrow, deep, and sinuous (Rosgen's Channel Type: E4, E6), or wide and shallow (Rosgen's Channel Type: B2 and B4). **Soil:** Soils are often organic, thick peat 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) (10-90%) and *Carex utriculata* (beaked sedge) (10-40%) co-dominate the association. 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 graminoid and forb species may also be present. Graminoid species include: *Carex microptera* (small-winged sedge) (1-10%), *Carex rossii* (Ross sedge) (20-50%), *Deschampsia cespitosa* (tufted hairgrass) (1-40%) *Poa pratensis* (Kentucky bluegrass) (1-11%), *Juncus balticus* (arctic sedge) (1-8%), *Carex nebrascensis* (Nebraska sedge) (35%), and *Carex canescens* (pale sedge) (10%). Forb species include: *Caltha leptosepala* (marsh marigold) (3-20%), *Sedum rhodanthum* (pink stonecrop)(1-10%), *Cardamine cordifolia* (bittercress) (1-3%), *Senecio triangularis* (arrowleaf groundsel) (1-3%), *Pedicularis groenlandica* (Elephant's head) (1-3%), *Epilobium* spp. (willow herb) (1%), and *Sedum rhodanthum* (pink stonecrop) (1-10%).

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 more often on rich Histisols, while *Carex utriculata* occurs on less nutrient rich soils. Richard *et al.* (1996) and Padgett *et al.* (1989) note that pure stands of *Carex utriculata* tend to occur on mineral soils with some organic epipedons.

Water availability appears to be a stronger factor in determining relative dominance of these two sedge species. *Carex utriculata* appears to tolerate standing water and may be a pioneering species since it readily establishes on exposed, saturated mineral soil (Padgett *et al.* 1989, Hansen *et al.* 1988). In Colorado, *Carex utriculata* occurs more

often in standing water and often grades into a mesic terrestrial habitat where *Carex aquatilis* is commonly dominant. The *Carex aquatilis*-*Carex utriculata* plant association may, therefore, represent a spatial transition between a wet *Carex utriculata* association and a mesic *Carex aquatilis* association.

Management: Palatable *Carex* (sedge) species can be heavily utilized by livestock in riparian areas in mid- to high-elevation rangelands. 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 regrowth. Late summer and fall grazing is not recommended if there are adjacent willow shrublands, as willow species are vulnerable to pruning damage (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 and 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 raise 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 would best be removed for the year prior to burning and for at least 2-3 years after to prevent damage to 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).

Potential Conservation Areas which support this community:

North Fork Fryingpan

Carex utriculata

Beaked sedge

Global Rank: G5

Global Rank Comments: This association is well documented throughout the western states.

State Rank: S4

State Rank Comments: This association is well documented throughout its habitat in Colorado.

General Description and Comments: : The *Carex utriculata* (beaked sedge) plant association is 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 water table is usually near the surface for most of the growing season.

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 1997).

Distribution in Colorado: This plant association occurs in Rocky Mountain National Park, the Roosevelt, Arapaho, White River, Routt, Gunnison 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 1997).

Elevation Range in Colorado: 7500-9600 ft (2300-2900 m).

Site Geomorphology: *Carex utriculata* (beaked sedge) grows in standing water or saturated soils of wet swales and overflow channels along low-gradient streams. It also occurs along the margins of lakes and beaver ponds. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Stream channels are wide and slightly sinuous (Rosgen's Channel Type: B5 and B6), to wide and more sinuous (Rosgen's Channel Type: C6)

Soils: Soils are saturated organics or fine silty clays to clays over cobbles and alluvium. Mottling often occurs within a few centimeters of the surface. In the Colorado River Basin, the soils classify as very-fine clayey-to-loamy skeletal calcareous Cumulic or Typic Cryaquolls, Aquepts, fine-loamy and sandy-skeletal Typic Cryaquepts, and Histic Cryaquepts.

Vegetation: This plant association is characterized by stands dominated by *Carex utriculata* (beaked sedge) with cover ranging from 20% to 99%. Stands often appear to be nearly pure *Carex utriculata*, but a variety of other graminoid species may be present as well. Other *Carex* (sedge) species present include *C. lenticularis* and *C. microptera* (small-wing sedge), but usually with low cover (1-30%) relative to the amount of *Carex utriculata* (beaked sedge) present. Other graminoid species that may be present include: *Glyceria striata* (fowl mannagrass), *Calamagrostis canadensis* (Canadian reedgrass), and *Juncus balticus* (mountain rush). Forb cover is very inconspicuous and can include: *Mentha arvensis* (field mint), *Mimulus guttatus* (monkey flower), and *Geum macrophyllum* (broad-leaved geum) (1-20%).

Willow carrs (shrublands) are often adjacent to, and a few scattered willows will occur within, the *Carex utriculata* (beaked sedge) stand. Individual willows tend to be very short if present, either from limiting growth conditions (extremely cold and/or extremely wet), or because of heavy browsing by wildlife or livestock. Willow species observed in and adjacent to *Carex utriculata* (beaked sedge) stands include: *Salix monticola* (mountain willow), *S. drummondiana* (Drummond willow), *S. geyeriana* (Geyer willow), *S. planifolia* (planeleaf willow) and *S. exigua* (coyote willow), depending on the elevation of the site.

Successional and Ecological Processes: The *Carex utriculata* plant association occurs on the wettest sites of the riparian or wetland area, such as low-lying swales, and shallow margins of lakes and ponds, often in standing water. It is an early-seral community 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 will 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 *C. aquatilis* (Cooper 1986).

Successional shifts in species composition can be initiated by a change in the physical environment of the riparian area. Flooding events can result in sediments deposited on the floodplain, raising the surface higher above the water table (Cooper 1986). As aggradation, or build up, of the floodplain proceeds, the site can become drier and the dominant graminoid cover changes.

Abandoned beaver ponds also go through a similar succession. With time, ponds become silted-in and *Carex utriculata* establishes on the new, saturated substrate. As the site becomes firm and raised above the old pond level, *Carex aquatilis* and willows may become established. With further aggradation and time *Calamagrostis canadensis* may become established in the undergrowth. Depending on site characteristics, various willow species may become established in the overstory as well, creating the *Salix monticola/Carex utriculata* plant association and the *Salix geyeriana/Calamagrostis canadensis* plant association, for example.

Distance from the stream channel can also differentiate the graminoid dominance spatially within the riparian mosaic. *Carex utriculata* commonly occurs at the stream channel edge where the water table is close to or at the ground surface. As the floodplain surface becomes higher with increased distance from the channel edge, the ground becomes slightly less saturated and shifts to mesic meadows of *Carex aquatilis*, or on higher surfaces, to slightly drier meadows of *Calamagrostis canadensis* (Kittel 1994).

Management: *Carex utriculata* generally occupies the wettest habitats in the riparian 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 a 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 (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. 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).

Potential Conservation Areas which support this community:

Fall Creek

Danthonia intermedia
montane grassland

Grank: G3G4
Srank: S3S4

General Description: The *Danthonia intermedia* (timber oatgrass) community occurs in subalpine or alpine dry, windswept environments. This habitat usually has shallow soils, often derived from colluvial or glacial parent material. The community is dominated by *Danthonia intermedia* and *Deschampsia cespitosa* (tufted hairgrass). There are typically a long list of other grasses sedges and forbs present which may each reach a total of 40%. Shrubs and bare ground are rare (Johnston et al. 1999).

Regional Distribution: This community is only reported from Colorado at this time.

Distribution in Colorado: Currently, it is only documented from Eagle County.

Elevation Range in Colorado: It is found between 11,000-12,000 feet.

Management Comments: Typically these sites are unsuitable for roads, trails and developments due to the high winds. Heavy grazing by cattle, sheep, deer, or elk decreases graminoid cover and increases bare soil (Johnston et al. 1999).

Potential Conservation Areas which support this community:
East Lake Creek

Deschampsia cespitosa
tufted hairgrass

Global Rank: G4

Global Rank Comments: This is a common association that is well documented throughout its range.

State Rank: S4

State Rank Comments: This is a common association in Colorado, however few pristine stands have been documented. It is threatened by improper livestock grazing, invasion by non-native species, and reduced fire frequency.

General Description and Comments: This dense, bunch-grass meadow occurs in broad, nearly flat, valley bottoms in openings of willow carrs and coniferous forests in subalpine regions across Colorado. It is characterized by uniform to patchy cover of *Deschampsia cespitosa* (tufted hairgrass) with minor cover of other graminoids and forbs. Drier phases of this association grows on gentle slopes above the valley floor.

Regional Distribution: This plant association occurs in Oregon, Washington (Dyrness 1973, as cited in Hansen *et al.* 1995), Nevada (Manning and Padgett 1995), Montana (Hansen *et al.* 1995, Cooper *et al.* 1997), Idaho, Wyoming (Youngblood *et al.* 1985, Girard *et al.* 1995), Utah (Padgett *et al.* 1989), and Colorado (Johnston 1987, Colorado Natural Heritage Program 1997).

Distribution in Colorado: This plant association has been documented from the White River Basin (Kittel *et al.* 1994), the Colorado River Basin (Sanderson and Kettler 1996), and the Routt, San Juan, and Rio Grande National Forests (Kettler and McMullen 1996, Richard *et al.* 1996, Kittel *et al.* 1999).

Elevation Range in Colorado: 9000-12,300 ft (2800-3800 m).

Site Geomorphology: This meadow plant association generally occurs in broad, glaciated valleys on well-drained ridges and hummocks adjacent to low-to-moderate gradient streams. It occurs on sites with a moderately-high water table (indicated by the presence of mottles or gleying in the soil at a depth of 8 in, 20 cm) and other environmental conditions similar to the *Carex aquatilis* (water sedge) and *Carex utriculata* (beaked sedge) plant associations. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Stream channels are wide and moderately sinuous (Rosgen's Channel Type: C4) or narrow and highly sinuous (Rosgen's Channel Type: E6).

Soils: Soils are a shallow to deep organic layer over stratified sandy or silty loams and loamy sands. Mottles and/or gleying may be present below 50 inches (20 cm) depth.

Vegetation: This plant association is a meadow dominated by *Deschampsia cespitosa* (tufted hairgrass) (13-70%). Other graminoids may be abundant depending on local conditions, but no one species is consistently present. These include *Carex aquatilis* (water sedge) (1-50%), *Carex utriculata* (beaked sedge) (1-20%), and *Calamagrostis canadensis* (bluejoint reedgrass) (6-10%). Forb cover is highly variable, *Caltha leptosepala* is the most present in almost all stands with 1-45% cover. Other forbs often, but not always, present include: *Ranunculus alismifolius* (buttercup), *Sedum rhodanthum* (rose crown), *Veronica wormskjoldii* (speedwell), and *Pedicularis groenlandica* (elephants head). Occasionally, a few shrub stems from adjacent stands occur within this association, including *Pentaphylloides floribunda* (shrubby cinquefoil), *Salix planifolia* (planeleaf willow), and *Salix brachycarpa* (barrenground willow).

Successional and Ecological Processes: The *Deschampsia cespitosa* (tufted hairgrass) plant association can continue to occupy sites indefinitely under relatively stable conditions (Manning and Padgett 1995). *Deschampsia cespitosa* occurs along a broad moisture gradient from mesic and dry-mesic environments to those that are very wet (Padgett *et al.* 1989). As sites become drier, *Deschampsia cespitosa* cover gradually decreases and *Pentaphylloides floribunda* (shrubby cinquefoil) cover may increase on sites with well-drained soils. In contrast, if a site becomes wetter, *Carex* (sedge) species may become dominant (Girard *et al.* 1995).

The absence of native increaser species such as *Juncus balticus* (mountain rush) and exotic species such as *Poa pratensis* (Kentucky bluegrass) and *Taraxacum officinale* (dandelion) may indicate low disturbance conditions (Padgett *et al.* 1989). As disturbance levels increase, *Poa pratensis* may replace *Deschampsia cespitosa*. Many subalpine areas now dominated by *Poa pratensis* may have supported *Deschampsia cespitosa* communities (Padgett *et al.* 1989).

Sheep grazing in the alpine areas of Montana appear to increase the abundance of *Poa pratensis* (Kentucky bluegrass) and *Juncus balticus* (mountain rush) in moist and wet sites, indicating these areas are most susceptible to alteration of species composition from grazing (Cooper *et al.* 1997).

Management: *Deschampsia cespitosa* (tufted hairgrass) is highly palatable to livestock and is therefore, subject to heavy grazing pressure. To maintain vigor and prevent damage to soils and vegetation, grazing should be deferred until soils dry and grazing levels should be light to moderate. On moderately disturbed sites, livestock grazing should take place after surface soils have dried and after maturation of the seed heads. On more severely disturbed sites, intensive rehabilitation is required when there is a high cover of exotic and increaser species. Rest periods from grazing are necessary in order to provide time for plant regrowth (Hansen *et al.* 1995). *Deschampsia cespitosa* can be relatively resistant to extensive trampling (Rich McEldowney, Colorado State University Range Ecosystem Science graduate student, *personnel communication*). On the Rio Grande National Forest, *Deschampsia cespitosa* (tufted hairgrass) has been observed to increase for a time under moderate to heavy grazing, but then become reduced and eventually replaced by *Poa pratensis* (Kentucky bluegrass) (Dean Erhard, Forest Ecologist, *personnel communication*).

Deschampsia cespitosa is relatively resistant to fire. However, with repeated burning, rhizomatous species such as *Poa pratensis* (Kentucky bluegrass) may be favored. Livestock grazing should be deferred immediately after burning in order to protect the young, palatable regrowth (Hansen *et al.* 1995).

The typically wet soils of this plant association are easily compacted by vehicles and livestock use (Padgett *et al.* 1989). *Deschampsia cespitosa* is not very useful as a stream bank stabilizer due to its fibrous root structure. However, this is a useful species for revegetation and mine reclamation efforts (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

East Lake Creek

Eleocharis quinqueflora
fewflower spikerush

Global Rank: G4

Global Rank Comments: This is a common association of upper subalpine elevations. It is widespread and is well documented throughout the western states.

State Rank: S3S4

General Description and Comments: The *Eleocharis quinqueflora* (fewflower spikerush) plant association is a uniform peatland community found in upper subalpine and lower alpine wetlands. It is easily recognized by its homogeneity, the presence of few species (usually little more than *Eleocharis quinqueflora* and *Carex aquatilis*), and the sparse nature of the vegetation growth.

Regional Distribution: This plant association occurs in Utah (Johnston 1987, Padgett *et al.* 1989), Montana (Hansen *et al.* 1995), northeastern Nevada, eastern California (Manning and Padgett 1995) and Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: This plant association is documented from the Routt National Forest (Kettler and McMullen 1996, Johnston 1987), the Colorado River Basin (Kittel *et al.* 1994), the Gunnison and San Juan National Forests (Johnston 1987, Richard *et al.* 1996), and the Front Range (Komarkova 1976, Cooper 1990a).

Elevation Range in Colorado: 9200-12,300 ft. (2800-3800 m).

Site Geomorphology: The *Eleocharis quinqueflora* (fewflower spikerush) plant association occurs in high elevation, marshy meadows associated with seeps where the water table is at the soil surface. Valley bottoms are moderately wide to wide and usually have a gentle to moderate gradient (0.4-6%). Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Adjacent stream channels are narrow and sinuous headwater rivulets (Rosgen's Channel Type: E4-5) with lateral seepage from surrounding toe slopes.

Soils: This association occurs on peat (Cryochemists) occasionally as deep as 7 feet (2 m). According to Cooper (1990a), the soils remain saturated throughout the growing season and may not be very rich in nutrients.

Vegetation: This plant association is characterized by widely-spaced *Eleocharis quinqueflora* (fewflower spikerush) with 16-80% cover and *Pedicularis groenlandica* (elephant lousewort) (1-10%) always present. *Carex aquatilis* (water sedge) is present in 85% of stands with 3-31% cover. Other forb and graminoid present are variable. Some the more frequently encountered (occurring in 33-80% of stands sampled) species include: *Caltha leptosepala* (marsh marigold) (1-20%), *Carex scopulorum* (rock sedge) (1-30%), *Carex utriculata* (beaked sedge) (1-30%), *Carex illota* (small-headed sedge) (10-16%), and *Carex jonesii* (Jones sedge) (1-26%).

Successional and Ecological Processes: *Eleocharis quinqueflora* (fewflower spikerush) is an early colonizer and persists under wet conditions. *Carex aquatilis* (water sedge) can be a co-dominant in this plant association (Padgett *et al.* 1989). Grazing in this association can increase the cover of increaser and invader species such as *Agrostis stolonifera* (creeping bentgrass) and *Juncus balticus* (baltic rush), and will damage the wet soils.

Management: Improper grazing can cause a shift to species of lower palatability in this plant association. The wet soils are susceptible to soil compaction from livestock and heavy equipment.

In alpine wetland areas, livestock should not be allowed to remain in any area for very long. Intensive range-riding or herding is recommended for nondestructive use by livestock in alpine areas (Thilenius 1975, 1979, as cited by Cooper *et al.* 1997). In addition, 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 regrowth and soil damage recovery (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

Cross Creek

Festuca idahoensis-Festuca thurberi
montane grasslands

Grank: G3G4
Srank: S3S4

General Description: This community commonly includes *Festuca idahoensis* (Idaho fescue) (5-50%), *Festuca thurberi* (Thurber's fescue) (5-75%). Other herbaceous species may also occur but in low abundance. It usually occurs on a relatively flat area on a valley floor or above a creek but within the floodplain and on alluvial soils.

Regional Distribution: This community is currently only known from Colorado.

Distribution in Colorado: At this time *Festuca idahoensis -Festuca thurberi* plant association is only reported from Garfield County.

Elevation Range in Colorado: This community is known to occur between 8820-10,200 feet.

Potential Conservation Areas which support this community:
Deep Creek

Juniperus scopulorum- Cercocarpus montanus
scarp woodlands

Grank: G2
Srank: S2

General Description: This community is usually found on exposed rocky outcrops on shallow loamy sands with high gravel content (Johnston 1987). Dominants include *Juniperus scopulorum* (Rocky Mountain juniper) and *Cercocarpus montanus* (mountain mahogany). *Ribes cereum* (wax currant), *Artemisia frigida* (prairie sagewort), *Opuntia polyacantha* (plains pricklypear), or *Juniperus osteosperma* (little Utah juniper) may also be present.

Regional Distribution: This community is found in Colorado, Wyoming, and Montana.

Distribution in Colorado: It is known from Larimer, Boulder, and Eagle counties.

Elevation Range in Colorado: The community ranges in elevation between 6000-7800 feet.

Management: Fire suppression may increase the density of juniper.

Potential Conservation Areas which support this community:
Milk Creek

Picea pungens/Alnus incana ssp. tenuifolia
Colorado blue spruce/thinleaf alder

Global Rank: G3

Global Rank Comments: This association is known from Wyoming to New Mexico. Stands are not large and are threatened by development, road building and maintenance, heavy recreational use, improper livestock grazing, and stream flow alterations.

State Rank: S3

State Rank Comments: Fewer than 100 stands exist in Colorado, and very few of these are in pristine condition.

General Description and Comments: The *Picea pungens/Alnus incana ssp. tenuifolia* (Colorado blue spruce/thinleaf alder) plant association occurs in montane riparian areas in Colorado. It occurs in deep, shaded canyons and narrow valleys along relatively straight stream reaches. It generally forms small patches, but can be continuous for several river miles.

Regional Distribution: This plant association occurs in Wyoming and Colorado (Johnston 1987, Colorado Natural Heritage Program 1997).

Distribution in Colorado: This plant association occurs in the Routt National Forest, the Yampa, White, Colorado, Gunnison, and San Miguel/Dolores River Basins, and the San Juan and Rio Grande National Forests (Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel *et al.* 1994, Kittel *et al.* 1995, Richard *et al.* 1996, Johnston 1987, Baker 1989).

Elevation Range in Colorado: 6100-9400 ft. (1900-2900 m).

Site Geomorphology: This plant association occurs along narrow to moderately-wide floodplains and stream benches in canyons subject to cold air drainage and limited sunlight. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Stream channels are steep and narrow (Rosgen's Channel Type: A3, A4), moderately broad and slightly sinuous (Rosgen's Channel Type: B3, B4), or broad and highly sinuous (Rosgen's Channel Type: C3, C4).

Soils: Soils are generally shallow and range from loamy sand to silty-clay loams with heavy organic matter content over gravel, cobbles, and boulders. In stands in the White and Colorado River Basins, the soils classify as sandy typic and oxyaquic Cryorthents, loamy typic and oxyaquic Cryoborolls, and fragmental typic Cryochrepts.

Vegetation: *Picea pungens* (Colorado blue spruce) dominates the overstory with 10-70% cover. There are typically many seedling and saplings as well as mature trees. *Abies lasiocarpa* (subalpine fir) may also be present with 0-25% cover. The thick shrub understory is confined to a narrow band lining the stream channel. Shrub species include 10-70% cover of *Alnus incana* (thinleaf alder), 0-40% cover of *Salix drummondiana* (Drummond willow), 0-30% cover each of *Salix monticola* (mountain willow) and *Acer glabrum* (mountain maple), and 0-10% cover each of *Cornus sericea* (red-osier dogwood) and *Lonicera involucrata* (honeysuckle).

The forb layer is species rich with up to 40 species and dense, with a total of up to 50% cover. Forb species include *Actea rubra* (baneberry), *Conioselinum scopulorum* (hemlock parsley), *Oxypolis fendleri* (cowbane), *Geranium richardsonii* (Richardson geranium), *Heracleum lanatum* (cow parsnip), *Maianthemum stellatum* (false Solomon seal), *Mertensia ciliata* (mountain bluebells), *Rudbeckia laciniata* (cutleaf cornflower), and *Equisetum arvense* (field horsetail).

Successional and Ecological Processes: In deep, narrow canyons with swift-moving streams and narrow floodplains and stream 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. More information is needed about the establishment requirements and successional role of *Picea pungens*.

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 (Vioreck 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* sp. 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.

Management: Due to heavy shading, this plant association provides low forage value for livestock. Dense stands of *Alnus incana* (thinleaf alder) hinder livestock access into this plant association. *Alnus incana* is not particularly palatable to livestock, but can be trampled as animals search for more palatable species. Open stands may provide moderate forage and shade in the summer (Hansen *et al.* 1995).

Most fires kill *Alnus incana* dominated stands, resulting in a sparse herbaceous understory and bank destabilization due to root death. *Alnus incana* sprouts quickly when cut at 4-5 year intervals and can be used 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).

Potential Conservation Areas which support this community:

Polk Creek

Picea pungens/Cornus sericea

Colorado blue spruce/red-osier dogwood

Global Rank: G4

Global Rank Comments: This plant association is known from Wyoming to Arizona.

State Rank: S2

State Rank Comments: In Colorado, fewer than twenty stands are documented. This association is highly threatened by road improvements and maintenance, improper grazing, heavy recreational use, and development.

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).

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 1997).

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).

Elevation Range in Colorado: 7000-8500 ft. (2100-2600 m).

Site Geomorphology: This plant association occurs on floodplains and benches in narrow valleys, 20-100 feet (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).

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 up to 50% with the percentage increasing with depth. There may be high organic matter in the top layers.

Vegetation: The upper canopy of this plant association is dominated by *Picea pungens* (Colorado blue spruce) with 15-60% cover. It is present in all stands. Other tree species present with less than 40% frequency include *Populus tremuloides* (quaking aspen) (1-50% cover), *Populus angustifolia* (narrowleaf cottonwood) (1-40%), *Abies lasiocarpa* (subalpine fir) (3-10%) and *Picea engelmannii* (Engelmann spruce) (1-30%). The shrub canopy is dominated by *Cornus sericea* (red-osier dogwood), which is present in all stands and forms an open to dense thicket with 5-80% cover. *Symphoricarpos rotundifolia* (snowberry) (1-10% cover) and *Lonicera involucrata* (honeysuckle) (1-10% cover) are present in >60% of sampled stands. Other shrubs with lower frequency but noticeably high abundance include: *Alnus incana* (thinleaf alder) (1-10%), *Betula occidentalis* (river birch) (10-50%), *Salix monticola* (yellow willow) (3-30%), *Salix drummondiana* (Drummond willow) (10-20% cover), *Acer glabrum* (Rocky Mountain maple) (10%), *Prunus virginiana* (chokecherry) (10%), and *Amelanchier utahensis* (Utah serviceberry) (1-10%).

The herbaceous understory is highly variable, depending on the site conditions and the amount of past disturbance. No one forb or graminoid species is present in all stands. Frequently encountered (>50% frequency) herbaceous species include: *Equisetum arvense* (field horsetail) (1-30% cover), *Maianthemum stellatum* (false Solomon's seal) (1-10% cover), and *Geranium richardsonii* (Richard's geranium) (1-10%). Less frequent but abundant species include: *Rudbeckia laciniata* (cone flower) (1-10%), *Clematis ligusticifolia* (virgin's bower) (1-10%) and *Thlaspi montanum* (penny cress) (10% 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). *Picea pungens* (blue spruce) is a slow-growing, long-lived tree that regenerates from seed (Burns and Honkala 1990). Seedlings are shallow-rooted and require perennially moist soils for establishment and optimal growth. *P. pungens* (blue spruce) is intermediate in shade tolerance, being somewhat more tolerant than *Pinus ponderosa* (Ponderosa pine) or *Pseudotsuga menziesii* (Douglas fir), and less tolerant than *Abies lasiocarpa* (subalpine fir) or *Picea engelmannii* (Engelmann spruce).

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).

Potential Conservation Areas which support this community:
Deep Creek

Pinus edulis/Stipa comata

xeric western slope pinyon-juniper woodlands

Grank: G2

Srank: S2

General Description: This community typically has an open, savanna-like appearance with a tree layer of large *Juniperus osteosperma* (little Utah juniper) and *Pinus edulis* (pinyon pine), with a few young trees or seedlings present. In good-condition stands the shrub layer is sparse, with trace amounts of *Opuntia* spp. (pricklypear species), *Gutierrezia sarothrae* (snakeweed), *Yucca glauca* (soapweed yucca), *Artemisia* spp. (sagebrush species), *Atriplex* sp. (saltbush), *Cercocarpus montanus* (mountain mahogany), and *Ephedra viridis* (mormon tea). *Sclerocactus whipplei* (cactus) commonly is present, with up to 1% cover. The dominants in the herb layer consist of varying amounts and proportions of *Hilaria jamesii* (James' galleta), *Oryzopsis hymenoides* (Indian ricegrass), and *Stipa comata* (needle and thread grass). Individual stands may have any one of these three grasses most abundant, though the other two will nearly always be common. An occasional stand may lack one of the three. Total cover by these three grasses will generally be 25-40%. *Bouteloua gracilis* (blue grama) is nearly always present, with trace to 5% cover. It occurs on flat to gently rolling hills, benches, plateaus, and mesas, on a variety of aspects. Soils are sandy. Parent materials include sandstones and occasionally old river terrace gravels.

Regional Distribution: Currently, this community is only described from Colorado but is expected to occur in Utah.

Distribution in Colorado: This community is found in Montrose, San Miguel, Mesa, Saguache, and Rio Grande, and Eagle counties.

Elevation Range in Colorado: The association occurs from about 5000-9100 feet in elevation.

Management: Domestic livestock grazing may result in decreases in *Oryzopsis hymenoides* (Indian ricegrass) and *Stipa comata* (needle and thread grass), though *Hilaria jamesii* (James' galleta) will eventually decline also, if grazing pressure is high enough. Commonly increasing as the above species decline will be *Gutierrezia sarothrae* (snakeweed), *Bouteloua gracilis* (blue grama), *Opuntia* spp. (pricklypear), and the exotic, *Bromus tectorum* (cheatgrass). The conspicuous cryptogamic soil crust disappears under continued livestock grazing pressure. Fire were probably an important ecological process to this community, therefore prescribed burning may be required to maintain the open savanna-like appearance.

Potential Conservation Areas which support this community:

Christine State Wildlife Area

***Pseudotsuga menziesii*/Cornus sericea**
Douglas fir/red-osier dogwood

Global Rank: G4

Global Rank Comments: This type is well documented and fairly common in Montana.

State Rank: S2

State Rank Comments: In Colorado, this is an uncommon association that naturally occurs in small patches. Less than ten stands are documented. It is threatened by heavy recreational use and improper livestock grazing.

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.

Regional Distribution: This plant association occurs in Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: This plant association occurs in the San Juan and Rio Grande National Forests (Richard *et al.* 1996, Kittel *et al.* 1999), the San Miguel/Dolores Kittel and Lederer 1993), Gunnison (Kittel *et al.* 1995), and White River Basins (Kittel *et al.* 1994).

Elevation Range in Colorado: 5600-8500 ft (1700-2400 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 feet (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).

Soil: The soils are generally well-drained, well-developed 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 that may be present include: *Populus angustifolia* (narrowleaf cottonwood) (1-10%), *Populus tremuloides* (quaking aspen) (3-17%), *Abies concolor* (white fir) (20%), *Acer negundo* (boxelder) (10%), and *Picea pungens* (blue spruce) (4-18%). *Cornus sericea* (red-osier dogwood) forms a dense shrub layer with 20-70% cover. Other shrub species that may be present include: *Acer glabrum* (mountain maple) (40-70%), *Quercus gambelii* (Gambel oak) (1-6%), *Alnus incana* (thinleaf alder) (10-32%) *Ribes* (currant) (3-13%), *Prunus virginiana* (chokecherry) (1-16%). 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.

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. Browsing of this species can be high if the stands are open enough for animals to walk through (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).

Potential Conservation Areas which support this community:

Deep Creek

Populus angustifolia/Alnus incana ssp. tenuifolia
narrowleaf cottonwood/thinleaf alder

Global Rank: G3?

Global Rank Comments: This association is known from New Mexico and Colorado. Although not well documented from other states, it is expected to occur throughout the range of *Populus angustifolia* in the Rocky Mountains. The question mark in the Global Rank indicates the community is probably more abundant, but new locations have not been documented.

State Rank: S3

State Rank Comments: In Colorado, this is a common community along montane streams, but few high quality examples exist. This association is highly threatened by improper livestock grazing, development and stream flow alterations.

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.

Regional Distribution: This plant association occurs in New Mexico (Durkin *et al.* 1994) and Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: This plant association occurs on the West Slope in the Yampa, Gunnison, and San Miguel River Basins, and the San Juan and Rio Grande National Forests (Kittel *et al.* 1993, Kittel *et al.* 1994, Kittel *et al.* 1999, Colorado Natural Heritage Program 1997, 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).

Elevation Range in Colorado: 6200-8900 ft. (1900-2700 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).

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 inches (30 cm).

Vegetation: The dominance of *Populus angustifolia* and *Alnus incana* are the key diagnostic characteristics of this plant association. Several other tree and shrub species may be present, but none equal the abundance of the diagnostic species. The overstory is an open to dense canopy of *Populus angustifolia* (narrowleaf cottonwood), which is always present, if sometimes only as sapling-sized individuals (83% frequency as mature trees with 5-89% cover, 23% frequency as saplings with 3-20% cover, and 17% frequency as seedlings with 1-6% cover). Other tree species that may be present include: *Pseudotsuga menziesii* (Douglas fir) (3-12% cover), *Juniperus scopulorum* (Rocky Mountain juniper) (1-10%), *Populus tremuloides* (quaking aspen) (3-48%), *Pinus ponderosa* (ponderosa pine) (3-13%), *Populus acuminata* (lance-leaved cottonwood) (48%), *Abies concolor* (white fir) (7%), or *Picea pungens* (Colorado blue spruce) (4%).

The shrub understory is dominated by a dense band of *Alnus incana ssp. tenuifolia* (thinleaf alder) (5-89% cover) lining the stream bank. A variety of other shrubs may be present, intermingling with the alder but always less than the total alder cover. Other shrub species include: *Salix bebbiana* (Bebb willow) (1-10% cover), *Salix monticola* (mountain willow) (1-14%), *Salix drummondiana* (Drummond willow) (3-35%), *Salix eriocephala* var. *ligulifolia*

(strapleaf willow) (1-17%), *Salix lucida* var. *caudata* (whiplash willow) (8-25%), *Salix exigua* (coyote willow) (1-32%), *Cornus sericea* (red-osier dogwood) (1-31%), *Rosa woodsii* (woods rose), *Acer glabrum* (Rocky Mountain maple) (1-10%), and *Betula occidentalis* (river birch) (3-10%).

The herbaceous undergrowth is generally sparse. Herbaceous species include: *Poa pratensis* (1-29%), *Taraxacum officinale* (dandelion) (1-18%), *Equisetum arvense* (field horsetail) (1-18%), *Rudbeckia laciniata* (coneflower) (1-20%), *Heracleum maximum* (cow parsnip) (1-12%), *Maianthemum stellatum* (False Solomon's seal) (1-12%), *Trifolium repens* (sweet clover) (1-48%), *Calamagrostis canadensis* (Canadian reedgrass) (1-17%), *Oxypolis fenderli* (cowbane) (1-11%), *Cardamine Cordifolia* (bittercress) (1-22%), *Carex rossii* (Ross sedge) (3-90%), *Carex praegracilis* (field sedge) (1-30%), and *Carex nebraskensis* (Nebraska sedge) (70%).

Successional and Ecological Processes: The *Populus angustifolia/Alnus incana* (narrowleaf cottonwood/thinleaf alder) plant association is considered a mid-seral community. In the San Luis valley, stands have high diversity of shrubs, with many willow species present in these habitats. Alder is the clear dominant shrub, forming the bulk of the biomass in the understory. With time and without flooding disturbance, the *Populus angustifolia/Alnus incana* stands may become dominated by invading conifers from adjacent upslope communities such as *Pseudotsuga menziesii* (Douglas fir), *Juniperus* (juniper), or *Picea engelmannii* (Engelmann spruce).

Landowners and managers should understand that cottonwood woodlands grow within a continually changing alluvial environment 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 dependent on flooding disturbance. Periodic flooding allows cottonwood seedlings to germinate and become established on newly deposited, moist sandbars. If not damaged by floods in subsequent years, seedlings trap sediment as they grow larger. Each year the surface accumulates a little bit more flood born sediments, and the sandbar rises. The young forest community becomes increasingly stable as it grows older.

If not damaged by flooding, excessive browsing from wildlife (including beaver) or livestock, fire, or channel modifications, the young shrubby cottonwoods may grow into a mature riparian forest. At the same time, natural river processes of bank erosion, deposition and channel migration continue, create 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 land surface 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 also adapted to thrive on the floodplain environment. It is one of the first species to establish on fluvial or glacial deposits and even on placer mining spoils (Viereck 1970, Van Cleve *et al.* 1971, Chapin *et al.* 1994, and 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) is a nitrogen fixer and increases ecosystem nitrogen supply with the deposition of nitrogen-rich leaf litter (Binkley 1986). The annual input of nitrogen to soils from alder ranges from 16-150

kg/ha/yr, as much as 150 times the annual atmospheric deposition over the same area (Binkley 1986, Bowman and Steltzer *in press*). Nitrogen-rich alder detritus speeds soil development and bank stability. It also provides an important source of nutrients for aquatic invertebrates.

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 and the nitrogen-rich *Alnus incana* (thinleaf alder) leaves are frequently browsed by cattle. Excessive 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 for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity (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.

Potential Conservation Areas which support this community:
East Brush Creek

Populus angustifolia-Juniperus scopulorum
narrow-leaf cottonwood-Rocky Mountain juniper

Global Rank: G2G3

Global Rank Comments: This is an uncommon association limited to desert riparian areas. It is known only from foothill streams of Wyoming, Colorado and New Mexico. The double Global rank indicates that the known abundance is between a G2 and a G3.

State Rank: S2

State Rank Comments: This association is uncommon in Colorado. Stands along the Colorado River appear to be decadent. Only one large, viable occurrence has been documented and it is threatened by improper livestock grazing and ground water development.

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. The association is characterized by an open canopy of *Populus angustifolia* (narrowleaf cottonwood) and *Juniperus scopulorum* (Rocky Mountain juniper), 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.

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 1997).

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, Kittel *et al.* 1999, Colorado Natural Heritage Program 1997).

Elevation Range in Colorado: 6000-8600 ft. (1800-2600 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 feet (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.

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 inches (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. Stands with northern aspects may include *Pseudotsuga menziesii* (Douglas-fir) (15% cover) or *Populus tremuloides* (quaking aspen) (10% cover). Two stands with *Juniperus osteosperma* (Utah juniper), rather than *J. scopulorum* (Rocky Mountain Juniper), are included in this type. The two plots are similar to others in all other respects; they occur in very dry conditions. One stand is in a deeply cut ephemeral wash, the other on a terrace nearly 4 meters (13 feet) above the stream water level. Both stands occur in the lower San Juan watershed.

There is very little shrub canopy and little to no herbaceous undergrowth due to dry conditions. If a shrub canopy exists, a wide variety of shrubs may make up this canopy and no species is present in every stand. Shrub species

infrequently encountered (<50% frequency) include: *Clematis ligusticifolia* (virgin's bower) (1-27%), *Acer glabrum* (Rocky Mountain maple) (1-18%), *Rhus trilobata* (squawbush) (1-6%), *Symphoricarpos rotundifolius* (snowberry) (1-2%), *Quercus gambelii* (Gamble oak) (6-8%), and *Berberis fendleri* (barberry) (11%).

Some rarely encountered (25% frequency or less) native herbaceous species include: *Leymus cinereus* (wild rye) (1-10%), *Maianthemum stellatum* (false Solomon's seal) (5-30%), and *Thermopsis montana* (golden banner) (9%). Certain species may occur in wet micro-habitats within this generally dry association (e.g. edges of stagnant pools). These species include *Carex utriculata* (beaked sedge) (7-24%) and *Carex praegracilis* (clustered field sedge) (22%) have been observed.

Non-native species are some of the more commonly encountered (>33% frequency) herbaceous components of this association, and generally occur in disturbed stands. Species include: *Poa pratensis* (Kentucky bluegrass) (1-29%), *Taraxacum officinale* (dandelion) (1-3%), *Agrostis stolonifera* (red top) (1-17%), and *Melilotus officinalis* (sweet clover) (1-12%)

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 land surface 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).

Management: Because the regeneration and establishment of new stands of cottonwood is dependent upon flooding events, 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. Cottonwood seedlings and saplings are frequently browsed by cattle, 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. Cottonwood-dominated riparian areas in Colorado are best grazed 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. *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).

Potential Conservation Areas which support this community:

Colorado River
Yarmony Creek

Populus angustifolia*/*Salix ligulifolia*-*Shepherdia argentea
narrowleaf cottonwood/strapleaf willow-silver buffaloberry

Global Rank: G2

Global Rank Comments: This is an extremely limited plant association known only from southwestern Colorado. Historically, it was more widespread and common in broad river valleys (Baker 1986). Overutilization by livestock and alterations in the river flow regime has impacted this community.

State Rank: S2

State Rank Comments: This association is known only from a few fragmented stands in southwestern Colorado. Probably no large, unaltered stands are left. Remaining stands are highly threatened by improper livestock grazing, heavy recreational use, stream flow alterations, and improvements and maintenance of roads and railroads.

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. Over-utilization by livestock and alterations in the river flow regime have caused a decline in its distribution.

Regional Distribution: This plant association is only known to occur in western Colorado (Baker 1984, Baker 1989, Colorado Natural Heritage Program 1997).

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).

Elevation Range in Colorado: 6000-7100 ft. (1800-2200 m).

Site Geomorphology: This plant association occurs in narrow to broad, 1000 feet (300 m) wide, alluvial valleys. Mature stands occur on terraces up to 10 feet (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).

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 typical Cryopsamments.

Vegetation: This plant association is characterized by an overstory canopy of *Populus angustifolia* (narrowleaf cottonwood) and the presence and abundance of *Shepherdia argentea* (silver buffalo berry). The tree canopy consists of mature *Populus angustifolia* (narrowleaf cottonwood) (10-30%), with seedling and sapling-sized *Populus angustifolia* (narrowleaf cottonwood) (3-40% cover) that can occur in bands close to rivers edge. Other trees that may be present include: *Pinus edulis* (pinyon pine) (3%) and *Populus x acuminata* (lance leaf cottonwood) (6%).

The shrub layer is diverse and widely spaced. *Shepherdia argentea* (silver buffalo berry) (20-59%) is the key characteristic shrub for this association. Low abundance may indicate a degraded occurrence. The presence of *Salix eriocephala* var. *ligulifolia* (strapleaf willow, formally known as *Salix ligulifolia*) is not required for a stand to key into this type (it was present in only 1 sampled stand, with 10% cover). *Rhus trilobata* (skunkbush) is present in all sampled stands with 1-40% cover. Other shrub species that may be present (75% frequency or less) include: *Alnus incana* (thinleaf alder) (1-22%), *Cornus sericea* (red-osier dogwood) (1-3%), *Rosa woodsii* (woods rose) (1-28%), *Crataegus rivularis* (river hawthorne) (10%), *Quercus gambelii* (Gamble oak) (10%), *Salix exigua* (coyote willow) (1%), *Salix irrorata* (blue-stem willow) (28%), and *Betula occidentalis* (river birch) (2%).

The herbaceous undergrowth is typically dominated by introduced hay grasses including: *Agrostis stolonifera* (redtop) (20%), *Poa pratensis* (Kentucky bluegrass) (1-10%), and *Dactylis glomerata* (orchard grass) (3%). A few native species also occur, including: *Maianthemum stellatum* (false Solomon seal) (1-3%), *Equisetum arvense* (field scouring rush) (1-3%), *Glycyrrhiza lepidota* (wild licorice) (1-3%), *Thlaspi montanum* (pennycress) (10%), and *Pascopyron smithii* (western wheat grass) (3%).

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 a 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/strappleaf willow-silver buffaloberry) plant association are known in Colorado.

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 foothills and plains environments.

Forage productivity for this plant association can be high and very palatable to livestock. Cottonwood and willow seedlings and saplings 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 for short periods during the growing season or solely during the winter season. This maintains high forage quality and quantity (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:
Colorado River

Populus tremuloides/Alnus incana ssp. tenuifolia
quaking aspen/thinleaf alder

Global Rank: G3

Global Rank Comments: This plant association has been documented only in Colorado. It is expected to occur in other Rocky Mountain States.

State Rank: S3

State Rank Comments: This plant association is known from throughout the western slope.

General Description and Comments: The *Populus tremuloides/Alnus incana ssp. tenuifolia* (quaking aspen/thinleaf alder) plant association is located in narrow ravines and along first and second-order streams where upland *Populus tremuloides* forests intermix with riparian shrub vegetation and at lower elevations where *Populus tremuloides* persists only in the riparian zone. The presence of obligate riparian species distinguish this association from upland *Populus tremuloides* communities.

Regional Distribution: This plant association has not been documented outside of Colorado.

Distribution in Colorado: This association occurs in the Routt National Forest, and the Colorado and Gunnison River Basins (Kettler and McMullen 1996, Kittel *et al.* 1994, Kittel *et al.* 1995).

Elevation Range in Colorado: 8400-9600 ft (2600-2900 m).

Site Geomorphology: This plant association occurs in narrow, 25-225 feet (10-70 m) wide, valleys along stream banks of first- and second-order streams. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Stream channels are steep and narrow (Rosgen's Channel Type: A3, A4) and occasionally, of moderate gradient and width (Rosgen's Channel Type: B3). Stream gradients range from 1-30%.

Soils: Soils are generally skeletal, shallow, sandy and sandy clay loams or deeper sandy clay loams. In the Colorado River Basin, the soils classify as coarse loamy to sandy cumulic Cryaqualls or Cryoborolls to oxyaquic Cryorthents.

Vegetation: This plant association has a tall, 20-40 foot (6-12 m), overstory of 10-70% cover of *Populus tremuloides* (quaking aspen). Several conifer species can occur, however the aspen is clearly the dominant tree canopy, at least along the stream banks. Other tree species that may be present include: *Pinus contorta* (lodgepole pine) (20%), *Abies lasiocarpa* (subalpine fir) (10%), *Picea pungens* (Colorado blue spruce) (3-10%), and *Pseudotsuga menziesii* (Douglas-fir) (3-10%).

The shrub and forb canopy along the immediate stream bank distinguish this riparian plant association from the adjacent forests. The shrub layer is dominated by 10-70% cover of *Alnus incana* (thinleaf alder). Other shrubs that may or may not be present in this association include: *Salix drummondiana* (Drummond willow) (3-22%), *Lonicera involucrata* (honeysuckle) (1-10%), *Rosa woodsii* (woods rose) (1-10%), *Salix bebbiana* (Bebb willow) (1-20%). The forb undergrowth can be dense and includes *Cardamine cordifolia* (bittercress) (1-10%), *Mertensia ciliata* (mountain bluebells) (1-20%), *Osmorhiza depauperata* (blunt-fruit sweet-cicely) (1-5%), and *Senecio triangularis* (arrowleaf groundsel) (1-5%). Graminoid cover includes: *Calamagrostis canadensis* (2-20%), *Equisetum arvense* (field arvense) (1-20%), and *Carex disperma* (soft-leaved sedge) (20%).

Successional and Ecological Processes: *Populus tremuloides* (quaking aspen) woodlands can be self-perpetuating climax plant associations or an early-seral stage of coniferous types (DeByle and Winokur 1985). *Populus tremuloides* (quaking aspen) is a non-obligate riparian species and often occurs in upland communities. Where valley bottoms are moist and stable, *Populus tremuloides* can dominate the riparian area, while also occurring on adjacent mesic hillslopes.

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 (Vioreck 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* sp. 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

Management: Dense stands of *Alnus incana* (thinleaf alder) hinder livestock access into this plant association. *Alnus incana* is not particularly palatable to livestock, but can be trampled as animals search for more palatable species. Open stands may provide moderate forage and shade in the summer (Hansen *et al.* 1995). With heavy livestock grazing, the shrub layer can become dominated by *Symphoricarpos* spp. (snowberry) (DeByle and Winokur 1985). This is likely to occur in valley bottoms where overgrazing has dried the soil and dropped the water table.

Fire as a management tool may be useful in regenerating old stands of *Populus tremuloides* (Hansen *et al.* 1995). Light fires will stimulate *Populus tremuloides* suckering, but may also kill the canopy trees. Most fires kill *Alnus incana* resulting in a sparse herbaceous understory and bank destabilization. It may be necessary to protect these sites from beaver and grazing animals in order to ensure successful regeneration following a fire (Hansen *et al.* 1988, Hansen *et al.* 1995).

Alnus incana sprouts quickly when cut at 4-5 year intervals and can be used 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).

Potential Conservation Areas which support this community:

East Brush Creek

Pseudotsuga menziesii/ Paxistima myrsinites
lower montane forest

Grank: G2G3
Srank: S2S3

General Description: The community is characterized by *Pseudotsuga menziesii* (Douglas fir), *Paxistima myrsinites* (pachistima), *Populus tremuloides* (aspen), *Pinus contorta* (lodgepole pine), *Juniperus communis* (common juniper), and *Carex geyeri* (elk sedge). Other species of coniferous trees may also be present but sparse. The canopy is typically dense. The tall shrub layer is sparse but the short shrub layer is well-developed with pachistima, oregon grape, and kinnikinnick. The cover of litter and duff keeps soil moisture through the season on most sites. This community type usually occurs on steep northerly slopes with a loamy surface soil and predominantly colluvium as the parent material (Johnston et al. 1999).

Regional Distribution: This community is currently only known from Colorado.

Distribution in Colorado: Within Colorado it is reported from Garfield, Montrose, and Ouray counties.

Elevation Range in Colorado: It is found between 8000-9800 feet.

Management Comments: These habitat types are typically not suitable for livestock grazing, except along the edges, because of deep shade and lack of nutritious forage. Deer and elk use these stands extensively in the summer and spring/fall but there is usually too much snow in the winter (Johnston et al. 1999).

Potential Conservation Areas which support this community:
Deep Creek

Quercus gambelii- *Cercocarpus montanus*/ *Carex geyeri*
mixed mountain shrubland

Grank: G3

Srank: S3

General Description: *Quercus gambelii* (Gambel's oak) dominates (5-80% cover) with 0-60% cover of *Cercocarpus montanus* (mountain mahogany). Other shrubs present include *Symphoricarpos oreophilus* (snowberry), *Amelanchier utahensis* (serviceberry), and *Artemisia tridentata* (sagebrush), each occurring up to 50% in cover. *Pseudotsuga menziesii* (Douglas fir), *Pinus edulis* (pinyon pine), *Juniperus* spp. (juniper), and *Populus tremuloides* (aspen) may be scattered throughout but in low abundance. The dominant understory, at least when in good condition, is *Carex geyeri* (Geyer's sedge) (10-80% cover). *Elymus trachycaulus* (slender wheatgrass), *Poa fendleriana* (muttongrass), *Poa secunda* (Sandberg bluegrass), *Stipa comata* (needle and thread grass), *Pseudoroegneria spicata* (bluebunch wheatgrass), and *Oryzopsis hymenoides* (Indian ricegrass) may also be found. Forb cover is generally low.

Regional Distribution: This plant community is currently known only from Colorado.

Distribution in Colorado: This community is known from the west slope in Rio Blanco, Garfield, Mesa, Pitkin, Montezuma, Moffat, Montrose, and Eagle counties.

Elevation Range in Colorado: It ranges from approximately 6600-9300 feet elevation.

Potential Conservation Areas which support this community:

Crown

East Brush Creek

Quercus gambelii-Symphoricarpos oreophilus
mixed mountain shrubland

Grank: G5
Srank: S3S4

General Description: This community is dominated by *Quercus gambelii* (Gambel's oak) and *Symphoricarpos oreophilus* (snowberry). *Padus virginiana* (chokecherry), *Amelanchier alnifolia* (serviceberry), *Artemisia tridentata* (sagebrush), *Artemisia ludoviciana* (white sagebrush), and *Rosa woodsii* (wild rose) may also be found. *Pinus ponderosa* (Ponderosa pine), *Juniperus scopulorum* (Rocky Mountain juniper), *Abies concolor* (white fir), *Pinus edulis* (pinyon pine), and *Juniperus osteosperma* (little Utah juniper) may be scattered. It can be found on hillsides, upland benches, and well-drained lowlands (0-70% slope). It usually occurs on cool moist sites, with shallow to deep well-drained loam to sandy loam soils (Johnston 1987). Ranges for percent cover are: *Quercus gambelii* (Gambel's oak) 5-95%, *Symphoricarpos oreophilus* (snowberry) 5-75%, other shrubs may reach 25%.

Regional Distribution: Johnston (1987) reports this community from Colorado and Utah, however, The Nature Conservancy reports it as occurring in Colorado, New Mexico and Texas.

Distribution in Colorado: This community is described from Pitkin, Routt, Mesa, Saguache, Rio Blanco, and Garfield counties.

Elevation Range in Colorado: This community ranges in elevation from 6000-9200 feet (Johnston 1987).

Potential Conservation Areas which support this community:
Crown

Salix drummondiana/Calamagrostis canadensis
Drummond willow/bluejoint reedgrass

Global Rank: G3

Global Rank Comments: This association has a wide distribution. Few undisturbed stands have been documented.

State Rank: S3

State Rank Comments: In Colorado, less than ten stands have been documented, but at least an additional ten to twenty stands are expected to occur. This association may have been reduced from its historic abundance by heavy livestock grazing at the turn of the century. Remaining stands are threatened by continued improper livestock grazing, altered stream flows and heavy recreational use.

General Description and Comments: The *Salix drummondiana/Calamagrostis canadensis* (Drummond willow/bluejoint reedgrass) plant association is characterized by a dense canopy of *Salix drummondiana* 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.

Regional Distribution: This plant association occurs in Montana (Hansen *et al.* 1995) and Colorado (Colorado Natural Heritage Program 1997).

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).

Elevation Range in Colorado: 7800-10,200 ft (2400-3100 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.

Soils: According to Johnston (1987), the soils classify as Cryaquolls 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. Other shrubs can be present and abundant, such as *Salix planifolia* (planeleaf willow) (1-20% cover) and *Alnus incana* (thin-leaf alder) (3-50%). The graminoid layer is dominated by 10-40% cover of *Calamagrostis canadensis* (bluejoint reedgrass). Other abundant graminoids include: *Carex aquatilis* (aquatic sedge) (10-30%), *Carex utriculata* (beaked sedge) (10-30%), and *Glyceria striata* (mannagrass) (10%). Forb cover is typically low, and includes: *Galium boreal* (bedstraw) (1-2%), *Geranium richardsonii* (Richardsonii) (1%), and *Mertensia ciliata* (1%).

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. Near beaver activity, this association may be a mid-successional community that will eventually become a *Salix planifolia* (planeleaf willow) or *Salix monticola* (mountain willow) type as the area dries slightly and becomes fill-in by sedimentation (Sanderson and Kettler 1996).

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. Land managers should consider maintaining beaver activity rather than removing them (Hansen *et al.* 1995).

Prescribed burning in this association is an effective method of rejuvenating decadent clumps of the associated 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 seeds 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 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

Cross Creek

North Fork Fryingpan

***Salix drummondiana*/mesic forb**

Drummond willow/mesic forb

Global Rank: G4

Global Rank Comments: This is a common and abundant association, although it commonly forms fairly small and often narrow riparian habitats.

State Rank: S4

State Rank Comments: In Colorado, over 40 stands have been documented and an additional 10-20 are expected to occur. However, it is currently threatened by improper livestock grazing, stream flow alterations and heavy recreational use.

General Description and Comments: The *Salix drummondiana*/mesic forb (Drummond willow/mesic forb) plant association most commonly occurs on relatively steep streams and rarely forms more than a narrow, 5-25 feet (1.5-7.5 m) wide, band along stream banks. The closed to partially open canopy of *Salix drummondiana* and a thick carpet of many forb species characterize this plant association.

Regional Distribution: This plant association occurs in Colorado (Colorado Natural Heritage Program 1997). It is expected to occur in Wyoming (Youngblood *et al.* 1985), Utah (Padgett *et al.* 1989) and Nevada (Manning and Padgett 1995).

Distribution in Colorado: This plant association occurs throughout the West Slope and in montane regions along the Front Range (Kittel and Lederer 1993, Kittel *et al.* 1994, Kittel *et al.* 1995, Kittel *et al.* 1996, Richard *et al.* 1996, Rondeau *et al.* 1997, Cooper and Cottrell 1990, Phillips 1977).

Elevation Range in Colorado: 7500-11,300 ft (2400-3500 m).

Site Geomorphology: This plant association occurs in a variety of habitats. All streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). It occurs in narrow, V-shaped valleys as a dense, narrow band along high gradient (1-41%) streams (Rosgen's Channel Type: A1-A3) and as large willow carrs in broad valleys, 150-1000 feet wide (50-300 m), along low gradient (1-3%), moderately sinuous streams (Rosgen's Channel Type: B1-B4). It is also located along broad, highly sinuous streams (Rosgen's Channel Type: C3-C5) and broad, actively downcutting channels (Rosgen's Channel Type: F6). This association also occur near seeps.

Soil: Soils range from deep sandy loams and sandy clay loams with no coarse fragments to shallow silty clay loams and sandy clay loams over coarse, angular cobbles. Soils in the Colorado River Basin classify as typic and oxyaquic Cryorthents, pachic and typic Cryofluvents, histic and typic Cryaquents, and pachic and typic Cryoborolls.

Vegetation: The *Salix drummondiana*/Mesic Forbs (Drummond willow/Mesic Forbs) association covers a wide elevational range and consequently has a wide diversity of species. *Salix drummondiana* (Drummond willow) forms an open to closed, narrow canopy of tall shrubs lining the stream bank with 20-98% cover. Several other shrub species may be present, some with equal cover but none that exceed that of *Salix drummondiana*. Other shrub species that may be present at upper elevations include: *Salix brachycarpa* (barrenground) (1-3%) and *Salix planifolia* (planeleaf willow) (2-37%). At lower elevations, other shrub that may be present include: *Lonicera involucrata* (honeysuckle) (1-30%), *Alnus incana* (thinleaf alder) (1-21%) (if the alder is equal to Drummond willow see the *Alnus incana*-*Salix drummondiana* plant association), *Salix monticola* (Rocky Mountain willow) (1-40%), *Salix bebbiana* (Bebb willow) (1-21%), and *Salix eriocephala* var. *ligulifolia* (strap leaf willow) (10-13%).

Mature trees may be present, not forming a true overhead canopy, but a few individuals scattered about the shrubland or their canopy leaning over from an adjacent forested association. Tree species that may be present include: *Picea engelmannii* (Engelmann spruce) (1-30%), *Abies lasiocarpa* (subalpine fir) (1-10%), *Populus angustifolia* (narrowleaf cottonwood) (1-20%), and *Populus tremuloides* (quaking aspen) (1-75%) Stands with a real canopy of aspen are included in this association, and likely that a *Populus tremuloides*/*Salix drummondiana* type may be split out at later date.

The herbaceous undergrowth in some stands is sparse due to heavy shade and shallow soils. Other stands have a rich diversity of forbs and graminoids in the undergrowth. In general, total forb cover exceeds that of graminoid cover, and no single species is dominant. Forb species include: *Mertensia ciliata* (mountain bluebell) (1-44%), *Heracleum lanatum* (cow parsnip) (1-40%), *Cardamine cordifolia* (bittercress) (1-30%), *Oxypolis fendleri* (cowbane) (11-23%), *Hydrophyllum fendleri* (waterleaf) (1-17%), *Saxifraga odontoloma* (brook saxifrage) (1-34%), and *Delphinium barbeyi* (delphinium) (1-30%). Graminoid species include: *Carex utriculata* (beaked sedge) (1-29%), *Equisetum arvense* (field horsetail) (1-19%), *Calamagrostis canadensis* (bluejoint reedgrass) (1-20%).

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. This association could be an early-seral stage of the *Abies lasiocarpa*-*Picea engelmannii* (subalpine fir-Engelmann spruce) plant associations which also occurs along steep streams and alternates with the willow carrs. In wider valleys, the *Salix drummondiana*/mesic forb (Drummond willow) plant association occurs as a broad willow carr on well-developed soils near seeps or downstream from beaver dams. It appears to be a stable community in these environments.

Management: *Salix drummondiana* (Drummond willow) is highly palatable to livestock and wildlife (Kovalchik 1987). Season-long grazing can reduce native forb cover and increase the abundance of non-native grasses including *Poa pratensis* (Kentucky bluegrass) and *Agrostis stolonifera* (redtop). Continued heavy browsing may weaken the root systems of *Salix drummondiana* (Drummond willow) (Padgett *et al.* 1989).

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 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 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. Land managers should consider maintaining beaver activity rather than removing them (Hansen *et al.* 1995).

Prescribed burning in this association is an effective method of rejuvenating decadent stands of the associated willow species. The willows will vigorously sprout following fire, especially in wetter stands. Quick, hot fires produce more sprouts than slower fires (Hansen *et al.* 1995).

Salix drummondiana is 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 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

Deep Creek

Salix monticola/Calamagrostis canadensis
yellow willow/bluejoint reedgrass

Global Rank: G3

Global Rank Comments: This association is known only from Colorado.

State Rank: S3

State Rank Comments: This association occurs throughout the mountains of Colorado. There are thirteen documented locations and an additional twenty to thirty more stands are expected to occur. This association is threatened by improper livestock grazing, inappropriate stream flow alterations, and heavy recreation use.

General Description and Comments: The *Salix monticola/Calamagrostis canadensis* (yellow willow/bluejoint reedgrass) plant association is a tall (4-5 ft, 1.5-2 m) shrubland with an open to closed canopy of willows and a lush carpet of grasses. It occurs along broad floodplains and narrow streams in the montane and upper montane elevations. It is recognized by a near monotypic stand of *Salix monticola* (yellow willow). Other willow species may be mixed in, but the bulk of the canopy is made up of *Salix monticola*. Forbs and mesic graminoids comprise the undergrowth and *Calamagrostis canadensis* is always present but may not have a high cover.

Regional Distribution: This association occurs only in Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: This plant association occurs along the Colorado Front Range (Cooper and Cottrell 1990), in northcentral Colorado, and the Crested Butte region (Cooper 1993). It also occurs in the Colorado and South Platte River Basins (Kittel *et al.* 1994, Sanderson and Kettler 1996, Kittel *et al.* 1997).

Elevation Range in Colorado: 8300-9400 ft (2500-2900 m)

Site Geomorphology: This plant association occurs on narrow to wide, 100-1,000 feet (30-300 m) wide, low-gradient (2-3.5%) valley bottoms and floodplains. In wider valleys, large stands of this association occur between meanders and at the edges of beaver ponds. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Stream channels are steep and narrow (Rosgen's Channel Type: A4), moderately steep and wide (Rosgen's Channel Type: B4), wide and sinuous (Rosgen's Channel Type: C3, C4), or braided from beaver activity (Rosgen's Channel Type: D6).

Soils: Soils are finely textured sandy clays to silty clay loams, often saturated to within 10 inches (30 cm) of the surface. Soils can also be silty loams over sand and coarse sand. Mottling often occurs at 5-15 inches (20-40 cm) depth. Soils in the Colorado River Basin classify as Fluventic Cryoborolls and Oxyaquic Cryorthents.

Vegetation: This plant association has a closed, mixed canopy of willows with *Salix monticola* (yellow willow) being the dominant or matrix willow with 17-85% cover. The matrix willow is the willow species with the highest abundance, even though other willow species may have a higher combined canopy cover. Other willows that may be present include: *Salix drummondiana* (Drummond willow) (2-26%), *Salix wolfii* (Wolf willow) (1%), *Salix geyeriana* (Geyer willow) (1-10%), and *Salix boothii* (Booth willow) (10%).

Calamagrostis canadensis (bluejoint reedgrass) forms an open to dense graminoid layer with 5-69% cover. Other graminoids that may be present include: *Carex aquatilis* (aquatic sedge) (1-20%), *Carex utriculata* (beaked sedge) (1-65%), *Carex microptera* (small-wing sedge) (11-19%), *Deschampsia cespitosa* (tufted hairgrass) (4%), and *Glyceria grandis* (mannagrass) (6%).

Total forb cover ranges from 20-50%. Forb cover is diverse, but each species has only approximately 1% cover. Forb species include *Cardamine cordifolia* (heartleaf bittercress), *Geranium richardsonii* (Richardson geranium), *Mertensia ciliata* (yellow bluebells), *Oxypolis fendleri* (cowbane), *Geum macrophyllum* (large-leaved avens), *Solidago canadensis* (goldenrod), *Senecio biglovii* (Bigelow groundsel), and *Galium boreale* (northern bedstraw).

Successional and Ecological Processes: *Salix monticola* (yellow 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 feet (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. A higher water table allows for the increase in cover of *Calamagrostis canadensis* (bluejoint reedgrass) and the conversion from a conifer/*Calamagrostis canadensis* type to a *Salix* spp./*Calamagrostis canadensis* type (Padgett *et al.* 1989).

Carex utriculata (beaked sedge), *Carex aquatilis* (aquatic sedge), and *Calamagrostis canadensis* (bluejoint reedgrass) are common dominant undergrowth of several *Salix* plant associations. These three graminoids indicate different micro-environments, generally separating out along a moisture gradient related to the depth of the water table, and can represent different stages of succession of the floodplain (Cooper 1986).

Carex utriculata (beaked sedge) occurs on the wettest sites, such as shallow pond margins, low-lying swales, and overflow channel with the shallowest water tables. *Carex aquatilis* (water sedge) occurs on intermediate sites that have saturated but not inundated soils. *Calamagrostis canadensis* (bluejoint reedgrass) dominates the drier sites with lower water tables. As wetter sites become drier, it can colonize stands of *Carex utriculata* (beaked sedge) and *Carex aquatilis* (water sedge) (Cooper 1986).

Changes in the physical environment, brought on by flooding or other disturbance, can initiate successional shifts in species composition. Sediment deposition on the floodplain raises the surface higher above the water table (Cooper 1986). As aggradation of the floodplain proceeds, the site becomes drier and the dominant graminoid understory changes. Thus *Carex aquatilis* (water sedge) dominated stands (regardless of any overstory canopy) may shift toward *Calamagrostis canadensis* (bluejoint reedgrass) dominated stands.

Management: The forage value of *Calamagrostis canadensis* (bluejoint reedgrass) is most palatable to livestock when foliage is young. With high grazing pressure, the production of *Calamagrostis canadensis* will decrease (Hansen *et al.* 1995, Girard *et al.* 1995).

The soils of this plant association are susceptible to compaction by livestock due to saturated conditions throughout much of the growing season. Season-long grazing can cause increases in less desirable species, and cause valuable native species to be eliminated from the site. Improper grazing can open the willow canopy which increases the solar input, dries surface soils, and causes stream bank damage. Accelerated erosion from domestic livestock can precipitate stream bank damage, and significant streambed down cutting. In time, the water table may be lowered and the site becomes drier, supporting less productive, non-obligate riparian communities.

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 the basic biological requirements for plant establishment. 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).

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 table across the floodplain and provide year-round saturated soils. Plant establishment and sediment build-up behind beaver dams, along with plant reproduction, raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity rather than removing them (Hansen *et al.* 1995).

Fire can stimulate production of willows, increasing available browse species for wildlife and livestock (Hansen *et al.* 1995). *Calamagrostis canadensis* (bluejoint reedgrass) is an aggressive invader of moist, burned sites due to its propagation from seeds and rhizomes. Prescribed burning can also aid in rejuvenating decadent stands of willows. Quick, hot fires result in more sprouts, while slow fires damage the willows and result in fewer sprouts. Care should be taken when burning this association near stream banks due to the excellent erosion protection it provides (Hansen *et al.* 1995).

Both *Salix monticola* (yellow willow) and *Calamagrostis canadensis* (bluejoint reedgrass) are valuable species for stabilizing or rehabilitating stream banks. *Calamagrostis canadensis* is valuable due to its propagation from rhizomes. *Salix monticola* can probably be grown and transplanted from nursery cuttings in the same manner as

Salix geeyeriana. Cuttings should be taken in the spring from dormant, 2-4 year old wood. Cuttings should be 12-20 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

Pitkin/Booth Creeks

Salix monticola/Carex utriculata

yellow willow/beaked sedge

Global Rank: G3

Global Rank Comments: This association is known only from Colorado.

State Rank: S3

State Rank Comments: In Colorado, this association is known from thirteen locations, and an additional ten to twenty are expected to occur. This association is threatened by improper livestock grazing, inappropriate stream flow alterations, and heavy recreational use.

General Description and Comments: The *Salix monticola/Carex utriculata* (yellow willow/beaked sedge) plant association is a tall, (5-8 ft., 1.5-2.5 m), deciduous shrubland with an open canopy of willows and a thick understory of grasses and sedges. It occurs on open floodplains and often forms a continuous willow canopy across the valley floor. The undergrowth is dominated by patches of *Carex utriculata* (beaked sedge). *Carex aquatilis* (water sedge) and *Calamagrostis canadensis* (bluejoint reedgrass) are often also present, but *Carex utriculata* is either the clear dominant or is most consistently present throughout the stand. This distinguishes this association from the *Salix monticola/Carex aquatilis* (yellow willow/aquatic sedge) and *Salix monticola/Calamagrostis canadensis*

Regional Distribution: This plant association occurs in Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: This plant association occurs in the Colorado (Kittel *et al.* 1994), the Gunnison (Kittel *et al.* 1995) and South Platte River Basins (Cooper and Cottrell 1990), and the San Juan National Forest (Richard *et al.* 1996).

Elevation Range in Colorado: 8300-10,240 ft. (2500-3100 m).

Site Geomorphology: This plant association commonly occurs near beaver ponds. Willows establish on hummocks of higher ground and *Carex utriculata* establishes at the pond margins. This association also occurs along wet stream banks and terraces of low gradient (<3%), broad valley bottoms. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Stream reaches can be moderately wide with a gentle gradient (Rosgen's Channel Type: B3), wide and meandering (Rosgen's Channel Type: C3), or altered by beaver activity, creating multiple channels (Rosgen's Channel Type: D6). One stand occurs on a severely eroding gulch (Rosgen's Channel Type: G6).

Soils: Soils are clay loam, sandy clay loam and heavy silty clay textures and occasional mottling. Some profiles have a buried organic layer. Others have up to 40% organic matter in the top 20 inches (50 cm). In the Colorado River Basin, soils classify as oxyaquic Ustorthents, typic Cryaquents, oxyaquic Cryofluvents, cumulic and histic Cryaquolls, and pachic Cryoborolls.

Vegetation: This association is characterized by a thick, closed willow canopy dominated by 10-80% cover of *Salix monticola* (yellow willow). In this association, *Salix monticola* is the "matrix" shrub, the species with the highest abundance, even though other willow species may have a higher combined canopy cover. Other shrub species that may be present include: *Salix geyeriana* (Geyer willow) (4-40%), *Salix brachycarpa* (barrenground willow) (2-28%), *Salix drummondiana* (Drummond willow) (1-20%) and *Salix eriocephala* var. *ligulifolia* (strap leaf willow) (1-11%), and *Salix boothii* (Booth willow) (1%).

Carex utriculata (beaked sedge) is the most abundant graminoid with 1-44% cover. Other graminoid cover is minor, and includes *Carex aquatilis* (aquatic sedge) (1-11%), *Poa pratensis* (Kentucky bluegrass) (1-24%), and *Deschampsia cespitosa* (tufted hairgrass) (1-4%). Total forb cover is generally <10% cover. Forb species include: *Cardamine cordifolia* (bittercress) (1-10%), *Mertensia ciliata* (chiming bells) (1-3%), and *Heracleum maximum* (cow parsnip) (1-3%).

Successional and Ecological Processes: This plant association requires a high water table and saturated soils for much of the growing season and may be an early successional stage of the *Salix monticola/Carex aquatilis* and the *Salix monticola/Calamagrostis canadensis* associations (Cooper and Cottrell 1996).

Carex utriculata (beaked sedge), *Carex aquatilis* (aquatic sedge), and *Calamagrostis canadensis* (bluejoint reedgrass) are common dominant undergrowth of several *Salix* plant associations. These three graminoids indicate different micro-environments, generally separating out along a moisture gradient related to the depth of the water table, and can represent different stages of succession of the floodplain (Cooper 1986).

Carex utriculata (beaked sedge) occurs on the wettest sites, such as shallow pond margins, low-lying swales, and overflow channel with the shallowest water tables. *Carex aquatilis* (water sedge) occurs on intermediate sites that have saturated but not inundated soils. *Calamagrostis canadensis* (bluejoint reedgrass) dominates the drier sites with lower water tables. As sites become drier, it can colonize stands of *Carex utriculata* (beaked sedge) and *Carex aquatilis* (water sedge) (Cooper 1986).

Changes in the physical environment, brought on by flooding or other disturbance, can initiate successional shifts in species composition. Sediment deposition on the floodplain raises the surface higher above the water table (Cooper 1986). As aggradation, or build up, of the floodplain proceeds, the site becomes drier and the dominant graminoid understory changes. Thus *Carex aquatilis* (water sedge) dominated stands (regardless of any overstory canopy) may shift toward *Calamagrostis canadensis* (bluejoint reedgrass) dominated stands.

Management: *Salix monticola* (yellow willow) appears to be less tolerant of browsing pressure than other tall montane willow species. It responds to heavy browsing pressure in the same way that *Salix geyeriana* (Geyer willow) does; it forms the classic “mushroom” shape with over browsing by deer and cattle (Hansen *et al.* 1995). *Carex* (sedge) species can be heavily grazed by livestock in narrow riparian areas in mid-elevation rangelands. Improper grazing by livestock in this plant association can dry sites, increase non-native cover, and reduce the vigor of willow root structure. 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 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).

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 table across the floodplain and provided 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).

According to Hansen *et al.* (1995), burning of this plant association temporarily increases the productivity of *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 in order to prevent livestock from consuming young, palatable regrowth. Prescribed burning 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 (yellow willow), *Carex utriculata* (beaked sedge) and *Carex aquatilis* (aquatic sedge) are effective stream bank stabilizers. *Carex utriculata* and *Carex aquatilis* hold stream banks with their dense network of rhizomatous roots. *Salix monticola* 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 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

East Brush Creek

Gypsum Creek

***Salix monticola*/mesic forb**
yellow willow/mesic forbs

Global Rank: G3

Global Rank Comments: This association is known only from Colorado.

State Rank: S3

State Rank Comments: In Colorado, over thirty stands have been documented. Many stands of this association may represent grazing induced shifts from other *Salix monticola* dominated plant associations. Stands with an intact and complete native herbaceous understory are threatened by improper livestock grazing, inappropriate stream flow alterations, and heavy recreational use.

General Description and Comments: The *Salix monticola*/mesic forb (yellow 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.

Regional Distribution: This plant association occurs in Colorado (Colorado Natural Heritage Program 1997).

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.* 1995), South Platte (Copper and Cottrell 1990, Kittel *et al.* 1997), North Platte and Rio Grande/Closed Basin (Kittel *et al.* 1999), as well as the western half of the San Juan National Forest (Richard *et al.* 1996).

Elevation Range in Colorado: 6600-10,700 ft. (2000-3260 m).

Site Geomorphology: The *Salix monticola*/mesic forb (yellow 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 were 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).

Soil: Soils are fine textured sandy clays to silty and sandy clay loams. Mottling and gleyed layers are common within 5 inches (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 soils classify as Cryofluvents and Cryorthents.

Vegetation: *Salix monticola* (yellow willow) forms a dense to open canopy with 20-100% cover and if not the clear dominant, then it is the matrix willow. The matrix species is the willow with the highest abundance, even though other willow species may have a higher combined canopy cover. Other shrub species that may be present include: *Salix drummondiana* (Drummond willow) (1-70%), *Ribes inermes* (1-70%), *Salix planifolia* (planeleaf willow) (1-30%), *Alnus incana* (thinleaf alder) (1-20%), *Salix bebbiana* (Bebb willow) (1-20%), *Salix geyeriana* (Geyer willow) (1-80%), *Lonicera involucrata* (bush honeysuckle) (1-20%), *Salix brachycarpa* (short fruit willow) (1-20%), *Salix wolfii* (Wolf willow) (1-30%), and *Salix eriocephala* (yellow willow) (1-20%).

Total forb cover ranges from 10-70%. No one forb species is particularly more abundant than any other, nor is any species consistently present in all stands. Forb species that may be present include: *Heracleum lanatum* (cow parsnip) (1-73%), *Rudbeckia laciniata* (cone flower) (1-28%), *Mertensia ciliata* (chiming bells) (1-20%), and *Fragaria virginiana* (wild strawberry) (1-10%). Graminoid cover ranges from zero to 50%, and in general never exceeds the total forb cover. Graminoid species that may be present include: *Calamagrostis canadensis* (bluejoint reedgrass) (1-30%) and *Carex utriculata* (beaked sedge) (1-4%). Generally, forbs are dominant under shrubs on hummocks and ridges while graminoids dominate the undergrowth in low-lying, wetter swales. In the San Juan

National Forest, stands of this association show a significant shift in forb species at lower elevations with *Rudbeckia laciniata* (cone flower) more dominant and the average cover of exotic species higher. This may indicate heavy grazing pressure in the past. Exotic graminoid and forb species include: *Poa pratensis* (Kentucky bluegrass) (1-50%), *Trifolium repens* (sweet clover) (1-22%), and *Taraxacum officinale* (dandelion) (1-12%).

Successional and Ecological Processes: *Salix monticola* (yellow 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 feet (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 (yellow 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) 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.

Management: Stands with an abundance on 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. Land managers should consider maintaining beaver activity in an area (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 (yellow 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 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

Cataract Creek
Deep Creek

Salix planifolia/Calamagrostis canadensis
planeleaf willow/bluejoint reedgrass

Global Rank: G4

Global Rank Comments: This is a common plant association known throughout the rocky mountain states.

State Rank: S4

State Rank Comments: This association appears to have been more abundant historically. It is continually threatened by improper grazing, road improvements and maintenance, and heavy recreational use.

General Description and Comments: The *Salix planifolia/Calamagrostis canadensis* (planeleaf willow/bluejoint reedgrass) plant association is the least common of the *Salix planifolia* plant associations. It is frequently grazed to the point of shifting the dominant undergrowth grasses. It may have been more abundant historically.

Regional Distribution: This plant association occurs in the Big Horn National Forest in north-central Wyoming (Girard *et al.* 1995), northeastern Utah (Padgett *et al.* 1989), and Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: This association occurs in southeastern Colorado, the San Juan National Forest, the White River Basin, and along the Front Range (Baker 1989, Richard *et al.* 1996, Kittel *et al.* 1994, Cooper and Cottrell 1990).

Elevation Range in Colorado: 9000-11,000 ft. (2700-3400 m).

Site Geomorphology: This is a high elevation wetland plant association, usually occurring in broad, glacial valleys and swales where direct snowmelt is the primary moisture source throughout the growing season. Streams were classified according to the *Rosgen Classification of Natural Rivers* (Rosgen 1996). Stream channels are wide and moderately sinuous, often associated with beaver ponds (Rosgen's Channel Type: B3). This association also occurs in narrow valleys with sinuous streams and wet floodplains (Rosgen's Channel Type: E4).

Soil: *Salix planifolia* shrublands occur on peat or mineral soils, deep clay loams and sandy clay loams, derived from glacial till. The mineral soils can have a high organic content.

Vegetation: *Salix planifolia* (planeleaf willow) forms a dense shrub layer with 40-90% cover. Other willow species that may be present include: *Salix brachycarpa* (shortfruit willow) (30%), and *Salix wolfii* (Wolf willow) (2-3%). *Calamagrostis canadensis* (bluejoint reedgrass) dominates the dense and sometimes rich herbaceous layer with 5-70% cover. Several *Carex* (sedge) species can also be present including *Carex utriculata* (beaked sedge) (3-10%), *Carex microptera* (smallwing sedge) (3-10%), and *Carex aquatilis* (water sedge) (1-4%). The forb layer can be diverse, but generally has less than 10% total cover. Forb species can include: *Caltha leptosepala* (marsh marigold) (3-50%), *Cardamine cordifolia* (heartleaf bittercress) (1-3%), *Pedicularis groenlandica* (elephant-head) (1%), and *Mertensia ciliata* (mountain bluebell) (1%).

Successional and Ecological Processes: : *Salix planifolia* (planeleaf willow), *Salix brachycarpa* (shortfruit willow) and *Salix wolfii* (Wolf willow) are abundant low-stature (1-3 ft, 0.3-1 m) willows of first- and second-order streams of subalpine elevations of Colorado. *Salix planifolia* and *Salix brachycarpa* can form extensive stands, often creating intricate mosaics in broad, subalpine valleys. In general, *Salix planifolia* occupies the wettest micro-habitats on peat soils, although it can grow well on mineral soils. *Salix brachycarpa* is more often found on slightly drier and more well-drained micro-habitats than *Salix planifolia*. *Salix brachycarpa* grows on lateral moraines, coarse-textured stream banks, ridge tops and on small hummocks (Kittel 1994).

Salix planifolia also grows at elevations below the subalpine, and becomes a much taller willow due to a longer growing season. The two ecotypes were once thought to be two varieties of the species (Weber 1990). In montane elevations, *Salix planifolia* is often a co-dominant in *Salix monticola* plant associations. While *Salix planifolia* is not rhizomatous, it can be stimulated by browsing and has been shown to produce ten times more shoot biomass and twice as much root biomass as *Salix monticola* (Cottrell 1995). This may explain why *Salix planifolia* is so abundant in the upper reaches of most mountain watersheds in Colorado.

Carex utriculata (beaked sedge), *Carex aquatilis* (water sedge), and *Calamagrostis canadensis* (bluejoint reedgrass) are dominant understory species of several *Salix* plant associations. These graminoids indicate different microenvironments within the *Salix* communities (Padgett *et al.* 1989) and may represent different stages of succession of the floodplain (Cooper 1986).

Carex utriculata, *Carex aquatilis*, and *Calamagrostis canadensis* separate out along a moisture gradient related to the depth of the water table at a particular site. *Carex utriculata* occurs on the wettest sites, such as low-lying swales, with the highest water tables. *Carex aquatilis* occurs on intermediate sites. *Calamagrostis canadensis* dominates the driest sites with the lowest water tables and often colonizes clumps of *Carex utriculata* and *Carex aquatilis* (Cooper 1986).

Floodplain aggradation, or build up, can result in a change in species composition over time. Late spring snow melt and long periods of summer rain cause high elevation streams to overflow their banks. Sediments are deposited on the floodplain, raising the surface higher above the water table (Cooper 1986). As aggradation of the floodplain proceeds and the site becomes less saturated, the dominant graminoid understory can change from *Carex utriculata* to *Carex aquatilis* to *Calamagrostis canadensis*.

Distance from the stream channel can differentiate the graminoids spatially. *Carex utriculata* commonly occurs at the stream channel edge where the water table is close to the ground surface. *Carex utriculata* is usually found in standing water. Further away from the channel are mesic meadows of *Carex aquatilis* and slightly drier meadows of *Calamagrostis canadensis*.

According to Padgett *et al.* (1989), the *Salix planifolia*/*Calamagrostis canadensis* association may represent an ecotonal community to the conifer/*Calamagrostis canadensis* community type. In Colorado, *Salix planifolia*/*Calamagrostis canadensis* stands have been observed at the ecotone to the conifer/*Calamagrostis canadensis* plant association (Sanderson and March 1996).

Management: *Salix planifolia* (planeleaf willow) is highly palatable to wildlife and livestock. The forage value of *Calamagrostis canadensis* (bluejoint reedgrass) is moderate to high when shoots are young. With high grazing pressure, the height and density of *Salix planifolia* will decrease and the growth of *Calamagrostis canadensis* will decline (Hansen *et al.* 1995, Girard *et al.* 1995).

Low-stature *Salix planifolia* willow carrs appear to be sensitive to trampling and soil compaction by livestock due to saturated conditions throughout the growing season (Girard *et al.* 1995). However, livestock may avoid the wettest sites until August or September. If season-long grazing does occur, the plants and soils will be damaged. Heavy grazing opens the canopy and lowers the water table due to streambed downcutting and increased evapotranspiration. This allows *Salix brachycarpa* (shortfruit willow) or *Pentaphylloides floribunda* (shrubby cinquefoil) and drier herbaceous species to become established (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 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 high water table necessary for the health of the riparian ecosystem. Beaver dams also aid in controlling channel downcutting, stream bank erosion, and downstream movement of sediment. Beaver dams raise the water table and provide water for hydrophytic plants such as willows and sedges. Sediment trapped behind beaver dams, raises the channel bed and creates a broader wetland area. Land managers should consider maintaining beaver activity in an area rather than removing them (Hansen *et al.* 1995).

Burning *Salix planifolia*/*Calamagrostis canadensis* stands may renew production of browse species for wildlife and livestock. *Calamagrostis canadensis* is an aggressive invader of moist, burned sites due to its propagation from seeds and rhizomes. Burning also temporarily increases the productivity of *Carex aquatilis* (water sedge) and *Carex*

utriculata (beaked sedge), if present. Grazing should be removed from burned sites for 2-3 years following a fire in order to prevent livestock from browsing young, palatable regrowth (Hansen *et al.* 1995).

Both *Salix planifolia* and *Calamagrostis canadensis* are valuable for revegetating and stabilizing stream banks. *Salix planifolia* can be grown from nursery cuttings and then transplanted. Best results are obtained from cuttings taken in the spring from dormant 2-4 year old wood. Cuttings should be 12-20 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear 10-15 days after planting if conditions are right. *Calamagrostis canadensis* can be propagated from rhizomes (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

Cross Creek

Salix wolfii*/*Carex utriculata

Wolf willow/beaked sedge

Global Rank: G4

Global Rank Comments: This association is known from Idaho, Utah and Colorado.

State Rank: S3

State Rank Comments: In Colorado, this association is known from only four locations, however it is expected to occur throughout its habitat.

General Description and Comments: The *Salix wolfii*/*Carex utriculata* (Wolf willow/beaked sedge) plant association is an uncommon community of very wet subalpine sites in western Colorado. In Colorado, *Salix wolfii* grows in small patches and does not form large, expansive willow carrs like *Salix planifolia*. *Salix wolfii* often forms a mosaic with stands of *Salix planifolia*, *Salix brachycarpa* (shortfruit willow) and open *Carex* spp. (sedge) meadows.

Regional Distribution: This plant association occurs in Utah (Padgett *et al.* 1989), eastern Idaho (Youngblood *et al.* 1985), Wyoming (Girard *et al.* 1995) and Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: This association occurs in the Colorado River Basin (Kittel *et al.* 1994).

Elevation Range in Colorado: 8600-9500 ft. (2600-2900 m).

Site Geomorphology: This plant association occurs on saturated floodplains in broad to narrow valleys. It is often associated with beaver pond wetlands.

Soil: Soil textures are silty loams to silty clay loams and classify as histic Cryaquepts, cumulic Cryoborolls, and terric Borofibrists.

Vegetation: This plant association is characterized by a low, dense shrub layer dominated by 40-60% cover of *Salix wolfii* (Wolf willow). Other shrubs that may be present include: *Salix planifolia* (planeleaf willow) (20-40%) and *Pentaphylloides floribunda* (shrubby cinquefoil) (1-3%). *Carex utriculata* (beaked sedge) dominates the lush graminoid undergrowth with 10-20% cover. Other graminoid species that may be present include: *Calamagrostis canadensis* (bluejoint reedgrass) (3-10%) and *Carex aquatilis* (water sedge) (1-20%).

Successional and Ecological Processes: *Salix planifolia* (planeleaf willow), *Salix brachycarpa* (shortfruit willow) and *Salix wolfii* (Wolf willow) are abundant low-stature (1-3 ft, 0.3-1 m) willows of first- and second-order streams of subalpine elevations of Colorado. *Salix planifolia* and *Salix brachycarpa* can form extensive stands, often creating intricate mosaics in broad, subalpine valleys. In general, *Salix planifolia* occupies the wettest micro-habitats on peat soils, although it can grow well on mineral soils. *Salix brachycarpa* is more often found on slightly drier and more well-drained micro-habitats than *Salix planifolia*. *Salix brachycarpa* grows on lateral moraines, coarse-textured stream banks, ridge tops and on small hummocks (Kittel 1994).

Stands of *Salix wolfii* are less frequently encountered, and are usually limited in size. *Salix wolfii* dominated stands are more common on the western slope (David Cooper, *personal communication*). Of the twenty-eight *Salix wolfii* stands documented by the Colorado Natural Heritage Program (1997), twenty-six are located on the west slope. According to Phillips (1977), *Salix wolfii* grows on deep, undecomposed peat, while *Salix planifolia* tends to grow on more decomposed (humified) organic soils.

Further north in Montana, *Salix planifolia* stands are observed on wetter and finer-textured soils than sites containing *Salix wolfii* dominated communities (Hansen *et al.* 1988).

Carex utriculata (beaked sedge), *Carex aquatilis* (water sedge), and *Calamagrostis canadensis* (bluejoint reedgrass) are dominant understory species of several *Salix* plant associations. These graminoids indicate different microenvironments within the *Salix* communities (Padgett *et al.* 1989) and may represent different stages of succession of the floodplain (Cooper 1986).

Carex utriculata, *Carex aquatilis*, and *Calamagrostis canadensis* separate out along a moisture gradient related to the depth of the water table at a particular site. *Carex utriculata* occurs on the wettest sites, such as low-lying swales, with the highest water tables. *Carex aquatilis* occurs on intermediate sites. *Calamagrostis canadensis* dominates the driest sites with the lowest water tables and often colonizes clumps of *Carex utriculata* and *Carex aquatilis* (Cooper 1986).

Floodplain aggradation, or build up, can result in a change in species composition over time. Late spring snow melt and long periods of summer rain cause upper elevation streams to overflow their banks. Sediments are deposited on the floodplain, raising the surface higher above the water table (Cooper 1986). As aggradation of the floodplain proceeds and the site becomes less saturated, the dominant graminoid understory can change from *Carex utriculata* to *Carex aquatilis* to *Calamagrostis canadensis*.

Distance from the stream channel can differentiate the graminoids spatially. *Carex utriculata* commonly occurs at the stream channel edge where the water table is close to the ground surface. *Carex utriculata* is usually found in standing water. Further away from the channel are mesic meadows of *Carex aquatilis* and slightly drier meadows of *Calamagrostis canadensis*.

The *Salix wolfii*/*Carex utriculata* plant association occurs on saturated floodplains and wetlands. In western Wyoming and eastern Idaho, *Carex aquatilis* appears to replace *Carex utriculata* (beaked sedge) as organic layers build and oxygen becomes available through lateral movement of water (Youngblood *et al.* 1985). If the water table is lowered and the site begins to dry out, the *Salix wolfii*/*Carex utriculata* association may become a *Salix wolfii*/*Deschampsia cespitosa* (Wolf willow/tufted hairgrass) or *Salix wolfii*/mesic forb type (Padgett *et al.* 1989).

Management: *Salix wolfii* is moderately palatable to livestock. Forage value for *Carex aquatilis* (water sedge) and *Carex utriculata* (beaked sedge) is variable depending on the season, previous grazing use, and the size of the rangelands. In narrow riparian areas within extensive rangelands, the undergrowth of this association may be heavily grazed (Hansen *et al.* 1995).

Low-stature *Salix wolfii* willow carrs appear to be sensitive to trampling and soil compaction by livestock due to saturated conditions throughout the growing season (Girard *et al.* 1995). However, livestock may avoid the wettest sites until August or September. If season-long grazing does occur, the plants and soils will be damaged. Heavy grazing opens the canopy and lowers the water table due to streambed downcutting and increased evapotranspiration. This allows *Salix brachycarpa* (shortfruit willow) or *Pentaphylloides floribunda* (shrubby cinquefoil) and drier herbaceous species to become established (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 willow species are vulnerable to pruning damage (Hansen *et al.* 1995).

Beaver activity in the vicinity of this plant association is important for maintaining the high water table necessary for the health of the riparian ecosystem. Beaver dams aid in controlling channel downcutting, stream bank erosion, and downstream movement of sediment. Beaver dams raise the water table and provide water for hydrophytic plants such as willows and sedges. Sediment trapped behind beaver dams, raises the channel bed and creates a broader wetland area. Land managers should consider maintaining beaver activity in an area (Hansen *et al.* 1995).

Prescribed burning can aid in rejuvenating decadent stands of *Salix wolfii*. Quick, hot fires result in more sprouts, while slow fires damage the willows and result in fewer sprouts. Burning also temporarily increases the productivity of *Carex aquatilis* and *Carex utriculata*. Grazing should be eliminated from the burned sites for 2-3 years following a fire in order to prevent livestock from browsing young, palatable regrowth (Hansen *et al.* 1995).

Salix wolfii and *Carex* (sedge) species are valuable for revegetating and stabilizing stream banks. *Salix wolfii* can be grown from nursery cuttings and then transplanted, but success is inconsistent. Best results are obtained from cuttings taken in the spring from dormant 2-4 year old wood. Cuttings should be 12-20 inches (30-50 cm) long and at least 0.5 inches (1 cm) in diameter. Roots and shoots should appear within 10-15 days after planting if conditions

are right. *Carex aquatilis* and *Carex utriculata* are very effective due to their dense network of rhizomatous roots (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

Fall Creek

Shepherdia argentea
silver buffaloberry

Global Rank: G4

Global Rank Comments: This association is common in Montana.

State Rank: S1

State Rank Comments: In Colorado, this association is in serious decline, and is threatened by improper livestock grazing, inappropriate stream flow alterations, and dropping water tables.

General Description and Comments: The *Shepherdia argentea* (silver buffaloberry) plant association is a medium-tall (4-6 ft., 1.2-2 m) shrubland. It occurs within a mosaic of deciduous tree and willow plant associations in the riparian corridor on broad floodplains of larger rivers on the Western Slope. Unfortunately, most stands in Colorado are degraded by improper grazing and stream flow alterations. Stands generally occur in wide valleys.

Regional Distribution: This association occurs in Colorado (Colorado Natural Heritage Program 1997).

Distribution in Colorado: *Shepherdia argentea* dominated stands are scattered along the Colorado West Slope at lower elevations. This plant association occurs in the Yampa River (Kittel and Lederer 1993) and Colorado River Basins (Kittel *et al.* 1994), on the San Juan National Forest (Richard *et al.* 1996), and in the lower San Juan River Basin (Kittel *et al.* 1999).

Elevation Range in Colorado: 6300-7200 ft. (1900-2200 m).

Site Geomorphology: This plant association occurs on moderate to wide floodplains, 250-1000 feet (80-300 meters) wide with gravel and cobble streambed materials. Streams were classified according to the Rosgen Classification of Natural Rivers (Rosgen 1996). Stream channels are low gradient, 0.3-4%, and moderately sinuous (Rosgen's Channel Type: B3, B4) or highly sinuous (Rosgen's Channel Type: C3). Some stream channels are heavily entrenched.

Soil: Soils are deep, fine, silty and sandy clay loams over stratified alluvial material. In the Colorado River Basin, the soils classify as loamy (calcareous) aeric Halaquepts or Cryaquepts, to fragmental (calcareous) lithic Cryorthents.

Vegetation: *Shepherdia argentea* (silver buffaloberry), with 25-73% cover, dominates the dense, but patchy, tall-shrub layer of this plant association. Other shrubs that may be present include: *Rosa woodsii* (woods rose) (1-47%), *Salix exigua* (coyote willow) (1-31%), and *Rhus trilobata* (skunkbush) (1-22%). *Artemisia tridentata* (big sagebrush) and *Chrysothamnus linifolius* (spreading rabbitbrush) may also be present.

The herbaceous undergrowth varies from a sparse (<10%) to dense (>50%) cover. Forb species that may be present include: *Solidago canadensis* (goldenrod) (1-24%), *Maianthemum stellatum* (false Solomon's seal) (1-22%), *Clematis ligusticifolia* (white virgin's-bower) (1-20%), and *Rudbeckia laciniata* (cutleaf coneflower) (1-10%). Some stands have a thick litter layer between clumps of 1-20% cover of the native bunchgrass *Leymus cinereus* (giant wild-rye). Non-native grasses, including *Poa pratensis* (Kentucky bluegrass) (1-36%), *Bromus tectorum* (cheatgrass) (5%), and *Bromus inermis* (smooth brome) (1-5%), are present in disturbed stands.

Successional and Ecological Processes: In Montana, *Shepherdia argentea* (silver buffaloberry) is widespread and is considered a mid-seral, grazing-induced successional stage of the *Fraxinus pennsylvanica/Prunus virginiana* (green ash/common chokecherry) or the *Acer negundo/Prunus virginiana* (boxelder/common chokecherry) habitat types. Disturbance by livestock opens up stands of *Shepherdia argentea* and allows the establishment of *Symphoricarpos occidentalis* (snowberry), *Toxicodendron rydbergii* (poison ivy), and *Taraxacum officinale* (dandelion) (Hansen *et al.* 1995).

In Colorado, *Shepherdia argentea* was probably once more widespread, but is on the decline with the loss of lower elevation riparian habitats. *Shepherdia argentea* is now an uncommon riparian shrub and is being replaced by *Elaeagnus angustifolia* (Russian olive). A few stands of the *Shepherdia argentea* association have *Populus*

angustifolia (narrowleaf cottonwood) present. Historically, the *Shepherdia argentea* plant association may have been part of a *Populus angustifolia* dominated riparian woodland. More information is needed about the historical range, regeneration requirements and drought tolerance of *Shepherdia argentea*.

Management: Forage production and palatability of the *Shepherdia argentea* (silver buffaloberry) plant association is low for both livestock and wildlife. The thorns of *Shepherdia argentea* typically deter livestock grazing. However, as stands open up, forage production and grazing pressure increase with the establishment of *Poa pratensis* (Kentucky bluegrass) (Hansen *et al.* 1995). Birds use the berries of the shrub.

Shepherdia argentea is fairly tolerant of fire when dormant. This shrub species is also useful for revegetating disturbed sites and nursery-grown stock readily establishes when planted. Once established, this shrub species is an excellent soil stabilizer (Hansen *et al.* 1995).

Potential Conservation Areas which support this community:

Colorado River

Potential Conservation Areas

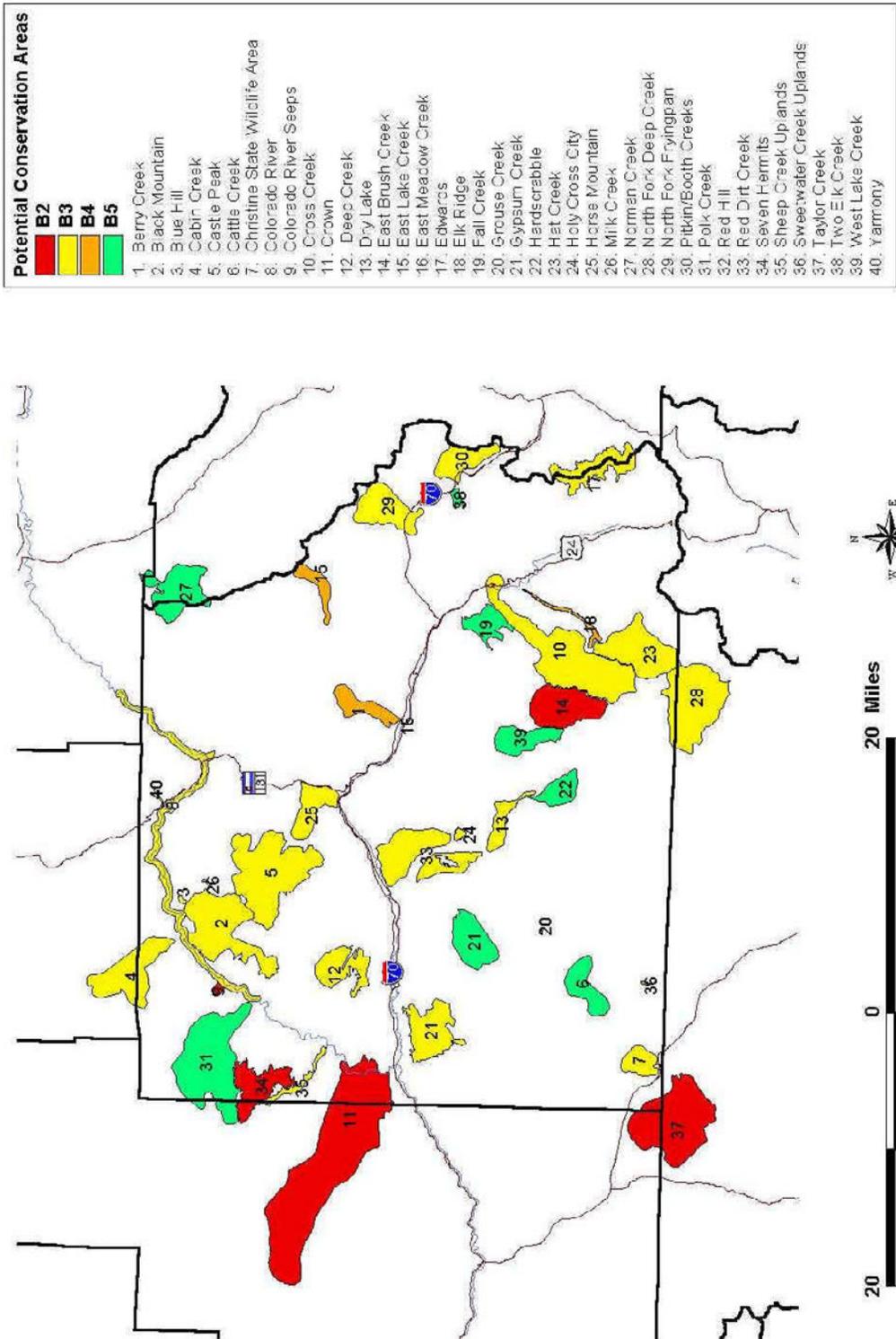


View of Deep Creek from within a cave. Photo by Cyndi Mosch.

Table 5. Potential Conservation Areas of Eagle County Displayed By Biodiversity Rank

| Potential Conservation Area | Biodiversity Rank | Page Number |
|--|-------------------|-------------|
| Very High Biodiversity Significance | | |
| Colorado River Seeps | B2 | |
| Crown | B2 | |
| Deep Creek | B2 | |
| East Lake Creek | B2 | |
| Sheep Creek | B2 | |
| High Biodiversity Significance | | |
| Black Mountain | B3 | |
| Blue Hill | B3 | |
| Cabin Creek | B3 | |
| Castle Peak | B3 | |
| Christine State Wildlife Area | B3 | |
| Colorado River | B3 | |
| Cross Creek | B3 | |
| Dry Lake | B3 | |
| East Brush Creek | B3 | |
| Elk Ridge | B3 | |
| Gypsum Creek | B3 | |
| Holy Cross City | B3 | |
| Milk Creek | B3 | |
| North Fork Fryingpan | B3 | |
| Pitkin/Booth | B3 | |
| Polk Creek | B3 | |
| Red Hill | B3 | |
| Seven Hermits | B3 | |
| Sweetwater Uplands | B3 | |
| Yarmony Creek | B3 | |
| Moderate Biodiversity Significance | | |
| Berry Creek | B4 | |
| Fall Creek | B4 | |
| Taylor Creek | B4 | |
| General Biodiversity Significance | | |
| Cattle Creek | B5 | |
| East Meadow Creek | B5 | |
| Edwards | B5 | |
| Grouse Creek | B5 | |
| Hardscrabble | B5 | |
| Hat Creek | B5 | |
| Horse Mountain | B5 | |
| North Fork Deep Creek | B5 | |
| Red Dirt Creek | B5 | |
| Two Elk Trail | B5 | |
| West Lake Creek | B5 | |

Potential Conservation Areas of Eagle County Displayed by Biodiversity Rank



Berry Creek

Location: Eagle County, north of Edwards between Beard and June Creeks

U.S.G.S. 7.5 min. quadrangle (s): Edwards

Legal Description: T4S R82W S9,10,11,14,15,16,21,22,27,28,32,33; T5S R82W S4

Biodiversity Rank: B4

Biodiversity Rank Justification: The uplands that are included in the site support the globally rare Harrington's beardtongue. Harrington's beardtongue (*Penstemon harringtonii*) is a globally vulnerable plant species that is restricted to Colorado and is found almost exclusively in sagebrush habitat. This species is only known from approximately 37 locations, all of which are centered near Edwards in Eagle County. In general, Harrington's beardtongue and its habitat are highly threatened from residential development. These threats in addition to a restricted range emphasize the urgent need for protection. Harrington's beardtongue populations are known to fluctuate in population numbers from year to year. Therefore, this specific location may be a higher priority than the current information reflects. This location is one of the smaller areas designated for protection of this species.

Berry Creek also provides habitat for a good, albeit somewhat hybridized population of Colorado River cutthroat trout. Perhaps more significantly, the site represents a fishery with a barrier to upstream migration by exotic species of trout. This feature will help to keep the current native fishery intact.

Natural Heritage elements at the Berry Creek site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|--|--------------------------|-------------|------------|-----------------------|----------|
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | C |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado cutthroat trout | G4T3 | S3 | FS/BLM/S C | B |

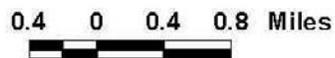
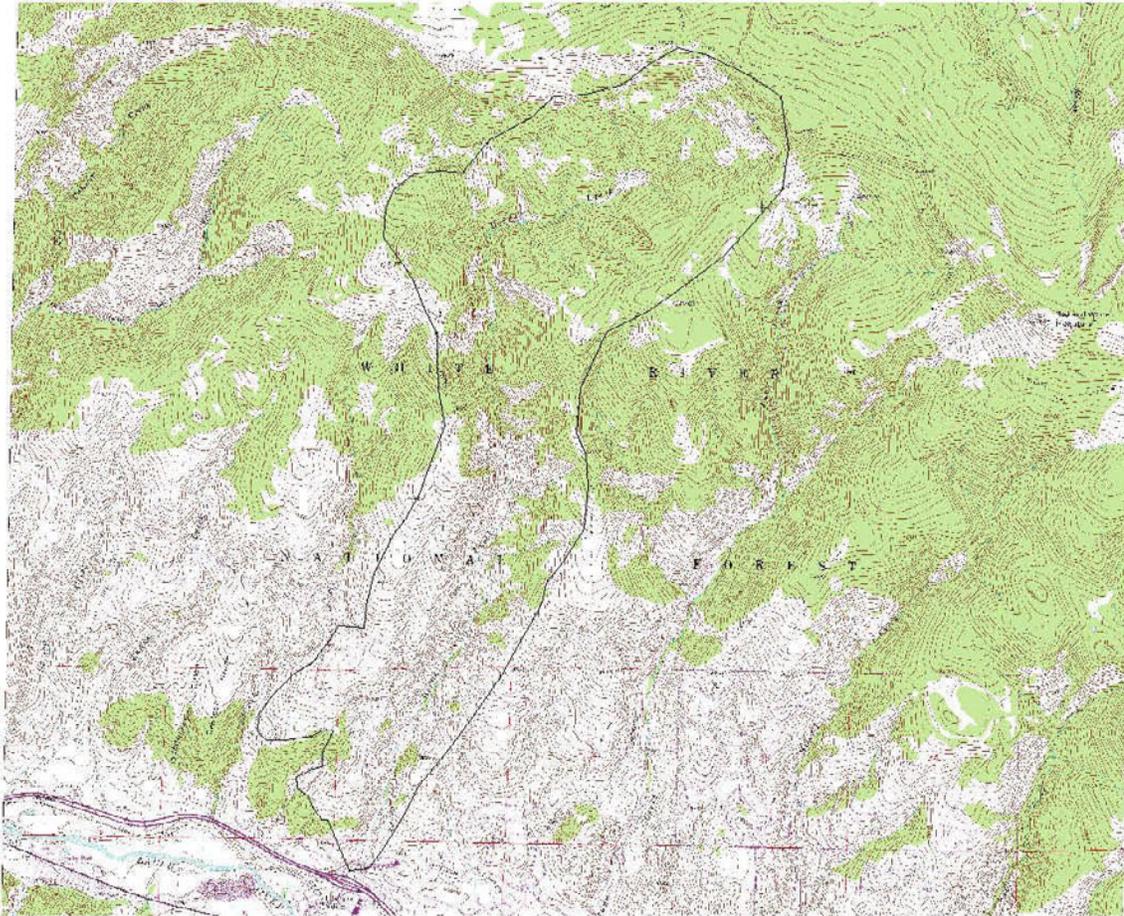
*EO = Element Occurrence

Boundary Justification: The site includes the immediate watershed that supports the trout and also includes a small mesa nearby. The downstream boundary continues to a culvert at I-70, which represents an upstream migration barrier to exotic trout species such as brook trout (*Salmo fontinalis*). The globally rare Harrington's beardtongue is found scattered on the mesa. The mesa only includes a small portion of a larger occurrence of this plant. This portion is the only undeveloped tract.

Management and Protection Comments: The Berry Creek area is primarily owned and managed by the U.S. Forest Service; small portions of private land and State Land Board property are also included in this site. This area is heavily used due to its proximity to Edwards and I-70. A dirt road follows the creek for approximately one mile and then continues onto the mesa top. The roads are heavily used by 4WD vehicles. Many social trails and campsites are present. There is evidence of illegal trash dumping along the creek. Weeds are common, especially in the riparian area. The area should be closed to motor vehicles and camping, and an exotic plant eradication plan should be developed.

General Description: The vegetation along Berry Creek is dominated by cottonwoods and several willow species. The uplands include mixed shrublands of mountain mahogany, sagebrush, pinyon, and juniper. The site includes 3587 acres and ranges in elevation between 7,400 and 11,000 feet.

Berry Creek Potential Conservation Area



Approximate location
of PCA within
Eagle County



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Map created 25 February
by T. L. Davis

Black Mountain

Location: Eagle County, between Black Mountain and Blue Hill, south of the Colorado River

U.S.G.S. 7.5 min. quadrangle (s): Burns South, Castle Peak

Legal Description: T2S R84W S18-20,29-31; T2S R85W S13,22-28, 33-36; T3S R84W S5-7; T3S R85W S1-4,9-12, 15-17,20-22.

Biodiversity Rank: B3

Biodiversity Rank Justification: Harrington's beardtongue (*Penstemon harringtonii*) is a globally vulnerable plant species which is restricted to Colorado and is found almost exclusively in sagebrush habitat. This species is only known from approximately 37 locations, all of which are centered near Edwards in Eagle County. In general, Harrington's beardtongue and its habitat are highly threatened from residential development. These threats, in addition to a restricted range emphasize the urgent need for protection. Harrington's beardtongue populations are known to fluctuate in population numbers from year to year. Therefore, this specific location may be a higher priority than the current information reflects. This site is one of ten that has been designed around the best locations of this species.

Natural Heritage elements at the Black Mountain site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|-------------------------------|--------------------------|-------------|------------|-----------------------|----------|
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | B |
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | B |
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | C |

*EO = Element Occurrence

Boundary Justification: This large boundary includes the three known occurrences and unsurveyed potential habitat that lay between them.

Management and Protection Comments: This site falls on public property managed by the Bureau of Land Management and also small portions of private property. Approximately one third of this site occurs within the Bull Gulch Wilderness Study Area. Until Congress determines otherwise, the area is under interim management so as not to impair the suitability of such areas for preservation as wilderness. Several small four-wheel drive roads and powerlines occur within the site. Livestock grazing is the main land use. Small portions of private property are adjacent to the site. Many of these private properties have been converted for agriculture. Exotic plant species (hay grasses and cheat grass) are common along roads and are moving into the natural community. If this invasion is not addressed through management, the native vegetation, including the *Penstemon*, will be adversely affected.

General Description: The Black Mountain site is dominated by sagebrush with scattered pinyon and juniper. The elevation range is 6,600-9,200 feet. The site includes 12,910 acres.

Black Mountain Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.



Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Blue Hill

Location: Eagle County, between the Colorado River and Colorado River Road just east of Derby Junction
 U.S.G.S. 7.5 min. quadrangle (s): Blue Hill, Castle Peak
 Legal Description: T2S R84W S17-19

Biodiversity Rank: B3

Biodiversity Rank Justification: The manystem stickleaf is found widely around Eagle County along roadsides. The roadcuts seem to imitate this species' unique habitat. The Blue Hill site is one of only four locations in the County which support this species in natural surroundings.

Natural Heritage elements at the a Blue Hill site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|------------------------------|--------------------|-------------|------------|-----------------------|----------|
| <i>Nuttallia multicaulis</i> | Manystem stickleaf | G3 | S3 | | B |

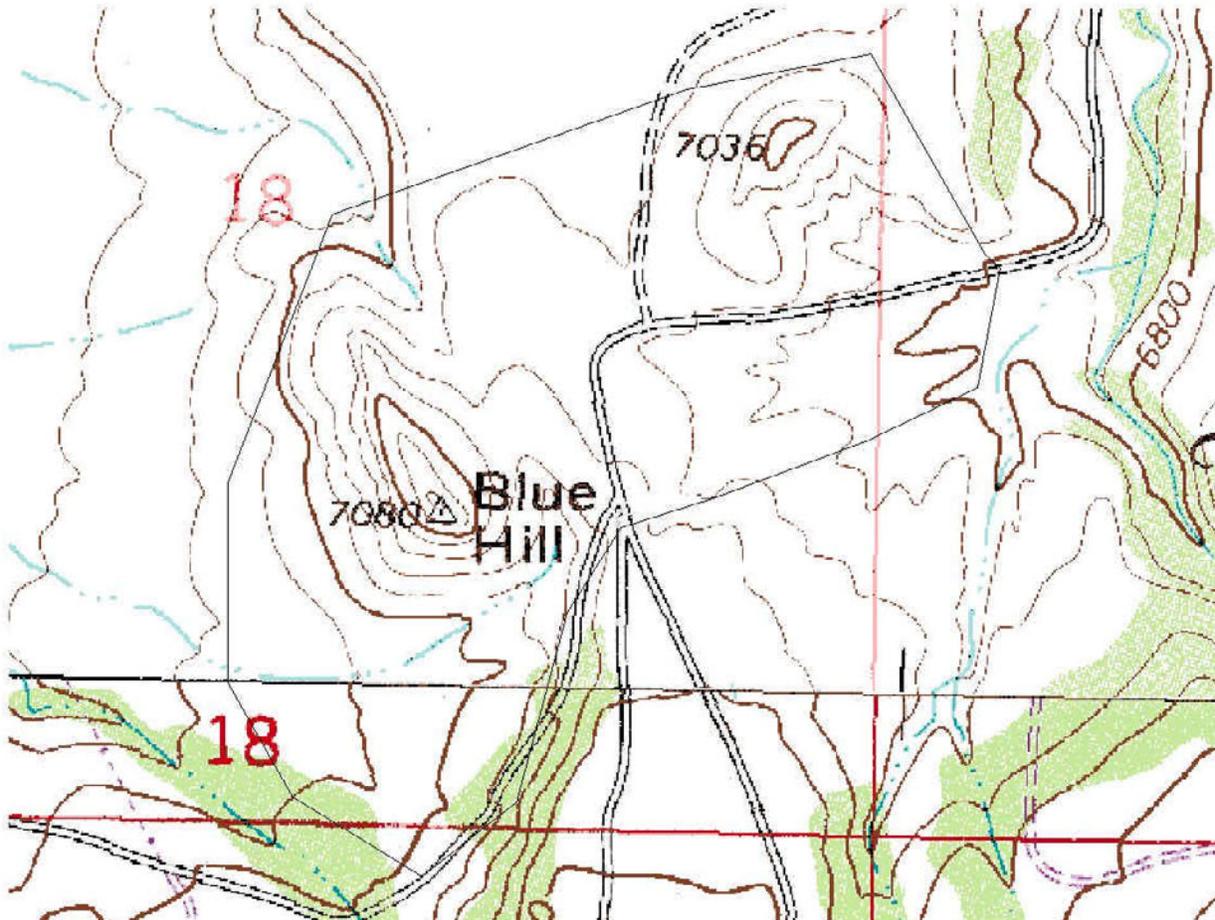
*EO = Element Occurrence

Boundary Justification: This boundary encompasses the occurrence and the surrounding adjacent suitable habitat to allow for movement over time.

Management and Protection Comments: This site falls on public land managed by the Bureau of Land Management. A small portion of private lands is also included in the site. Recreationists, especially dirt bikers, use this area heavily. Motorized vehicles are no longer allowed access but it appears that this activity is still occurring. Trampling will negatively impact the area.

General Description: Blue Hill is named for the blackish-blue colored soil which dominates this area in barren outcrops. The surrounding habitat is mainly sagebrush. The site includes 139 acres between 6,760 and 7,080 feet elevation.

Blue Hill Potential Conservation Area



0.05 0 0.05 0.1 Miles



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Cabin Creek

Location: Eagle and Routt Counties, northwest of Burns between Derby Mesa and the County Line
 U.S.G.S. 7.5 min. quadrangle (s): Burns North
 Legal Description: T1S R85W S17-21,28-34; T1S R86W S36; T2S R85W S3-6,9,10; T2S R86W S1

Biodiversity Rank: B3

Biodiversity Rank Justification: Harrington's beardtongue (*Penstemon harringtonii*) is a globally vulnerable plant species that is restricted to Colorado and is found almost exclusively in sagebrush habitat. This species is only known from approximately 37 locations, all of which are centered near Edwards in Eagle County. In general, Harrington's beardtongue and its habitat are highly threatened from residential development. These threats in addition to a restricted range, emphasize the urgent need for protection. Harrington's beardtongue populations are known to fluctuate in population numbers from year to year. Therefore, this specific location may be a higher priority than the current information reflects. This site is one of ten that has been designed around the best locations of this species.

Natural Heritage elements at the Cabin Creek site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|-------------------------------|--------------------------|-------------|------------|----------------------|----------|
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | B |
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | B |
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | C |

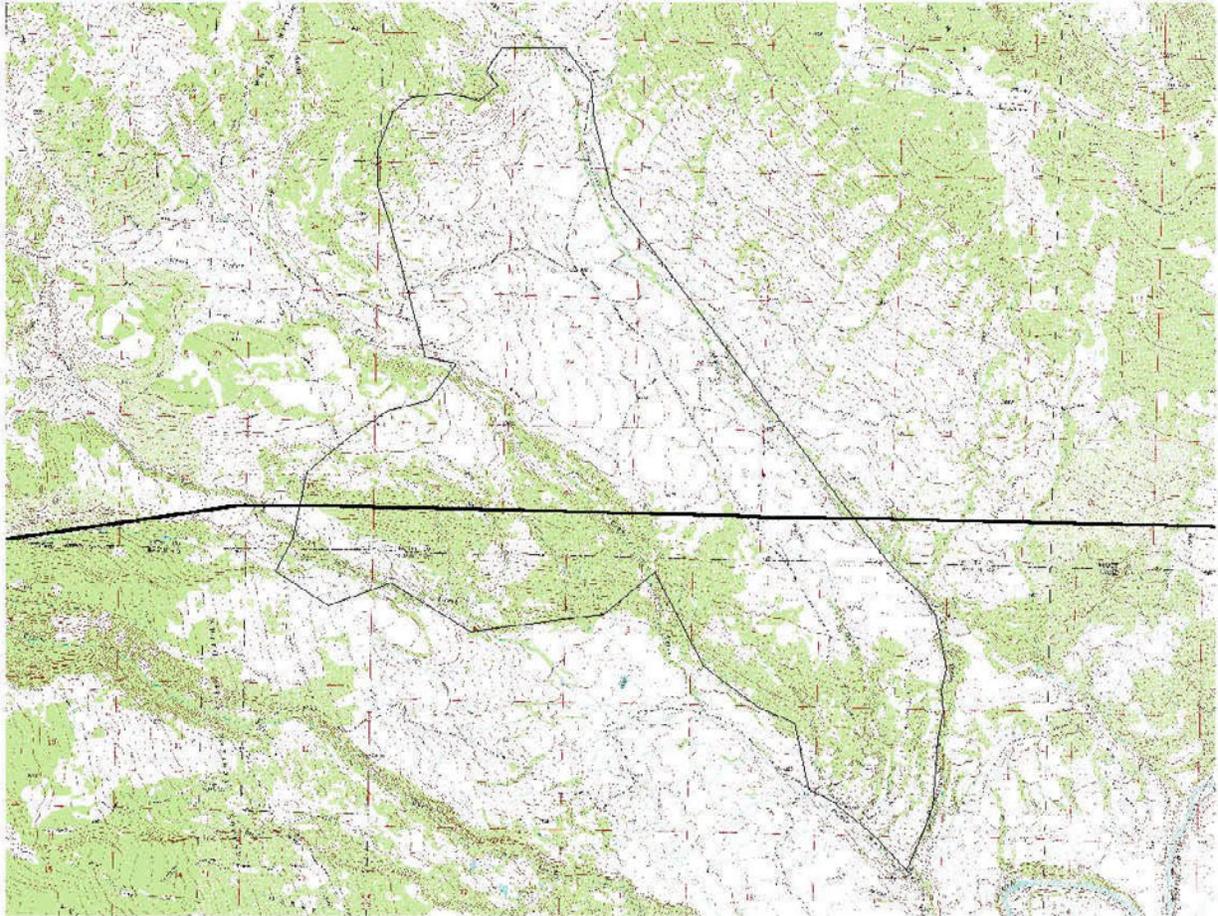
*EO = Element Occurrence

Boundary Justification: Three occurrences of Harrington's beardtongue drive this site, however, small subpopulations within these occurrences are not included in this boundary due to their degraded quality. The heart of the site should protect the most viable and defensible areas for this species.

Management and Protection Comments: The site includes a mixture of private and public lands (Bureau of Land Management). Other than a high quality dirt road that crosses the site, it is relatively undisturbed. Weed species pose a threat to Harrington's beardtongue and therefore the site should be monitored for weeds.

General Description: The Cabin Creek site is dominated by pinyon-juniper and sagebrush stands. This site includes 9149 acres between 6,600-9,200 feet.

Cabin Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.



Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Castle Peak

Location: Eagle County, south of the Colorado River, west of Highway 131, and north of Interstate 70
 U.S.G.S. 7.5 min. quadrangle (s): Castle Peak, State Bridge, Eagle
 Legal Description: T3S R83W S, 1-5, 7-29, 18, 19, 33-36; T3S R84W S 12, 13, 24; T3S R85W S; T4S R84W S 1-3

Biodiversity Rank: B3

Biodiversity Rank Justification: This site encompasses a good occurrence of a globally rare community type, an average occurrence of Colorado River cutthroat trout and an excellent example of a northern goshawk occurrence.

Natural Heritage elements at the Castle Peak site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|--|--------------------------|-------------|------------|-----------------------|----------|
| <i>Alnus incana</i> / mesic forb | Riparian shrubland | G3G4Q | S3 | | B |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado cutthroat trout | G4T3 | S3 | FS/ BLM/ S | C |
| <i>Accipiter gentilis</i> | Northern goshawk | G5 | S3B | FS/BLM | A |

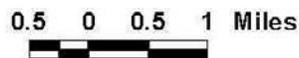
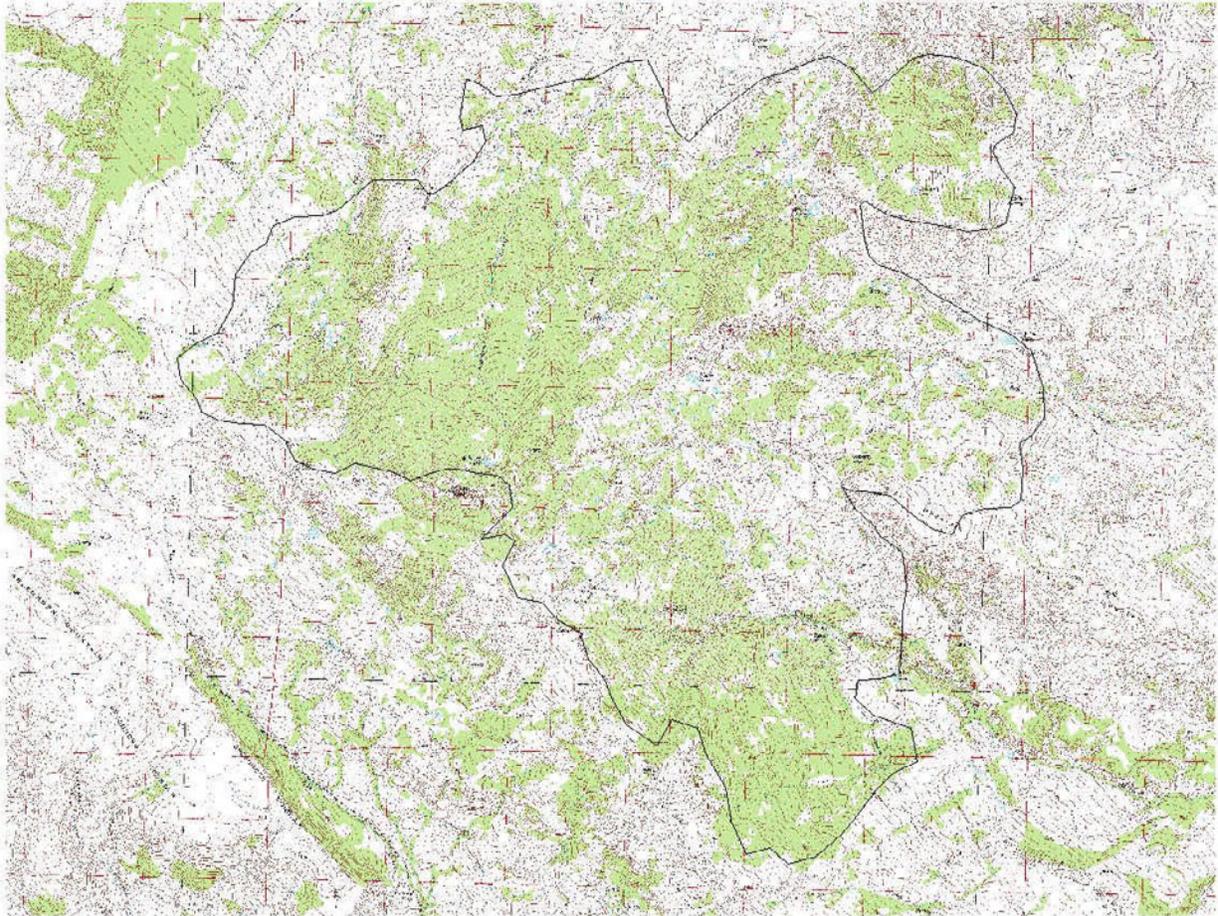
*EO = Element Occurrence

Boundary Justification: The boundaries were developed to encompass the full extent of the northern goshawk occurrence and all adjacent suitable habitat. Additionally, the boundaries encompass the extent of the watershed immediate to the occurrence of Colorado River cutthroat trout and the mesic area that supports the globally rare riparian community.

Management and Protection Comments: This area encompasses BLM lands and a small portion of private lands. The western half of the PCA occurs within the Castle Peak Wilderness Study Area. Interim management for the area is designated to protect wilderness values until Congress either designates the area as wilderness or removes it from further consideration. Livestock grazing currently occurs sporadically across this site and evidence of a long history of grazing is demonstrated by the preponderance of plant species that tend to increase with heavy grazing (e.g. arrowleaf balsam root). Raising current grazing levels may impact the quality of the area. Specifically, grazing in the riparian occurrence (*Alnus incana*/mesic forb) would negatively impact the area.

General Description: Castle Peak is defined by subalpine and montane habitats on a volcanic uplift in the middle of otherwise sagebrush rangelands. The subalpine and montane forests are marked by stands of second growth Engelmann's spruce and subalpine fir and grade into climax forests of mature aspen. Wetland pockets are scattered throughout this area. The potential conservation area delimits approximately 17,124 acres and ranges in elevation from 8,200-11,100 feet.

Castle Peak Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Cattle Creek

Location: Eagle County, south of Red Table Mountain and north of the Fryingpan River
 U.S.G.S. 7.5 min. quadrangle (s): Toner Reservoir
 Legal Description: T7S R85W S6-8,17,18; T7S R86W S1,2,11-15 ,22-24,26,27

Biodiversity Rank: B5

Biodiversity Rank Justification: An excellent example of the Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) has been documented in this PCA. The trout present in this fishery have been determined to be genetically pure based on meristic (morphologic) indicators.

Table. Natural Heritage elements at the Cattle Creek site.

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|--|--------------------------------|-------------|------------|-----------------------|----------|
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | S/ BLM/ S(| AB |

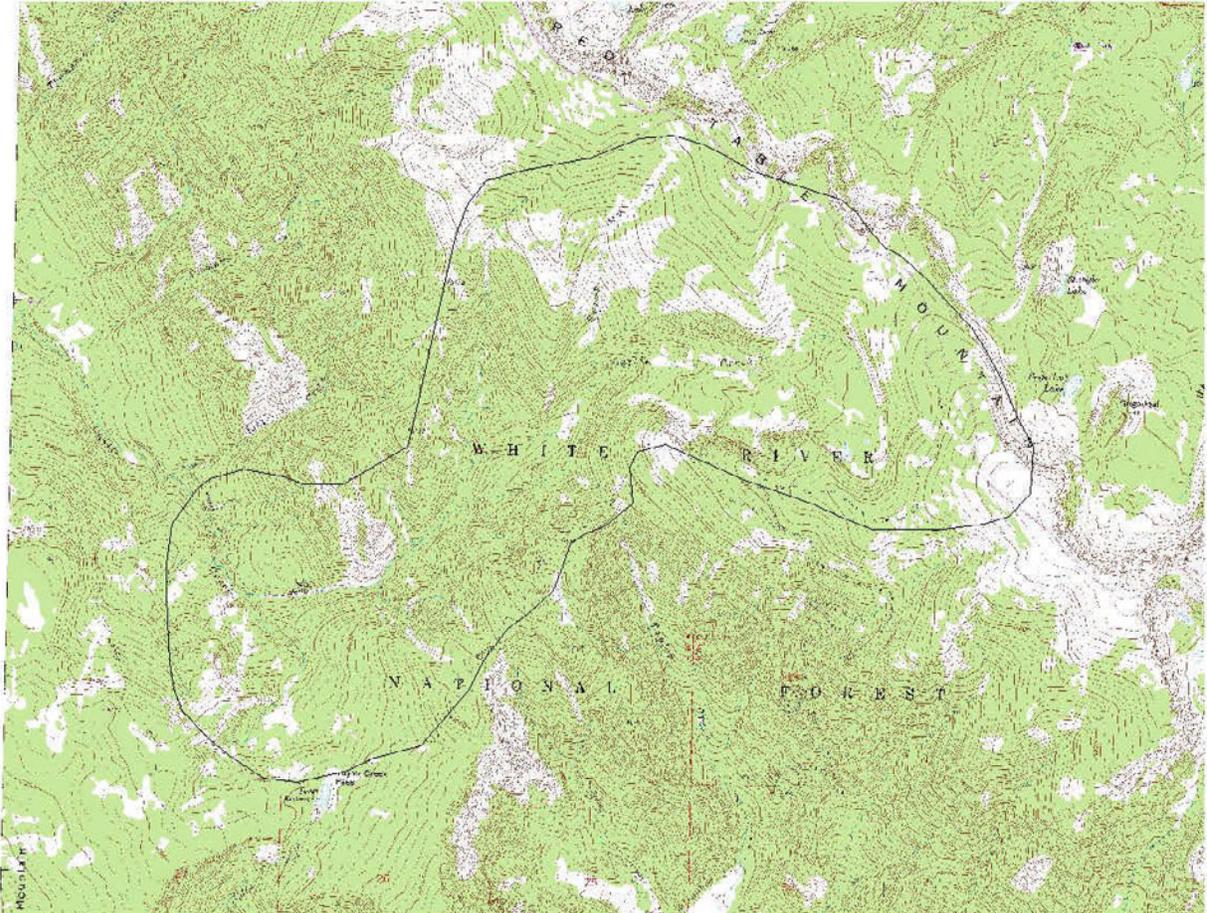
*EO = Element Occurrence

Boundary Justification: The boundaries encompass the immediate watershed in which the Colorado River cutthroat trout occur. The immediate watershed is included to illustrate that activities occurring within this area have the potential to impact the fishery. The downstream limit of these boundaries occurs near a 75-foot waterfall that presents a barrier to upstream migration by non-native trout species. Above the falls the trout fishery is purely Colorado River native.

Management and Protection Comments: This site includes lands owned and managed by the USFS. The current barrier could be enhanced to prevent non-native fish species from moving upstream. Livestock grazing is currently most prevalent below the falls.

General Description: Cattle Creek flows through subalpine meadows and woodlands near the headwaters and grades into upper montane forests near the lower stretches of the site. The area encompasses 4376 acres and ranges in elevation from 8,500-11,700 feet.

Cattle Creek Potential Conservation Area



0.3 0 0.3 0.6 Miles



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.



Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Christine State Wildlife Area

Location: Eagle County, between Basalt Mountain and the Roaring Fork River

U.S.G.S. 7.5 minute quadrangle: Leon

Legal Description: T8S R87W S1, 12. T8S R86W S5-7. T7S R87W S36. T7S R86W S31, 32.

Biodiversity Rank: B3

Biodiversity Rank Justification: Harrington's beardtongue (*Penstemon harringtonii*) is a globally-vulnerable plant species which is restricted to Colorado and is found almost exclusively in sagebrush habitat. This species is only known from approximately 37 locations, all of which are centered near Edwards in Eagle County. In general, Harrington's beardtongue and its habitat are highly threatened from residential development. These threats in addition to a restricted range, emphasize the urgent need for protection. Harrington's beardtongue populations are known to fluctuate in population numbers from year to year. Therefore, this specific location may be a higher priority than the current information reflects. This PCA supports a small number of individuals scattered over 500 acres.

Natural Heritage element occurrences at the Christine State Wildlife Area PCA

| Element | Common Name | Global Rank | State Rank | Federal/State Status | EO* Rank |
|-----------------------------------|--|-------------|------------|----------------------|----------|
| <i>Pinus edulis/ Stipa comata</i> | xeric western slope pinyon-juniper woodlands | G2 | S2 | | C |
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS | C |

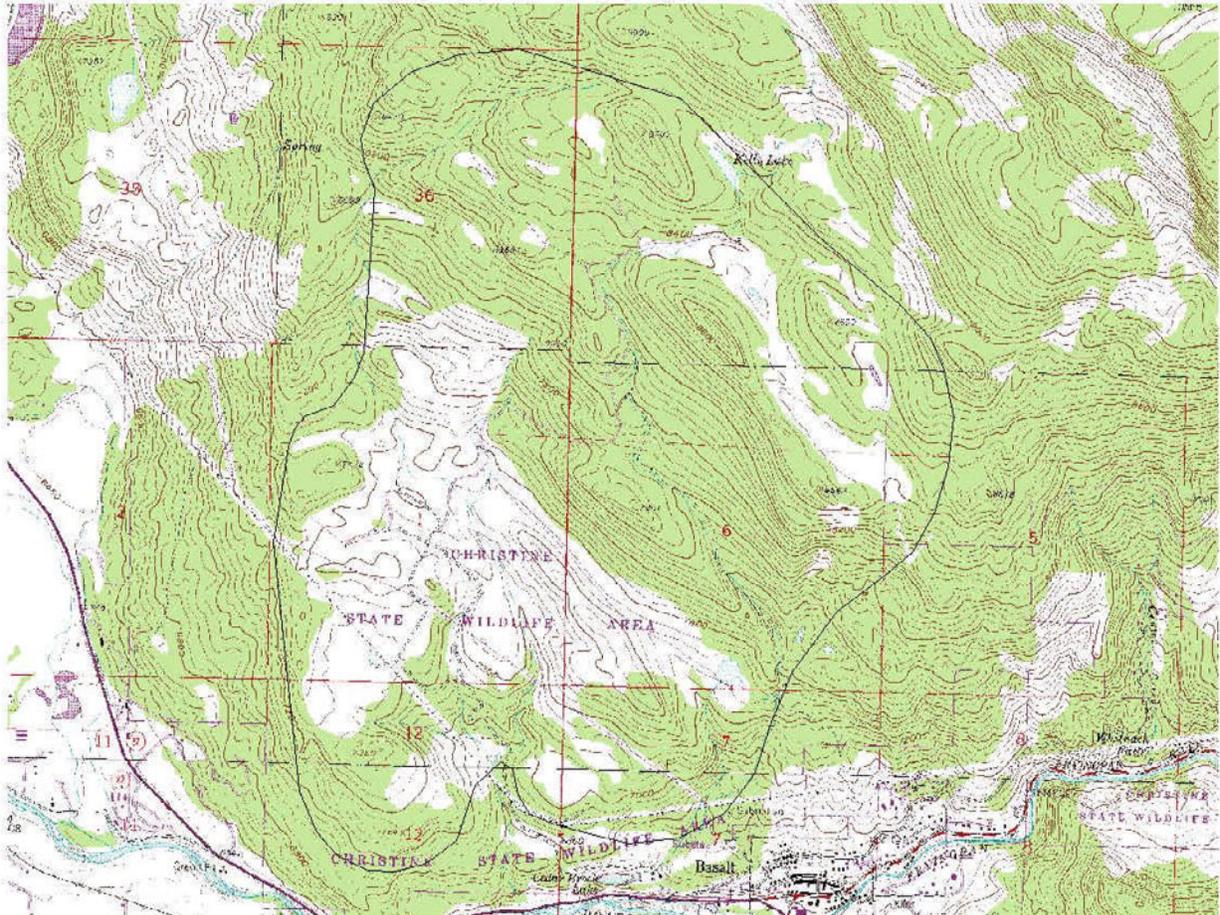
*EO=Element Occurrence

Boundary Justification: The PCA boundary includes the two occurrences and a buffer that is intended to protect the occurrences from direct disturbances, such as trampling. Indirect disturbances occurring outside the PCA boundaries, such as unnatural erosion caused from upslope activities or the establishment of exotic species, were not directly considered in the development of these boundaries.

Management and Protection Comments: Christine State Wildlife Area PCA is on public land managed by the Colorado Division of Wildlife and the White River National Forest except for a small section which is private property. The current management appears to be adequate. There is no grazing and vehicle access is restricted. The site will benefit from limiting recreation access to existing trails and roads. Exotic plant species are present and may degrade the occurrence. If the weeds are not kept from spreading into the native communities, the impacts to the site would be significant. The surrounding development makes this area increasingly important as wildlife habitat.

General Description: This PCA includes a mosaic of plant communities dominated by pinyon-juniper (*Pinus edulis-Juniperus osteosperma*), Gambel's oak (*Quercus gambelii*), or sagebrush (*Artemisia tridentata*). Approximately 2800 acres are included within the boundaries between 7,200-8,600 feet elevation.

Christine SWA Potential Conservation Area



0.2 0 0.2 0.4 Miles



Approximate location
of PCA within
Eagle County



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Map created 25 February
by T. L. Davis

Colorado River

Location: Eagle County, Colorado River from Radium to Red Dirt Creek

U.S.G.S. 7.5 min. quadrangle (s): Burns South, Blue Hill, McCoy, Radium, State Bridge

Legal Description: T1S R82W; T2S R82W; T2S R83W; T2S R84W; T2S R85W; T3S R85W; T3S R86W.

Biodiversity Rank: B3

Biodiversity Rank Justification: Over 250 miles of the Colorado River is found within the State of Colorado.

There are no pristine sections along the Colorado River, and the section from Radium to Red Dirt Creek is no exception. What this section has to offer is one of the most intact portions of riparian habitat left along the 250 mile Colorado state stretch of river and includes eleven plant community occurrences. Of most significance is the globally rare narrowleaf cottonwood/ strapleaf willow- silver buffaloberry (*Populus angustifolia*/*Salix eriocephala* var. *ligulifolia*- *Shepherdia argentea*) and the narrowleaf cottonwood- Rocky Mountain juniper (*Populus angustifolia*-*Juniperus scopulorum*) associations.

Natural Heritage elements at the Colorado River site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|---|--|-------------|------------|-----------------------|----------|
| <i>Populus angustifolia</i> / <i>Salix eriocephala</i> var. <i>ligulifolia</i> - <i>Shepherdia</i> <i>argentea</i> | narrowleaf cottonwood riparian forest | G2 | S2 | | C |
| <i>Populus angustifolia</i> - <i>Juniperus scopulorum</i> | montane riparian forest | G2G3 | S2 | | C |
| <i>Populus angustifolia</i> - <i>Juniperus scopulorum</i> | montane riparian forest | G2G3 | S2 | | B |
| <i>Betula occidentalis</i> / mesic forb | riparian shrubland | G3 | S2 | | B |
| <i>Alnus incana</i> - <i>Cornus</i> <i>sericea</i> | riparian shrubland | G3G4 | S3 | | C |
| <i>Alnus incana</i> - <i>Cornus</i> <i>sericea</i> | riparian shrubland | G3G4 | S3 | | B |
| <i>Alnus incana</i> - <i>Cornus</i> <i>sericea</i> | riparian shrubland | G3G4 | S3 | | C |
| <i>Alnus incana</i> - <i>Cornus</i> <i>sericea</i> | riparian shrubland | G3G4 | S3 | | B |
| <i>Shepherdia argentea</i> | riparian shrubland | G3G4 | S1 | | C |
| <i>Shepherdia argentea</i> | riparian shrubland | G3G4 | S1 | | C |
| <i>Alnus incana</i> / mesic forb | riparian shrubland | G3G4Q | S3 | | B |

*EO = Element Occurrence

Boundary Justification: These boundaries include the most intact portion of the Colorado River above Glenwood Springs. It includes all of the rare riparian communities found along the Colorado River in this upper portion.

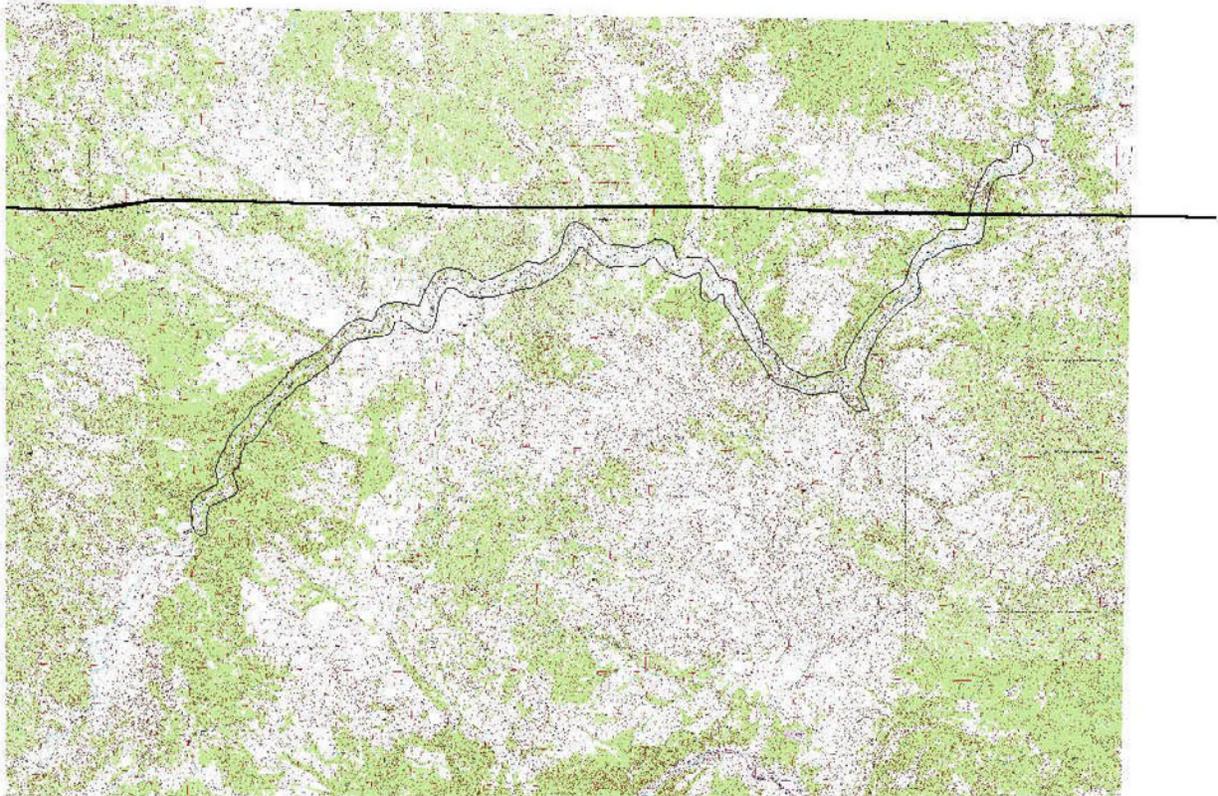
Management and Protection Comments: This portion of the Colorado River crosses private and public land (Bureau of Land Management and State Land Board). In addition to the tracks of the Denver and Rio Grande Western Railroad, a dirt road parallels the bed of the Colorado River canyon for much of this stretch. The road joins a number of small towns including Radium, Rancho Del Rio, Bond, Burns, and Derby Junction. Widening of the unpaved road could potentially harm the remaining riparian habitat.

The river between Radium and State Bridge is large and swift but has a fairly low gradient (60 feet/5 miles). Peak flows currently run 2500-3000 CFS. Prior to diversion projects flow approached twice this rate. Large-scale

diversions date back to the 1940's. Diversions or dams will affect the volume of water through here, likely affecting the riparian vegetation. Fifty percent of the water in Grand County is diverted to the east slope, resulting in new but altered habitat. According to historic photos, there are more *Salix exigua* and *carex* spp. communities today than before diversions (Jackson et al. 1995).

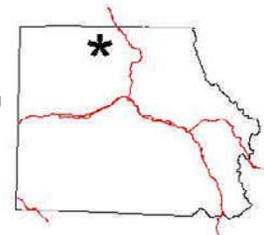
General Description: The 35-mile stretch of the Colorado River from Radium to Red Dirt Creek is one of the least disturbed sections. Riparian vegetation ranges from junipers to alders, coyote willow, dogwoods, cottonwoods and mesic graminoids. Adjacent steep sandstone slopes and rolling hills support Douglas fir and Ponderosa pine (north-facing) or juniper and sagebrush (south-facing). The site includes 10,652 acres between 6,400-8,000 feet elevation.

Colorado River Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Colorado River Seeps

Location: Eagle County, along the Colorado River between Derby Junction and Jack Flats
 U.S.G.S. 7.5 min. quadrangle(s): Burns South
 Legal Description: T2S R85W S31

Biodiversity Rank: B2

Biodiversity Rank Justification: This unique setting provides habitat for excellent examples of two plant associations of global significance. The sagebrush/Great Basin wildrye community at this site is in excellent condition. This plant association may have been more widespread and common in the past but due to heavy grazing, development, and the infestation of exotic species it is no longer recognizable in many locations. The river birch is rarely found as a dominant plant species and thus is treated as a globally rare plant association. This may be one of the most pristine low elevation riparian areas in Eagle County. Pristine wetlands are more commonly found on the National Forest lands, but typically at much higher elevations.

Natural Heritage elements at the Colorado River Seeps site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|--|--------------------------------------|-------------|------------|-----------------------|----------|
| <i>Artemisia tridentata</i> var. <i>tridentata</i> / <i>Leymus cinereus</i> | sagebrush bottomland shrubland | G2G3 | S1 | | A |
| <i>Betula occidentalis</i> / mesic graminoid | lower montane riparian shrubland | G3 | S2 | | A |
| <i>Platanthera sparsifolia</i> var. <i>ensifolia</i> | canyon bog orchid | G4G5T3 ? | S3 | | A |

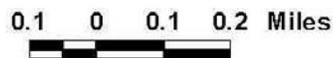
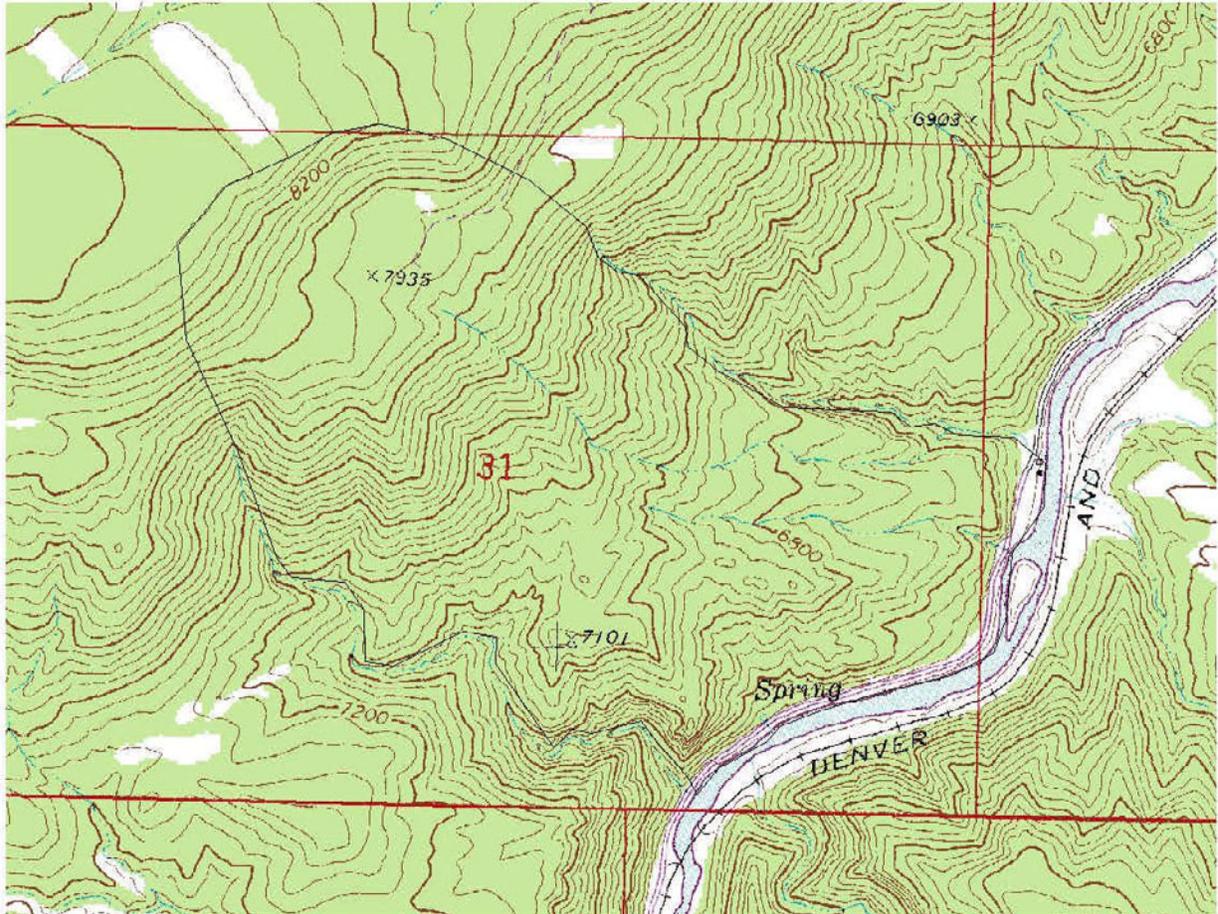
*EO = Element Occurrence

Boundary Justification: The boundary strictly encompasses the seeps. The hydrology creating these springs is unique and more research is needed to fully understand the significance. While similar additional seeps may be discovered in the area, the boundaries do not account for the full extent of potential area along this slope north to Derby Mesa.

Management and Protection Comments: This property is publicly owned and managed by the Bureau of Land Management except for a small privately owned portion near the top of the seep. Formal recognition of this site by the BLM may help to ensure its protection. The slope is likely too steep to be affected by livestock grazing, and this likely explains the persistence of the sagebrush/Great Basin wildrye plant association found here. A hydrology management plan that addresses private and public lands is important to protecting the hydrology of the site.

General Description: Melt-off from the spectacular Flat Top Mountains runs east down to Derby Mesa. Some of this water apparently goes underground, later to emerge seeping from a steep red sandstone canyon wall above the Colorado River. There are two parallel seeps that trickle down this slope for approximately one mile as it drops almost 2,000 feet (from 8,400-6,500 feet). The seeps are dominated by river birch (*Betula occidentalis*) and several riparian grasses. This oasis seems out of place in the pinyon-juniper dominated surroundings. Between these two wet areas there is an "island" approximately 30 to 50 meters across dominated by big sagebrush (*Artemisia tridentata* var. *tridentata*) and Great Basin wildrye (*Leymus cinereus*). This site includes approximately 400 acres.

Colorado River Seeps Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Cross Creek

Location: Eagle County, from Interstate 70 take Hwy 24 north up the Eagle River to Gilman

U.S.G.S. 7.5 min. quadrangle (s): Minturn, Mount Jackson, Mount of the Holy Cross, Grouse Mountain

Legal Description: T6S R81W S1-3,9-12,15-17,19-21,29-33; T6S R82W 23-27,34-36; T7S R81W S5-8,18; T7S R82W S1-3,10-16, 21-27,34,35.

Biodiversity Rank: B3

Biodiversity Rank Justification: The wetland complex of Cross Creek is nearly continuous from the headwaters to Eagle River comprising nearly 20 miles of unfragmented habitat that support over five distinct riparian communities. Nearly the entire wetland/riparian complex is in excellent condition, including the side slopes. The near pristine condition and intact hydrologic regime provides habitat for the globally rare Colorado River cutthroat trout. An A-ranked occurrence denotes a very pure population, with no signs of hybridizing with introduced trout. Of the three populations known to occur in the Cross Creek drainage, the upper population on West Cross Creek is the most genetically pure, indicating native stock, although there is indication that this population was at least supplemented with native stock from Trappers Lake. The other two trout occurrences within the watershed show signs of hybridization or occur in limited patches of habitat within the watershed.

Natural Heritage elements at the Cross Creek site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|--|--------------------------------|-------------|------------|-----------------------|----------|
| <i>Salix planifolia/ Calamagrostis canadensis</i> | subalpine riparian willow carr | G3 | S3 | | A |
| <i>Salix drummondiana/ Calamagrostis canadensis</i> | lower montane willow carr | G3 | S3 | | B |
| <i>Salix drummondiana/ Calamagrostis canadensis</i> | lower montane willow carr | G3 | S3 | | B |
| <i>Listera borealis</i> | northern twayblade | G4 | S2 | BLM | |
| <i>Eleocharis quinqueflora</i> | alpine wetlands | G4 | S3S4 | | A |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | FS/ BLM/ SC | A |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | FS/ BLM/ SC | B |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | FS/ BLM/ SC | |
| <i>Falco peregrinus anatum</i> | American peregrine falcon | G4T3 | S3B | LE | |
| <i>Carex aquatilis</i> | montane wet meadow | G5 | S4 | | A |
| <i>Abies lasiocarpa-Picea engelmannii/ Mertensia ciliata</i> | montane riparian forest | G5 | S5 | | A |
| <i>Abies lasiocarpa-Picea engelmannii/ Mertensia ciliata</i> | montane riparian forest | G5 | S5 | | A |

*EO = Element Occurrence

Boundary Justification: The boundary delimits the extent of the Cross Creek watershed. In order to ensure adequate protection for the wetland complex and trout, the entire watershed must be considered; any activity occurring within the watershed boundary has the potential to impact the local hydrology and water quality and therefore the occurrences of trout and riparian communities. Lower portions of Cross Creek within the boundaries currently support populations of non-native cutthroat trout, rainbow trout, and brook trout, however, there exist barriers to preclude upstream migration of these non-natives into reaches where only natives occur. The downstream boundary was extended to encompass the nesting area for peregrine falcons. While the upstream portions of the site provide hunting areas for these falcons, the boundaries do not specifically address all potential foraging areas for the nesting pair.

Management and Protection Comments: The Cross Creek site lies within the Holy Cross Wilderness Area except for the lower elevations and some small inholdings which are private property. This site is partially protected by The Wilderness Act, but this act does not preclude water development or grazing. Water diversion would significantly disrupt the high quality wetlands and flow rates. A proposed water diversion project (Homestake 110) is currently under review. The project would divert water from Cross and Fall Creeks into Homestake Creek and then over to the east slope of Colorado Springs area.

General Description: This site includes alpine and subalpine habitat found within the large granite gorges produced by Cross Creek. Extensive willow carrs and sedge meadows are supported along the creek and several alpine lakes. The site includes elevation ranges of 7,900-14,000 feet and approximately 18,900 acres.

Cross Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.



Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Crown

Location: Garfield, Eagle and Pitkin counties, above Basalt to the south
 U.S.G.S. 7.5 minute: Mount Sopris and Basalt quadrangles.
 Legal Description: T8S R87W S3-10, 13-34; T7S R87W S31-33; T8S R88W S1, 12-14, 23-25.

Biodiversity Rank: B2

Biodiversity Rank Justification: Harrington's beardtongue (*Penstemon harringtonii*) is a globally vulnerable plant that is restricted to Colorado and is found almost exclusively in sagebrush habitat. This species is only known from approximately 37 locations centered around the town of Edwards in Eagle County. In general, Harrington's beardtongue and its habitat are highly threatened due to residential and recreational development. These threats, in addition to its restricted range, create an urgent need for protection of this species. The Crown includes two occurrences of Harrington's beardtongue. There is also an excellent example of a state-rare, mixed-mountain shrubland and a less pristine occurrence of a globally rare plant community within this large high quality PCA.

Natural Heritage element occurrences at Crown PCA

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | EO* Rank |
|--|--------------------------|-------------|------------|-----------------------|----------|
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS | A |
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS | B |
| <i>Quercus gambellii-Cercocarpus montanus/Carex geyeri</i> | Mixed mountain shrubland | G3 | S3 | | C |
| <i>Quercus gambelii/Symphoricarpos oreophilus</i> | mixed mountain shrubland | G5 | S3S4 | | A |

*EO=Element Occurrence

Boundary Justification: This PCA includes the mosaic of community types in which the four element occurrences are found. The surrounding high quality habitat is included to act as a buffer to direct disturbances, such as trampling, and indirect disturbances, such as unnatural erosion. The PCA also provides additional suitable habitat to allow for natural migration of the elements.

Management and Protection Comments: This PCA is a mixture of private and public (Bureau of Land Management) lands. Residential and recreational development pressures are high in this area. Any developments may threaten this PCA.

The Bureau of Land Management is aware of Harrington's beardtongue at this location, but a management plan for this species in this resource area, and specifically at this location, has not been developed. Grazing, off-road vehicle use, motorcycle use, and recreation are currently the main land uses. Grazing has been noted on Harrington's beardtongue but probably is not affecting the quality and condition of this occurrence. There are roads scattered throughout the PCA which are causing erosion problems and are acting as conduits for weeds, such as Kentucky bluegrass (*Poa pratensis*). One of the best defenses against the spread of these exotic species is to discourage future trails/roadways. Management actions could include road closures or restrictions regarding hiking, biking and motor vehicles, an exotic plant eradication program, and grazing restrictions.

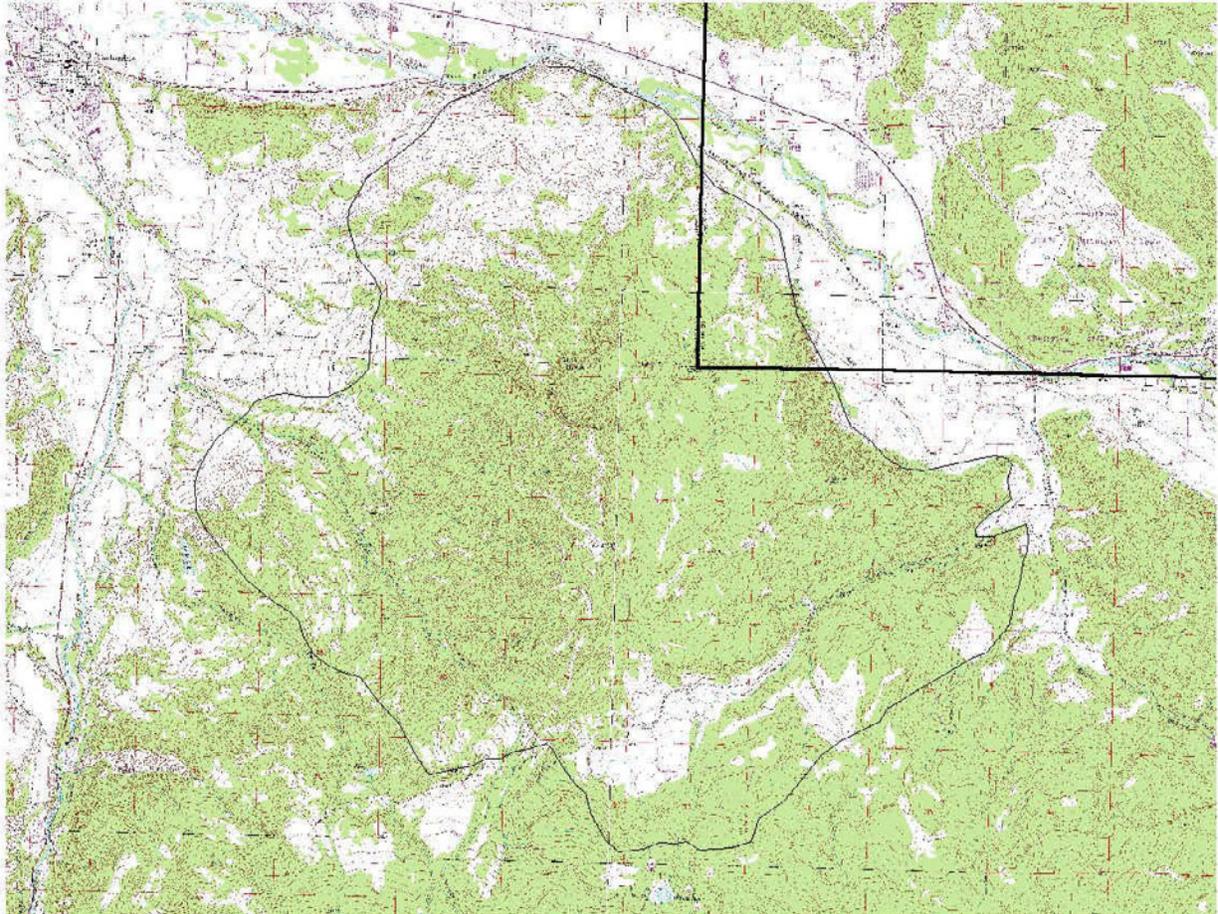
In the late 1990's, the BLM conducted a controlled burn on the slope above Prince Creek. The purpose of the burn was to restore the sagebrush park that is being invaded by juniper (*Juniperus osteosperma*) and to reduce the height and density of the Gambel's oak (*Quercus gambelii*) for wildlife. The effects of fire on Harrington's beardtongue are unknown. This burn may help to determine this question. However, it is important to recognize that the fire may improve habitat conditions but it may harm the viability of this population. A prescribed burn may provide

information on the fire tolerance of Harrington's beardtongue. In order to understand the positive, negative, or neutral effects of prescribed burns on Harrington's beardtongue we recommend that a monitoring plan be implemented before another burn is conducted.

This large area is in good condition overall, however there are scattered roads and trails used by recreationists. The activity along these thorough-ways is creating erosion and weed problems.

General Description: The PCA ranges in elevation from about 6,500 feet along the Roaring Fork River, to 8,800 feet at the summit of The Crown. The PCA is characterized by pinyon-juniper (*Pinus edulis-Juniperus osteosperma*) woodlands, Gambel's oak (*Quercus gambelii*) shrublands, and sagebrush (*Artemisia tridentata*) shrublands. Approximately 16,300 acres are included in the PCA boundaries.

Crown Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Deep Creek

Directions: Eagle and Garfield Counties, meets the Colorado River approximately 2 miles north of Dotsero

U.S.G.S. 7.5 min. quadrangle (s): Dotsero, Broken Rib Creek, Sweetwater Lake, Carbonate, Deep Lake

Legal Description: T3S R89W S22-27,34-36; T3S R88W S19-23,25-28; T3S R87W S30-32; T4S R88W S1-6,10-14; T4S R87W S3-14; T4S R86W S17-20,29-31

Biodiversity Rank: B2

Biodiversity Rank Justification: This PCA contains a concentration of excellent and good examples of globally vulnerable and apparently secure natural communities. Additionally, there are four globally rare plant species, two state-rare bats, and three state-rare bird species represented here. Deep Creek stands out from neighboring canyons in its ruggedness, remoteness, and pristine condition. Although several nearby drainages, e.g. Grizzly and No Name Creeks, have a similar appearance with similar landscape composition, none is as pristine as Deep Creek. In Colorado, most drainages of this length and size have roads or at least trails running parallel and adjacent to the stream, Deep Creek has neither. The canyon represents one of the most intact, pristine, canyon landscapes found in Colorado. Although rare elements can be found here, the integrity of the landscape is the most impressive feature.

Natural Heritage elements at the Deep Creek site

| Element | Common Name | Global Rank | State Rank | Federal /State Status | *EO Rank |
|---|-------------------------------|-------------|-------------|-----------------------|----------|
| <i>Gila robusta</i> | Roundtail chub | G2G3 | S2 | BLM/ SC | H |
| <i>Pseudotsuga menziesii</i> / <i>Paxistima myrsinites</i> | Lower montane forest | G2G3 | S2S3 | | B |
| <i>Salix monticola</i> / mesic forb | Montane riparian willow carr | G3 | S3 | | B |
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/ BLM | A |
| <i>Nuttallia multicaulis</i> | Manystem stickleaf | G3 | S3 | | B |
| <i>Draba spectabilis</i> | Whitlowgrass | G3? T3Q | S3 | | E |
| <i>Festuca idahoensis</i> - <i>Festuca thurberi</i> | Montane grassland | G3G4 | S3S4 | | E |
| <i>Festuca idahoensis</i> - <i>Festuca thurberi</i> | Montane grassland | G3G4 | S3S4 | | E |
| <i>Sullivantia hapemanii</i> var. <i>purpusii</i> | Hanging garden sullivantia | G3T3 | S3 | FS | E |
| <i>Sullivantia hapemanii</i> var. <i>purpusii</i> | Hanging garden sullivantia | G3T3 | S3 | FS | B |
| <i>Picea pungens</i> / <i>Cornus sericea</i> | Montane riparian forest | G4 | S2 | | E |
| <i>Pseudotsuga menziesii</i> / <i>Cornus sericea</i> | Lower montane riparian forest | G4 | S2 | | E |
| <i>Euderma maculatum</i> | Spotted bat | G4 | S2 | FS/BLM | H |
| <i>Salix drummondiana</i> / mesic forb | Montane riparian willow carr | G4 | S4 | | E |
| <i>Haliaeetus leucocephalus</i> | Bald eagle | G4T?Q | S1B, S3N | LT/T | H |
| <i>Falco peregrinus anatum</i> | American peregrine falcon | G4T3 | S2B | LE | A |
| <i>Plecotus townsendii pallescens</i> | Townsend's big eared bat | G4T4 | S2 | BLM | C |
| <i>Accipiter gentilis</i> | Northern goshawk | G5 | S3B | FS/ BLM | E |

*EO = Element Occurrence

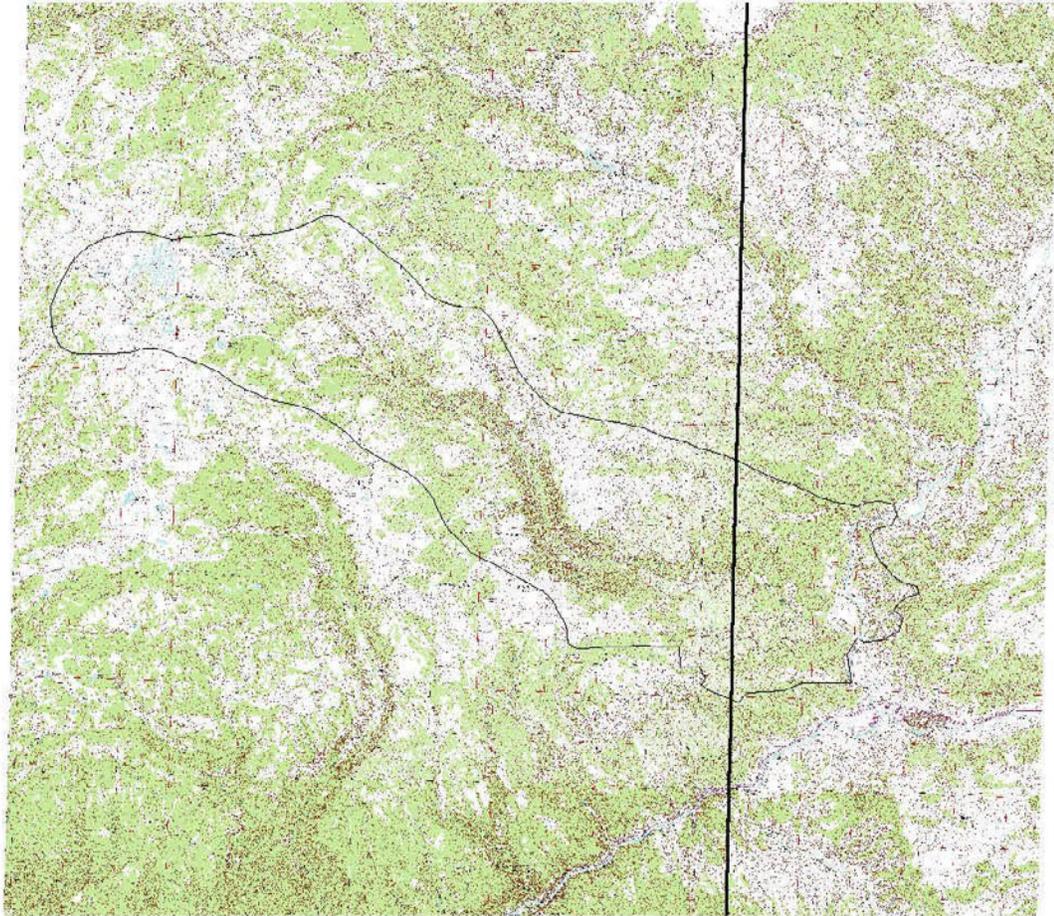
Boundary Justification: The site boundaries for Deep Creek include the entire watershed of Deep Creek. Although the flat and gentle slope areas are not pristine, they represent an area with the potential to impact the roadless, pristine slopes and valley bottom of Deep Creek.

Management and Protection Comments: Most of Deep Creek is federally owned by either US Forest Service or Bureau of Land Management, there are a few portions which are privately owned. Currently there is no special protection, although the many extraordinary features of Deep Creek have prompted the BLM and Forest Service to evaluate the potential for protecting the canyon under the auspices of the Wild and Scenic River Act (Pearson and Fielder 1992). Over 8,000 acres of this site is roadless and is considered a Potential Research Natural Area.

Due to its ruggedness, cattle use only the upper and lower stretches. Impacts from grazing and logging on the plateau are unknown. Monitoring these activities as they relate to the canyon's health would help establish this knowledge. Logging, hunting, grazing, and recreation are the major activities. Nearly all these activities take place on the plateau or gentle slopes. A Forest Service campground is maintained at Deep Lake. Many hunting camps are along Coffee Pot Road and at the small lakes. Very little human disturbance is within the canyon. Trails are nonexistent and it is only accessible by traversing the creek itself, during low water. Coffee Pot Road, an unpaved forest service road, is atop the plateau and parallels Deep Creek. The road is the major access for Deep, Heart, and Bison lakes in the headwaters of Deep Creek. Recreational use, cattle grazing, and logging are all popular activities on the plateau. All these activities may or may not have an effect on the canyon itself. To our knowledge there is no grazing or logging within the canyon, and very little recreation. Deep Creek has been nominated as a Wild and Scenic River by White River National Forest.

General Description: Beginning at Deep Lake (10,460 feet) on the White River Plateau. Deep Creek plunges more than 4,500 feet in 15 miles to join the Colorado River near Dotsero (6,200 feet). Approximately 1 mile from Deep Lake, Deep Creek carves a rugged and remote limestone gorge, forming a dramatic pristine canyon over 2,500 feet deep and 13 miles long. The headwaters of Deep Creek are subalpine forests of aspen, spruce and fir, interspersed with meadows and many small lakes. As the creek drops closer to its confluence with the Colorado River, the landscape becomes more arid and vegetation turns toward pinyon-juniper and sagebrush on the slopes and cottonwood forests in the canyon bottom. The limestone strata have created ideal conditions for the formation of caves. Over forty known caves are within the canyon walls. This site includes 37,200 acres.

Deep Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.



Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Dry Lake

Location: Eagle County, north of I70, east of the Colorado River, at the southwest base of Greenhorn Mountain
U.S.G.S. 7.5 min. quadrangle (s): Gypsum
Legal Description: T4S R85W S3-5,8-10,14-17,19-22,27-29

Biodiversity Rank: B3

Biodiversity Rank Justification: Harrington's beardtongue (*Penstemon harringtonii*) is a globally vulnerable plant species that is restricted to Colorado and is found almost exclusively in sagebrush habitat. This species is only known from approximately 37 locations, all of which are centered near Edwards in Eagle County. In general, Harrington's beardtongue and its habitat are highly threatened from residential development. These threats in addition to a restricted range emphasize the urgent need for protection. Harrington's beardtongue populations are known to fluctuate in population numbers from year to year. Therefore, this specific location may be a higher priority than the current information reflects. This site is one of ten that have been designed around the best locations of this species.

Natural Heritage elements at the Dry Lake site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|-------------------------------|--------------------------|-------------|------------|-----------------------|----------|
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/ BLM | B |

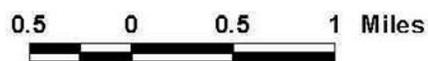
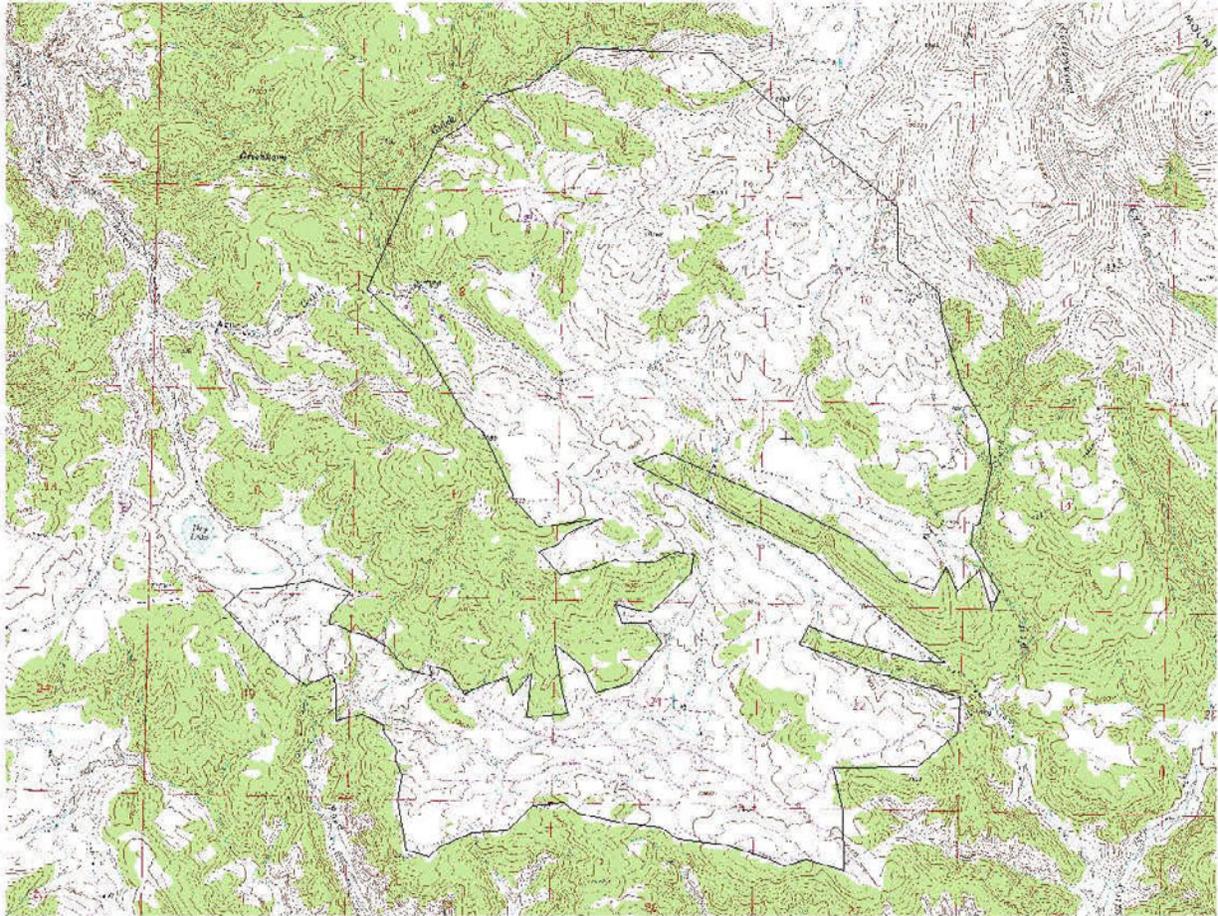
*EO = Element Occurrence

Boundary Justification: The Dry Lake site encompasses the occurrence and includes the potential habitat that exists between the sub occurrences. The potential habitat will allow the population to move over time and/or expand. There is an abundance of apparently unoccupied potential habitat surrounding this site. Additional surveys may show this area to be occupied in the future.

Management and Protection Comments: The site occurs primarily on public land managed by the Bureau of Land Management, however there is a small parcel of private property within the boundary. Grazing is the main land use. Several dirt roads scatter the landscape. Development, causing fragmentation or destruction, is the main threat to this low elevation species. Future developments would negatively impact Harrington's beardtongue.

General Description: Rolling sagebrush hills with scattered pinyon and juniper extend for miles along this large mesa. There are 5,274 acres between 7,200-8,400 feet within this site.

Dry Lake Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

East Brush Creek

Location: Eagle County, south of the Town of Eagle

U.S.G.S. 7.5 min. quadrangle(s): Fulford, Seven Hermits

Legal Description: T6S R83W S7-9, 15-18,21,22; T6S R84W S12

Biodiversity Rank: B3

Biodiversity Rank Justification: East Brush Creek includes occurrences of three globally rare plant associations in good condition. Low elevation riparian areas, especially on private land, have often been manipulated and converted for agriculture. It is important to conserve areas such as this one that is still in its natural form. The uplands adjacent to this creek are also globally significant.

Natural Heritage elements at the East Brush Creek site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|--|------------------------------|-------------|------------|----------------------|----------|
| <i>Salix monticola/ Carex utriculata</i> | Montane riparian willow carr | G3 | S3 | | B |
| <i>Populus tremuloides/ Alnus incana</i> | Montane riparian forest | G3 | S3 | | B |
| <i>Quercus gambellii- Cercocarpus montanus/ Carex geyeri</i> | Mixed mountain shrublands | G3 | S3 | | B |
| <i>Populus angustifolia/ Alnus incana</i> | Montane riparian forest | G3? | S3 | | B |

*EO = Element Occurrence

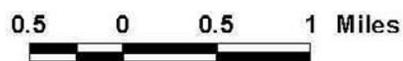
Boundary Justification: This boundary includes the stretch of East Brush Creek that includes the riparian occurrences and the adjacent uplands to include the oak/mountain mahogany community. The upper watershed of East Brush Creek is extremely important in the continued quality of the occurrences downstream. The upland community of oakbrush and mountain mahogany continues along the slopes above West Brush Creek as well. These are not included in the boundaries as the area covered is quite large.

Management and Protection Comments: The riparian occurrences occur on private property (during summer 1999, these were viewed from the road only) that was sold in late 1999 to public agencies (including USFS, CO State Division of Parks and Outdoor Recreation, Town of Eagle and Eagle County). The upland community is contained within the White River National Forest. Eagle County is experiencing extreme development pressures, this property may be developed for housing or water in the future although the intentions of the landowner are not known. The Adam's Rib Ski Area was proposed for some of the property upstream.

Current land uses include grazing, recreation, and road access to several Forest Service campgrounds, trails, and four-wheel-driving. A dirt road runs parallel to the creek for the stretch included in this site. Developments within riparian areas are discouraged. Changes in the hydrology would also severely alter the riparian vegetation. Non-native plant species (Kentucky blue grass, dandelion, clover, and several hay grasses) are currently common within the riparian area. Discouraging the spread of these species will benefit the site. A reduction in livestock grazing may improve the species composition and the persistence and spread of these exotic species. Road maintenance or widening would also detrimentally affect the riparian area.

General Description: Heavily vegetated, steep red sandstone slopes drop into East Brush Creek. The south-facing slopes are dominated by oak/mountain mahogany (*Quercus gambellii/Cercocarpus montanus-Carex geyeri*) and the north-facing slopes are covered by Douglas fir (*Pseudotsuga menziesii*) and scattered aspen (*Populus tremuloides*) patches. The riparian area is dominated by narrowleaf cottonwood, aspen, and willows. This site includes an elevation range of 7,400-9,400 feet and 2,659 acres.

East Brush Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

East Lake Creek

Location: Eagle County. South of Edwards, in the Holy Cross Wilderness Area
 U.S.G.S. 7.5 min. quadrangle (s): Grouse Mountain, Mount Jackson
 Legal Description: T6S R82W S20-22,27-34; T7S R82W S3-5,8-10,16,17

Biodiversity Rank: B2

Biodiversity Rank Justification: The East Lake Creek headwaters include three globally common plant associations that are in excellent condition. These occurrences are important as exemplary sites and to preserve in this high quality condition. More significantly, this site contains a good example of a breeding population of boreal toads. Currently, this site represents the best know occurrence of boreal toads in Eagle County. The headwaters of this drainage also support a population of Colorado River cutthroat trout.

Natural Heritage elements at the East Lake Creek site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|--|--------------------------------|-------------|------------|-----------------------|----------|
| <i>Bufo boreas boreas</i> | Boreal toad | G4T1Q | S1 | FS/C/E | B |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | FS/ BLM/ SC | C |
| <i>Cardamine cordifolia- Mertensia ciliata- Senecio triangularis</i> | Alpine wetland | G4 | S4 | | A |
| <i>Danthonia intermedia</i> | Montane grassland | G3G4? | S3S4 | | A |
| <i>Deschampsia cespitosa- Ligusticum tenuifolium</i> | Mesic alpine meadow | GU | SU | | A |

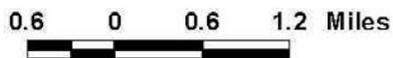
*EO = Element Occurrence

Boundary Justification: The entire upper East Lake Creek watershed is included in the boundary. The current hydrologic regime is necessary to allow for the persistence of high-quality plant associations, and any actions within the boundaries of the watershed have the potential to impact the elements of biodiversity present in the area.

Management and Protection Comments: This site is contained completely within the Holy Cross Wilderness Area with the exception of some small private inholdings. This area is a Potential Research Natural Area. This area is pristine and the management is adequate. East Lake Creek Trail is the only disturbance in the site.

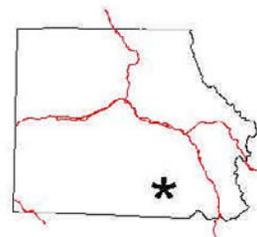
General Description: This site includes the East Lake Creek headwaters that occur in the high mountains of the Holy Cross Range and then descend through the subalpine. This stretch of the creek covers approximately 5 miles (approximately 8,168 acres) and drops almost 4,000 feet in elevation (9,800-13,670 feet).

East Lake Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

East Meadow Creek

Location: Eagle County, north of Vail near the eastern county line

U.S.G.S. 7.5 min. quadrangle (s): Vail West, Piney Peak

Legal Description: T3S R80W S29-32; T3S R81W S36; T4S R80W S6; T4S R81W S1-3,9-12

Biodiversity Rank: B5

Biodiversity Rank Justification: East Meadow Creek supports a good population of genetically pure Colorado River cutthroat trout, a globally rare element.

Natural Heritage elements at the East Meadow Creek site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|--|--------------------------------|-------------|------------|-----------------------|----------|
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | FS/ BLM/ SC | B |

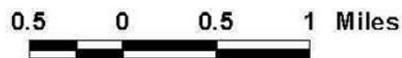
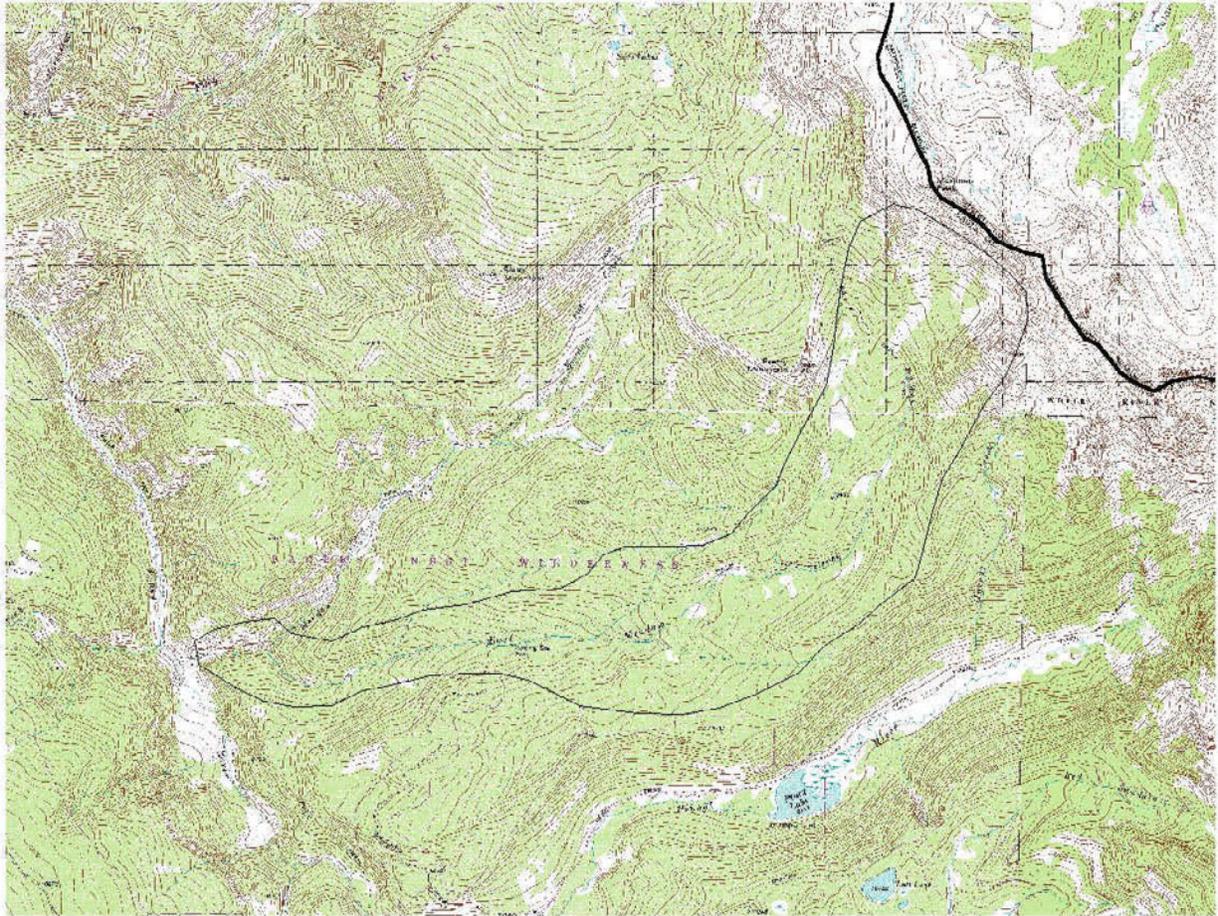
*EO = Element Occurrence

Boundary Justification: The boundaries of this site circumscribe the full extent of the immediate watershed. Activities within this boundary have the potential to impact the local hydrology and therefore the cutthroat trout occurrence.

Management and Protection Comments: This site falls within the Eagles Nest Wilderness Area and therefore is partially protected by The Wilderness Act. However, it is currently not protected from exotic brook trout that are present well downstream of the cutthroat trout occurrence. Although the USFS installed a barrier to upstream migration by brook trout in the the late 1990's, evaluations of the effectiveness of this barrier would provide a higher degree of confidence in knowing that threats to the native trout have been minimized.

General Description: East Meadow Creek is a montane creek marked by abundant fallen timber and a slope of 10%. The potential conservation area includes 2,322 acres and ranges in elevation from 8,400-12,000 feet.

East Meadow Creek Potential Conservation Area



Approximate location
of PCA within
Eagle County



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Map created 25 February
by T. L. Davis

Edwards

Location: Eagle County, Edwards Rest Area
U.S.G.S. 7.5 min. quadrangle: Edwards
Legal Description: T5S R82W S4,5

Biodiversity Rank: B5

Biodiversity Rank Justification: This state-rare orchid is represented only twice in this County. This particular occurrence is large. However, the fact that it occurs adjacent to a rest area may degrade the population over time.

Natural Heritage elements at the Edwards site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|---|-------------------|-------------|------------|----------------------|----------|
| <i>Platanthera sparsiflora</i> var. <i>ensifolia</i> | canyon bog orchid | G4G5 T3? | S3 | | B |

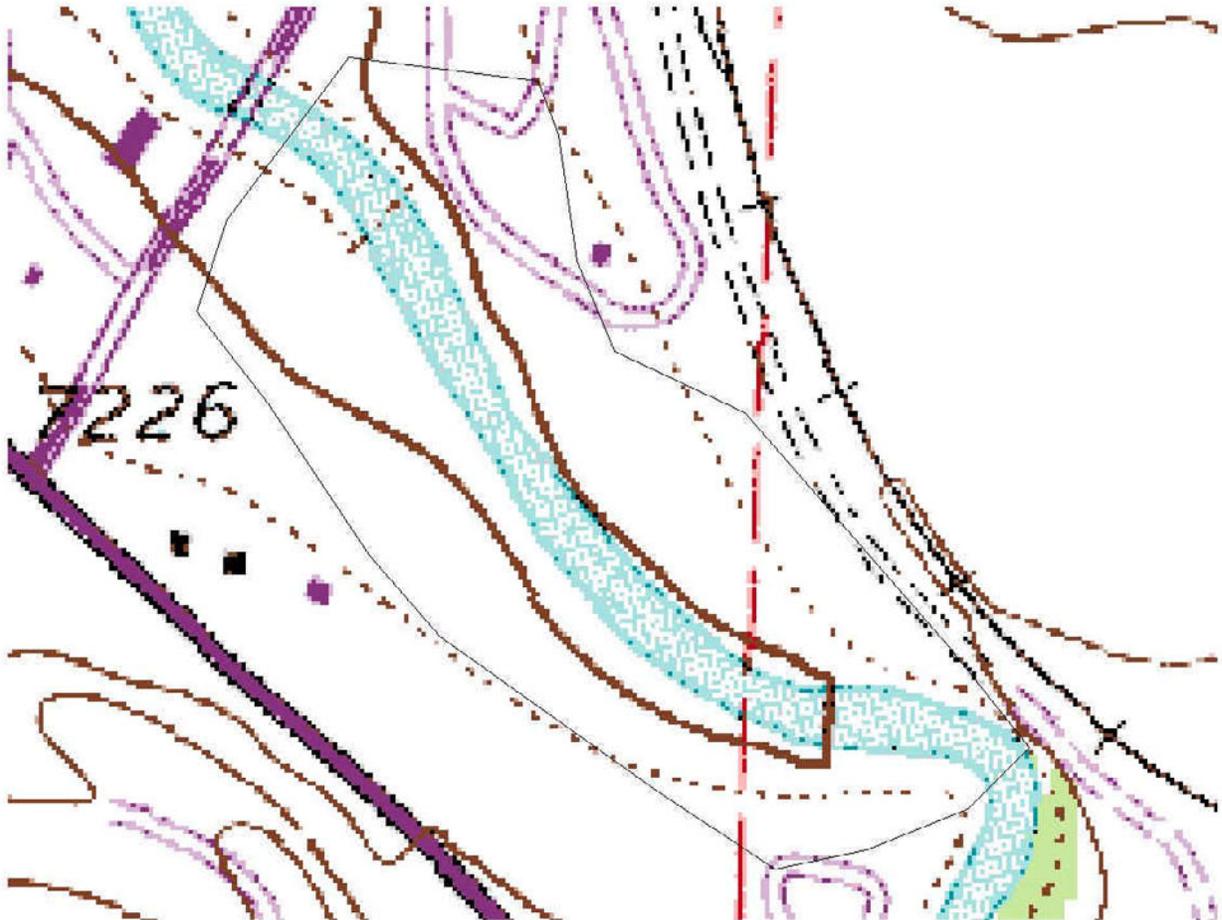
*EO = Element Occurrence

Boundary Justification: This site is drawn to encompass the occurrence. A small amount of adjacent habitat is included up- and down-stream to allow the population to move over time.

Management and Protection Comments: In the summer of 1999, during which fieldwork was being conducted for this project, renovations at this rest area were occurring as were plans for a bike path to cross the river and for a water plant to be constructed in the area along the river. CNHP was not able to revisit this location due to the construction. A check of this location, following construction is recommended. The property is privately owned. Further developments above the river may impact this location. Recreation along the river may threaten the plants by trampling. Exotic plant invasions may become an issue. Hydrological modifications may potentially impact the area.

General Description: This site includes a small area of cottonwood-dominated riparian area along the Eagle River, surrounded by development. It includes 24 acres at 7,200 feet in elevation.

Edwards Potential Conservation Area



0.03 0 0.03 0.06 Miles



Approximate location
of PCA within
Eagle County



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Map created 25 February
by T. L. Davis

Elk Ridge

Location: Eagle/Summit counties, along the county line from Sheep Mountain to Ptarmigan Pass
 U.S.G.S. 7.5 min. quadrangle (s): Copper Mountain, Pando
 Legal Description: T6S R79W S29-32; T7S R79W S5-9,16,17,20,21 ,28 ,29

Biodiversity Rank: B3

Biodiversity Rank Justification: This site includes two state-rare alpine species and one globally rare species which is endemic to Colorado. The thickleaf whitlowgrass (*Draba crassa*) is known from approximately 30 locations scattered around the Colorado Rocky Mountains. The other two mustard species are known from fewer locations in the state but are more common worldwide.

This is the only location known for any rare alpine species in Eagle County. However, the Gore Range and the Holy Cross Wilderness likely support more of these species but have not been surveyed.

Natural Heritage elements at the Elk Ridge site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|--------------------------|-------------------------|-------------|------------|-----------------------|----------|
| <i>Draba crassa</i> | thick-leaf whitlowgrass | G3 | S3 | | B |
| <i>Draba lonchocarpa</i> | lancepod whitlowgrass | G4T4 | S2 | | B |
| <i>Draba oligosperma</i> | woods draba | G5 | S2 | | A |

*EO = Element Occurrence

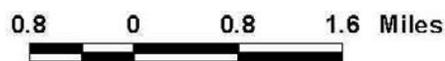
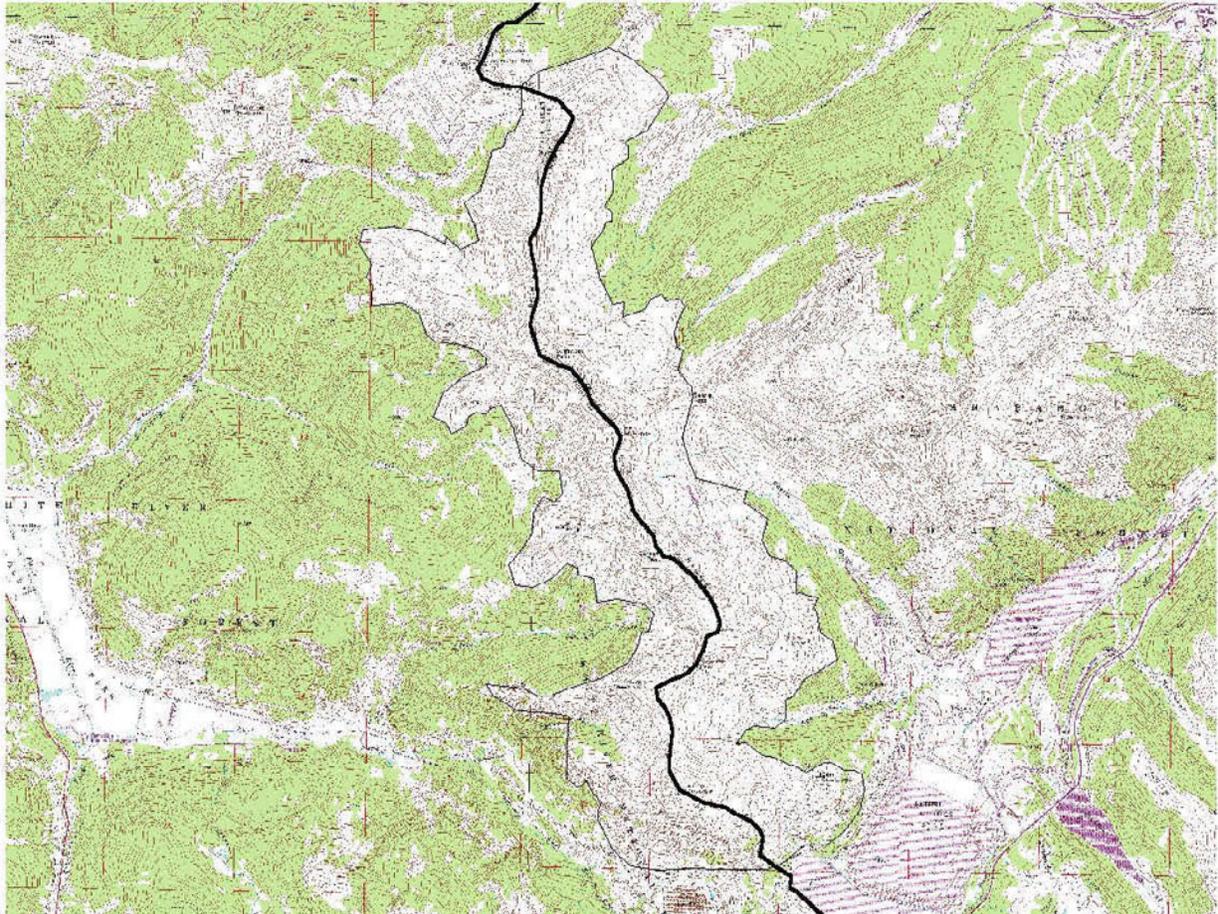
Boundary Justification: This boundary includes the alpine habitat of Elk Ridge. Spot checks for rare species were conducted at each end and it is likely that there are further occurrences in the middle.

Management and Protection Comments: This ridge is included in the White River National Forest, except for a small portion at the southern end which is privately owned. Future mining activities may destroy the rare plants and the habitat. Closing extant roads and discouraging the development of new roads in this alpine area will benefit the site by reducing the potential for trampling.

Current management practices are adequate. There appears to be little disturbance currently within the alpine habitat. This alpine ridge is predominantly undisturbed. A few old roads are evident, along with old mining activity. Currently, however, the heaviest use in this area occurs along the Colorado Trail.

General Description: The Elk Ridge includes several 12,000 + peaks. This alpine ridge includes fellfields, scree, rock outcrops, alpine grasslands and meadows, rock gardens, snowfields and small snowmelt streamlets. This alpine stretch ranges in elevation between 11,200-12,693 feet and includes approximately 6,110 acres.

Elk Ridge Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Fall Creek

Location: Eagle County, Fall Creek drains into the Eagle River three miles north of Redcliff, headwaters are in the Holy Cross Range

U.S.G.S. 7.5 min. quadrangle (s): Mount of the Holy Cross, Minturn

Legal Description: T6S R81W S14,23,26,27,34; T7S R81W S3,4,7-10,16,17

Biodiversity Rank: B4

Biodiversity Rank Justification: The Fall Creek drainage includes a high-quality riparian corridor. Two globally common communities in excellent condition have been described here.

Natural Heritage elements at the Fall Creek site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|---------------------------------------|--------------------------------|-------------|------------|--------------------------|----------|
| <i>Salix wolfii/ Carex utriculata</i> | Subalpine riparian willow carr | G4 | S3 | | A |
| <i>Carex utriculata</i> | Montane wet meadow | G5 | S4 | | A |

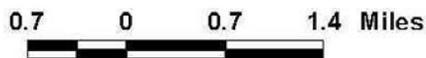
*EO = Element Occurrence

Boundary Justification: The primary riparian corridor of Fall Creek is included all the way to its headwaters. The hydrologic regime of the area is important to the maintenance of the quality of these wetland areas and must be considered in all activities in the watershed.

Management and Protection Comments: This site is partially protected by The Wilderness Act, but this act does not preclude water development. Water diversion would significantly disrupt the high quality wetlands. A proposed water diversion project (Homestake 110) is currently under review. The water diversion would divert water from Cross and Fall Creeks into Homestake Creek and then over to the east slope of Colorado Springs area.

General Description: Riparian habitats from the alpine to subalpine are included along Fall Creek. The site encompasses 1,139 acres from 9,000-12,600 feet in elevation.

Fall Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Grouse Creek

Location: Eagle County, southwest of Minturn, between Cross Creek and West Grouse Creek
 U.S.G.S. 7.5 min. quadrangle (s): Minturn
 Legal Description: T5S R81W S27,28,33,34; T6S R81W S3-6,8-10

Biodiversity Rank: B5

Biodiversity Rank Justification: The purple lady's slipper is known from the northwest United States and scattered throughout the Colorado mountains. Although rather widely distributed it is usually found in small populations.

Natural Heritage elements at the Grouse Creek site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|---------------------------------|-----------------------|-------------|------------|----------------------|----------|
| <i>Cypripedium fasciculatum</i> | purple lady's slipper | G4 | S3 | FS | A |
| <i>Cypripedium fasciculatum</i> | purple lady's slipper | G4 | S3 | FS | C |

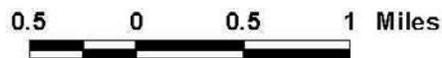
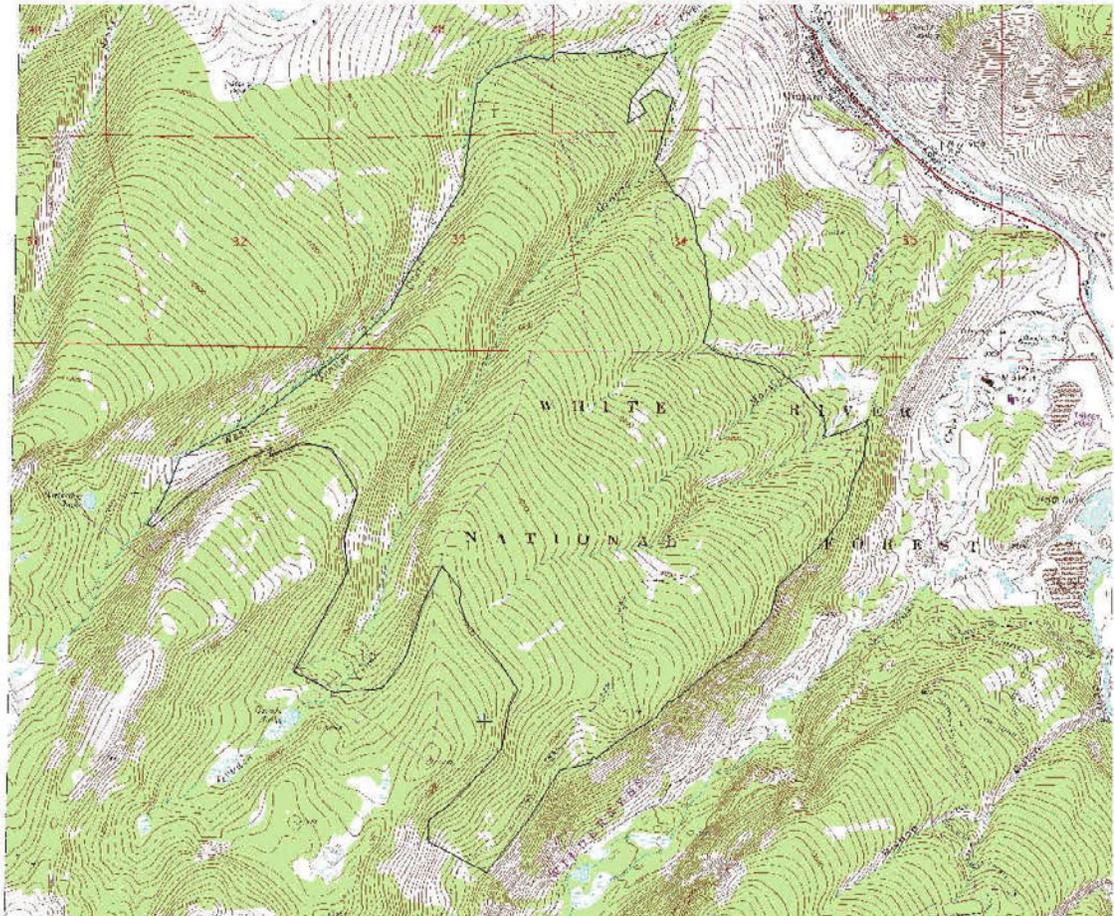
*EO = Element Occurrence

Boundary Justification: This site boundary includes the two occurrences plus the adjoining potential habitat. This species occurs in common lodgepole or spruce fir forest and therefore, this boundary is difficult to limit. Similar areas in the County should be considered suitable habitat.

Management and Protection Comments: This site is entirely included within the National Forest boundary. Several clearcuts are adjacent to the site and the site may be used for timber as well. Recreation in the area is high. Trampling, erosion, forestry, weed infestations, and prevention of orchid collection should be addressed in the forest management plan for this area.

General Description: The Grouse Creek site includes a small portion (3466 acres) of the lodgepole and spruce-fir forest between 8,400-10,600 feet. The forest is typical with arnica and blueberry as the dominant understory.

Grouse Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Gypsum Creek

Location: Eagle County, between Hardscrabble Mountain and Red Table Mountain, along Gypsum Creek near the confluence with White Creek

U.S.G.S. 7.5 min. quadrangle (s): Red Creek

Legal Description: T6S R84W S30,31; T6S R85W S25,36.

Biodiversity Rank: B3

Biodiversity Rank Justification: Low elevation riparian areas, especially occurring on private property, have commonly been converted for agriculture or developed. This site is particularly significant, as it is one of the only representatives of this type for Eagle County. The site includes a good example of a globally rare plant community.

Natural Heritage elements at the Gypsum Creek site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|--|------------------------------|-------------|------------|----------------------|----------|
| <i>Salix monticola/ Carex utriculata</i> | montane riparian willow carr | G3 | S3 | | B |

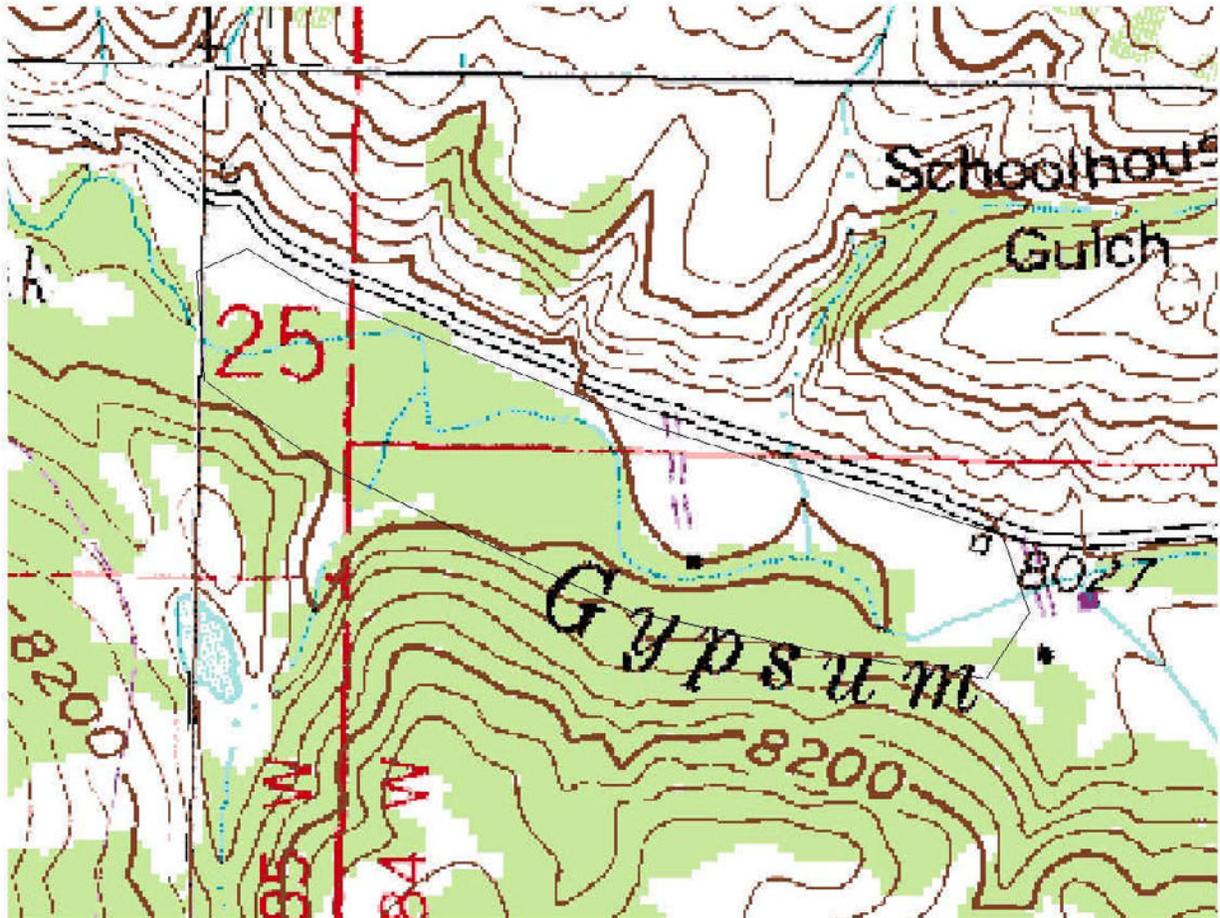
*EO = Element Occurrence

Boundary Justification: The boundary encompasses the community occurrence but does not extend upstream. The entire upper watershed is important to the maintenance of this high-quality wetland; good water quality is important.

Management and Protection Comments: This site occurs on private property. Current management is adequate. The site will benefit ecologically from the maintenance of current management practices. Road and home construction in the general area has impacted nearby wetlands (B. Heicher pers. comm.). Additional development or an increase in livestock use would negatively impact this site.

General Description: A large willow carr dominates this site and is maintained by high beaver activity. The uplands include mixed shrubs, spruce-fir and aspen. This site includes 25 acres between 7,980-8,020 feet.

Gypsum Creek Potential Conservation Area



Approximate location
of PCA within
Eagle County



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Map created 25 February
by T. L. Davis

Hardscrabble

Location: Eagle County, south of Eagle between Gypsum and Brush Creeks

U.S.G.S. 7.5 min. quadrangle (s): Suicide Mountain, The Seven Hermits

Legal Description: T5S R84W S30-31; T5S R85W S25-27,33-36; T6S R84W S6; T6S R85W S1-3,10-12

Biodiversity Rank: B5

Biodiversity Rank Justification: The Hardscrabble area includes a good occurrence of nesting northern goshawk and an excellent example of a genetically pure Colorado River cutthroat trout population. This particular occurrence of Colorado River cutthroat trout has been identified by the USFS as one of two conservation populations in the Brush Creek drainage. Criteria for such designation are that the population is believed to be indigenous, genetically pure, allopatric above a barrier, and not believed to be in a recently stocked watershed.

Natural Heritage elements at the Hardscrabble site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|--|--------------------------------|-------------|------------|----------------------|----------|
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | FS/ BLM SC | A |
| <i>Accipiter gentilis</i> | Northern goshawk | G5 | S3B | FS/ BLM | B |

*EO = Element Occurrence

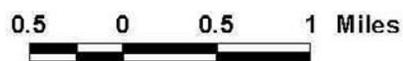
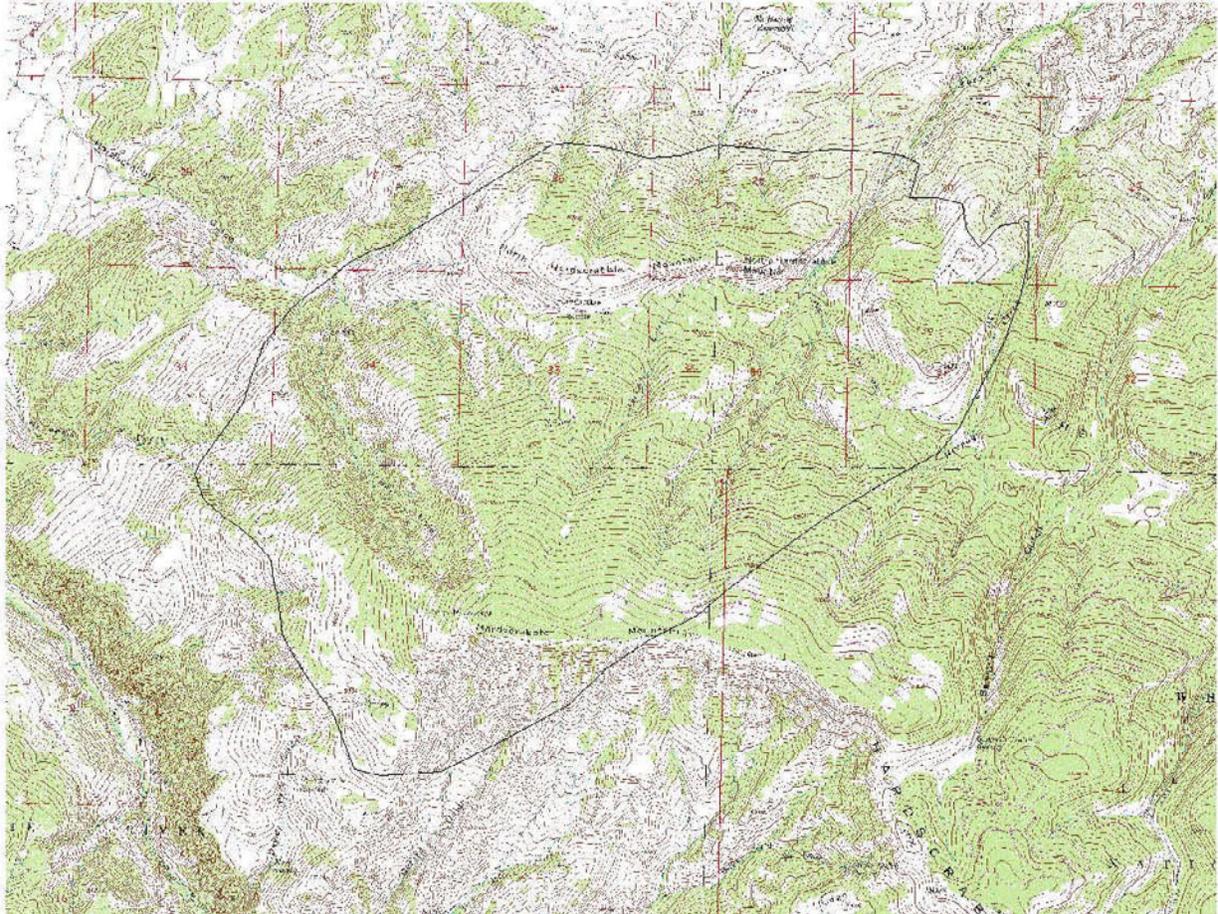
Boundary Justification: The boundaries were developed to include the nesting areas for northern goshawk, as well as adjacent areas suitable for foraging. The occurrence of Colorado River cutthroat trout and the immediate watershed upon which it depends are included within this same boundary.

Management and Protection Comments: This site occurs entirely on public lands managed by the USFS and BLM. Current levels of livestock grazing appear to be compatible with the goshawk occurrence. Impacts from livestock grazing to the trout occurrence are unknown at this point. However, after Bill Heicher (CDOW) explained the potential for heavy cattle use to negatively affect the sensitive fishery, rancher Lloyd Gerard voluntarily relocated a stock trail to keep his own cattle from walking up the creek. Efforts like those of Gerard and Heicher will substantially help the trout occurrence to persist. One way to directly build on these efforts might be to address travel management overall in the area, including travel not only by livestock, but also by humans and all the associated forms of locomotion (off-road vehicles, biking, hiking, etc.).

At the downstream edge of the trout occurrence, a diversion carries water out toward the Eagle County airport. This diversion has negatively affected the trout occurrence over the years since it was established (B. Heicher pers. comm.). Monitoring the hydrology and dependent fishery is strongly advised.

General Description: This site encompasses the lower edge of a montane forest comprised of mixed lodgepole pine and aspen, with scattered patches of Engelmann’s spruce and subalpine fir. The eastern edges include some montane shrublands as well. The boundaries include 5,960 acres and the elevation ranges from 7,800-10,550 feet.

Hardscrabble Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Hat Creek

Location: Eagle County, tributary of East Brush Creek entering near Fulford Cave
 U.S.G.S. 7.5 min. quadrangle (s): Crooked Creek Pass, Fulford
 Legal Description: T6S R83W S22,27,28,33-35; T7S R83W S3,4,8-10

Biodiversity Rank: B5

Biodiversity Rank Justification: Hat Creek supports one of two conservation populations of Colorado River cutthroat trout in the Brush Creek drainage. This designation is bestowed by the USFS and criteria for such designation are that the population is believed to be indigenous, genetically pure, allopatric above a barrier, and not believed to be in a recently stocked watershed.

Natural Heritage elements at the Hat Creek site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|--|--------------------------------|-------------|------------|----------------------|----------|
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | FS/ BLM/ SC | A |

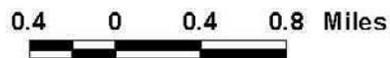
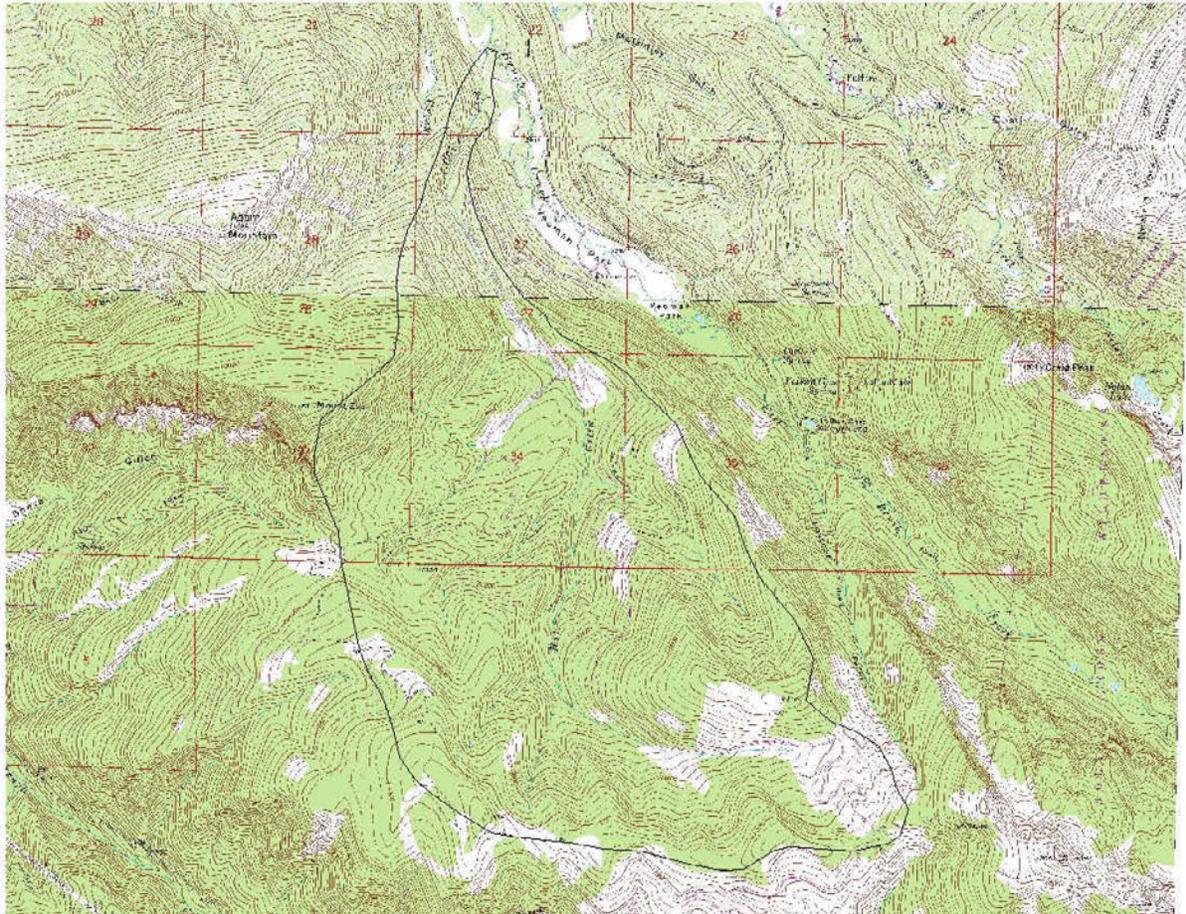
*EO = Element Occurrence

Boundary Justification: The boundaries of this site circumscribe the full extent of the immediate watershed. Activities within this boundary have the potential to impact the local hydrology and therefore the cutthroat trout occurrence.

Management and Protection Comments: The full extent of this site occurs on public lands managed by the USFS. There exists a fifteen-foot waterfall along the stream that serves as an effective barrier to upstream migration by exotic trout. Current management is adequate; current efforts to discourage overuse of the riparian habitat by livestock will help ensure the persistence of this fishery.

General Description: The headwaters of Hat Creek originate in a subalpine setting and the creek flows downstream through montane habitats. The site describes 3,130 acres ranging from 8,880-11,200 feet in elevation.

Hat Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Holy Cross City

Location: Eagle County, includes Sopris, Missouri, French, and Fancy creeks in the Homestake Creek drainage within the Holy Cross wilderness area

U.S.G.S. 7.5 min. quadrangle (s): Mount of the Holy Cross, Mount Jackson, Nast, Homestake Reservoir

Legal Description: T7S R81W S17,18-20,28-34; T7S R82W S25,35,36 T8S R81W S5-7,18; T8S R82W S1,2,11-13.

Biodiversity Rank: B3

Biodiversity Rank Justification: The Holy Cross City area supports a breeding occurrence of boreal toad, a good population of Colorado River cutthroat trout, and a vegetation community in excellent condition. The boreal toad occurrence is significant as it represents the highest recorded breeding locale for this species anywhere in its range. This high elevation contributes to a slower than usual developmental rate, which in part contributes to the average rank it has been assigned. Nonetheless, the site supports one of only three known breeding locations for boreal toad, a globally rare element, in Eagle County.

Natural Heritage elements at the Holy Cross City site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|---|--------------------------|-------------|------------|-----------------------|----------|
| <i>Bufo boreas</i> | boreal toad | G4T1Q | S1 | FS/C/E | C |
| <i>Onchorhynchus clarki pleuriticus</i> | Colorado cutthroat trout | G4T3 | S3 | FS/ BLM/ SC | B |
| <i>Eriophorum altaicum</i> var. <i>neogaeum</i> | Altai cottongrass | G4T3? | S3 | | A |

*EO = Element Occurrence

Boundary Justification: The entire watersheds of Sopris, French, and Fancy Creeks are included in the boundary. The current hydrologic regime is necessary to allow for the persistence of high-quality plant associations, and any actions within the boundaries of the watershed have the potential to impact the elements of biodiversity present in the area.

Management and Protection Comments: The lower portion of the site includes National Forest lands. There are private inholdings throughout the site. The upper portion of the watershed is within the Holy Cross wilderness area, however the hydrologic regime is not protected even under this status. The Homestake Project has been pumping water to Arvada and Colorado Springs for nearly twenty years. The second phase of this project also plans to take water from the Cross Creek drainage. Limiting future water manipulations to areas downstream from the occurrences would greatly enhance the protection of all the elements. The current hydrology must be maintained to allow for the continued prosperity of these species. There is a trail along the creek but this does not seem to be negatively impacting the occurrence.

General Description: Alpine and subalpine habitats are included in this site. The focus is the wetlands which include wet meadows and spruce-fir or willow dominated riparian areas. The site describes 9,563 acres ranging from 9,240-13,600 feet in elevation.

Holy Cross City Potential Conservation Area



0.6 0 0.6 1.2 Miles



Approximate location
of PCA within
Eagle County



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Map created 25 February
by T. L. Davis

Horse Mountain

Location: Eagle County, approximately 7 miles southeast of Eagle
 U.S.G.S. 7.5 min. quadrangle (s): Fulford
 Legal Description: T5S R83W S30,31; T5S R84W S25,36

Biodiversity Rank: B5

Biodiversity Rank Justification: Horse mountain supports a small and relatively unexplored population of a globally rare plant as well as a modestly-sized bachelor roost of a state rare bat species.

Natural Heritage elements at the Horse Mountain site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|---------------------------------------|--------------------------|-------------|------------|-----------------------|----------|
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | D |
| <i>Plecotus townsendii pallescens</i> | Townsend's big eared bat | G4T4 | S2 | BLM | C |

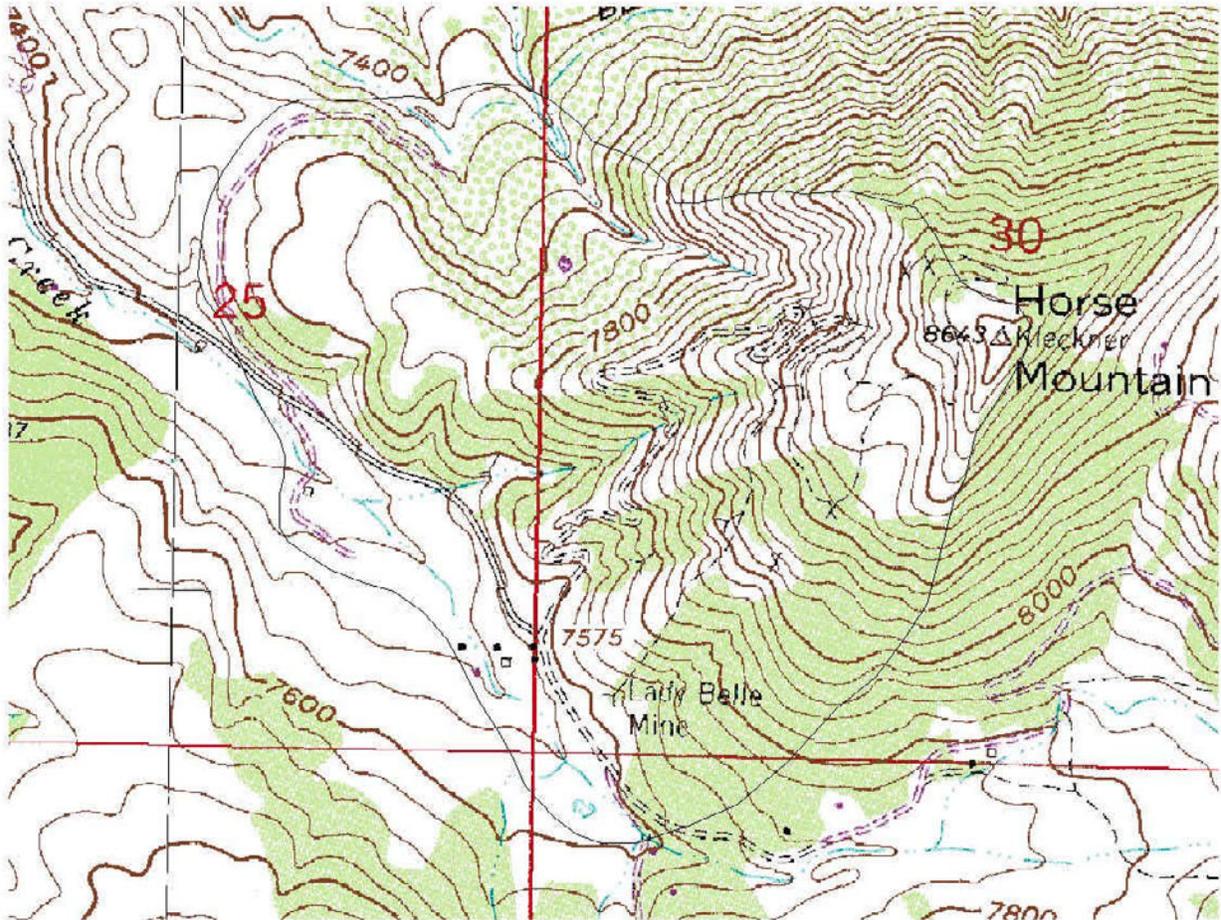
*EO = Element Occurrence

Boundary Justification: The boundaries encompass the eastern slopes of Horse Mountain and were designed to include the extent of the mine opening that provide roosting opportunities for the bat colony. Additionally, the boundaries include expanses of the riparian areas at the foot of the slopes. These areas provide foraging habitat for the bats. The known extent of the plant occurrence is located near the center of the designated area and potential habitat for additional plants occurs within these boundaries.

Management and Protection Comments: This area includes lands that are managed privately as well as public lands managed by both the BLM and the USFS. If public safety associated with abandoned mine entrances needs to be addressed, the installation of grates would allow the bats to persist while still protecting the safety of the public. Current management of the site is compatible with the persistence of the elements of biodiversity present.

General Description: Horse Mountain supports a matrix of pinyon-juniper forest and montane shrublands. The lower slopes are privately managed as agriculture. The site spans 329 acres and ranges in elevation from 7,400-8,600 feet.

Horse Mountain Potential Conservation Area



0.08 0 0.08 0.16 Miles



Approximate location
of PCA within
Eagle County



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Map created 25 February
by T. L. Davis

Milk Creek

Location: Eagle County, the south-facing slope of Horse Mountain, north of Wolcott
 U.S.G.S. 7.5 min. quadrangle (s): Wolcott, State Bridge
 Legal Description: T3S R83W S29-33; T4S R83W S3-6,8-10; T3S R84W S25,36

Biodiversity Rank: B3

Biodiversity Rank Justification: A globally rare plant community is found within this site. Additionally, the globally rare manystem stickleaf is found in abundance here. The manystem stickleaf is found widely around Eagle County along roadsides. The roadcuts seem to imitate this species unique habitat. The Milk Creek site is one of only four locations in Eagle County that support this species in natural surroundings.

Natural Heritage elements at the Milk Creek site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|---|--------------------|-------------|------------|----------------------|----------|
| <i>Juniperus scopulorum/ Cercocarpus montanus</i> | Woodlands | G2 | S2 | | C |
| <i>Nuttallia multicaulis</i> | Manystem stickleaf | G3 | S3 | | B |

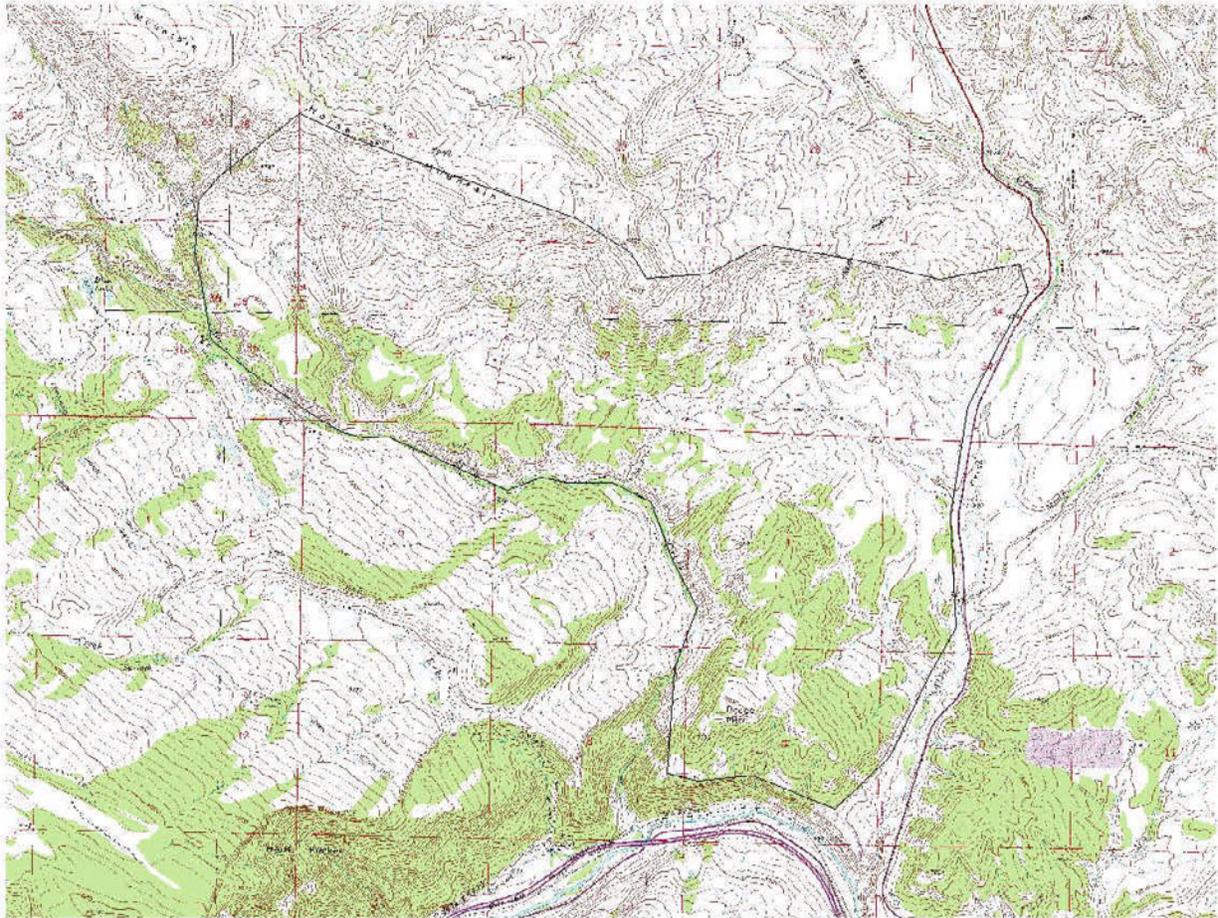
*EO = Element Occurrence

Boundary Justification: This site encompasses the occurrences and includes the immediately adjacent potential habitat for the manystem stickleaf.

Management and Protection Comments: This site occurs primarily on public property managed by the Bureau of Land Management with some outlying private properties. A highly traveled dirt road bisects this site. Approximately half of the site has been designated a Special Recreation Management Area by BLM. The BLM plans to establish a designated trail system for motorized vehicle recreation. Existing trails not part of the designated system will be closed and rehabilitated. Exotic plant species, likely being spread by activity along the road, have the potential to adversely impact the native vegetation present. The lower sagebrush slopes are currently grazed. The specific habitat of the rare plant includes the steep, unstable barren slopes above the sagebrush. It is unlikely that cattle disturb this area much, however, the grazing permit on this allotment is being changed from cattle to sheep this year and sheep have a higher potential to affect these steeper slopes. The less steep areas are used heavily by motorbikes. Discouraging the development of new roads will help protect the integrity of the site.

General Description: This site includes the uplands of the Milk Creek area. Sagebrush, pinyon, juniper, and mountain mahogany are dominant for much of this site, however the steep south-facing slopes of Horse Mountain along with other scattered patches lack vegetation almost completely. These dark colored barren areas support the rare plant species. The Milk Creek site includes 4,625 acres between 7,100-9,200 feet in elevation.

Milk Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Norman Creek

Location: Eagle County, a tributary of Big Alkali Creek draining off Castle Peak
 U.S.G.S. 7.5 min. quadrangle: Castle Peak
 Legal Description: T2S R84W S28,29

Biodiversity Rank: B3

Biodiversity Rank Justification: The manystem stickleaf is found widely around Eagle County along roadsides. The roadcuts seem to imitate this species unique habitat. The Norman Creek site is one of only four locations in the county that support this species in natural surroundings.

Natural Heritage elements at the Norman Creek site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|------------------------------|--------------------|-------------|------------|----------------------|----------|
| <i>Nuttallia multicaulis</i> | manystem stickleaf | G3 | S3 | | B |

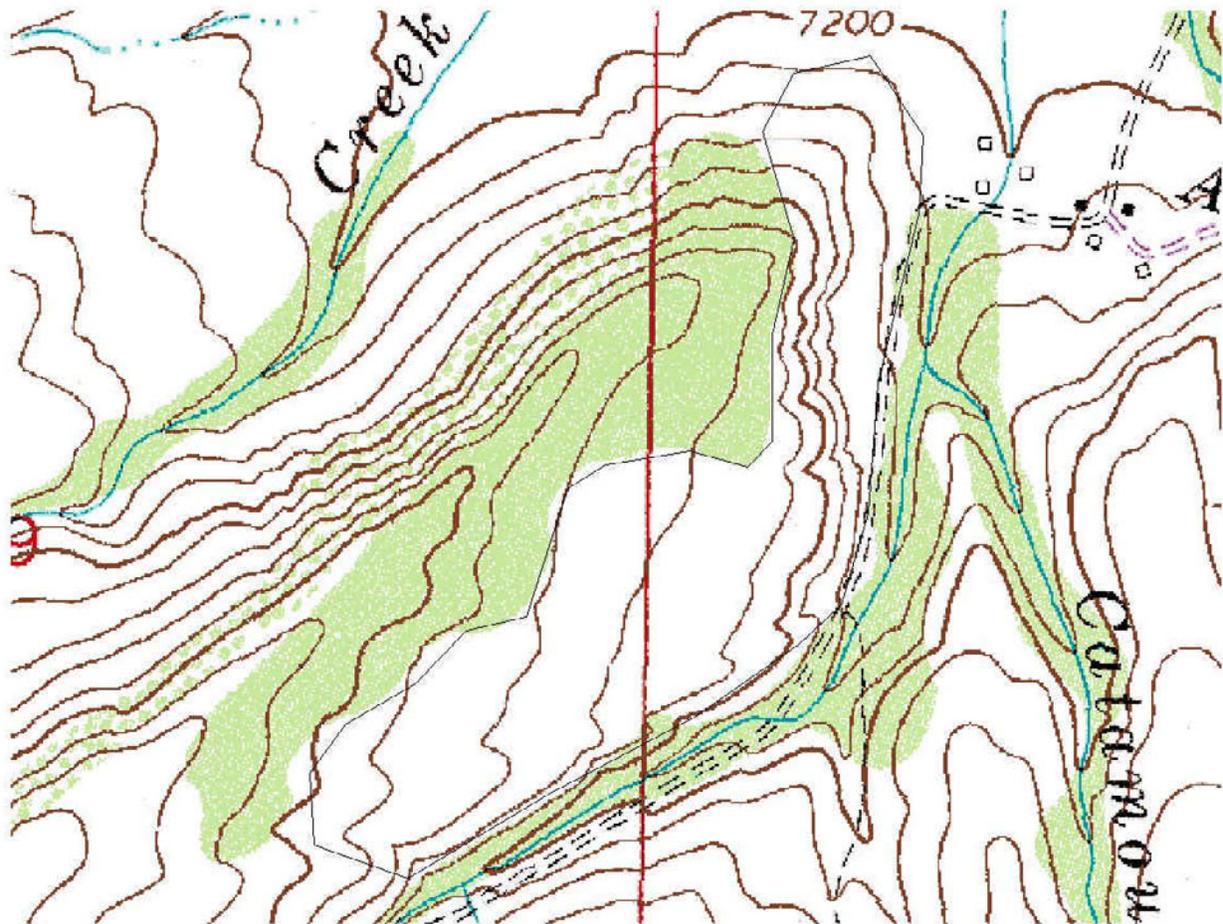
*EO = Element Occurrence

Boundary Justification: The Norman Creek site boundary includes the occurrence and all adjacent suitable habitat.

Management and Protection Comments: This occurrence occurs on a mix of private and public (Bureau of Land Management) lands. Development plans are not known at this time. The property is grazed, however, the steep, barren, and unstable nature of the slopes of this site are likely to deter cattle from using it. Roadside weeds are not likely to become dominant on this habitat; monitoring would help provide an early warning signal to this effect.

General Description: This site is typified by steep barren slopes with interspersed gullies. The surrounding habitat consists of pinyon-juniper, sagebrush and mountain mahogany. This small site includes 60 acres between 7,200-7,600 feet in elevation.

Norman Creek Potential Conservation Area



0.05 0 0.05 0.1 Miles



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

North Fork Deep Creek

Location: Summit/Eagle counties, situated west of Green Mountain Reservoir and reaches up to the northern portion of Elliot Ridge in the Gore Range

U.S.G.S. 7.5 minute quadrangles: Sheephorn Mountain and Piney Peak

Legal Description: T2S R81W S 1-3, 10-15, 23-26; T2S R80 W S 6-8, 17-19, 30; T1S R80W S 31; T1S R81W S 36

Biodiversity Rank: B5

Biodiversity Rank Justification: The Purple lady's-slipper (*Cypripedium fasciculatum*) is a state-rare orchid species. This site includes the largest known occurrence of this orchid. There are over 5000 individuals estimated, scattered over 1000 or more acres of excellent condition lodgepole pine (*Pinus contorta*) and spruce-fir (*Picea engelmannii-Abies lasiocarpa*) forests.

Natural Heritage elements at the North Fork Deep Creek site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|---------------------------------|-----------------------|-------------|------------|-----------------------|----------|
| <i>Cypripedium fasciculatum</i> | purple lady's slipper | G4 | S3 | FS | A |

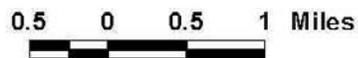
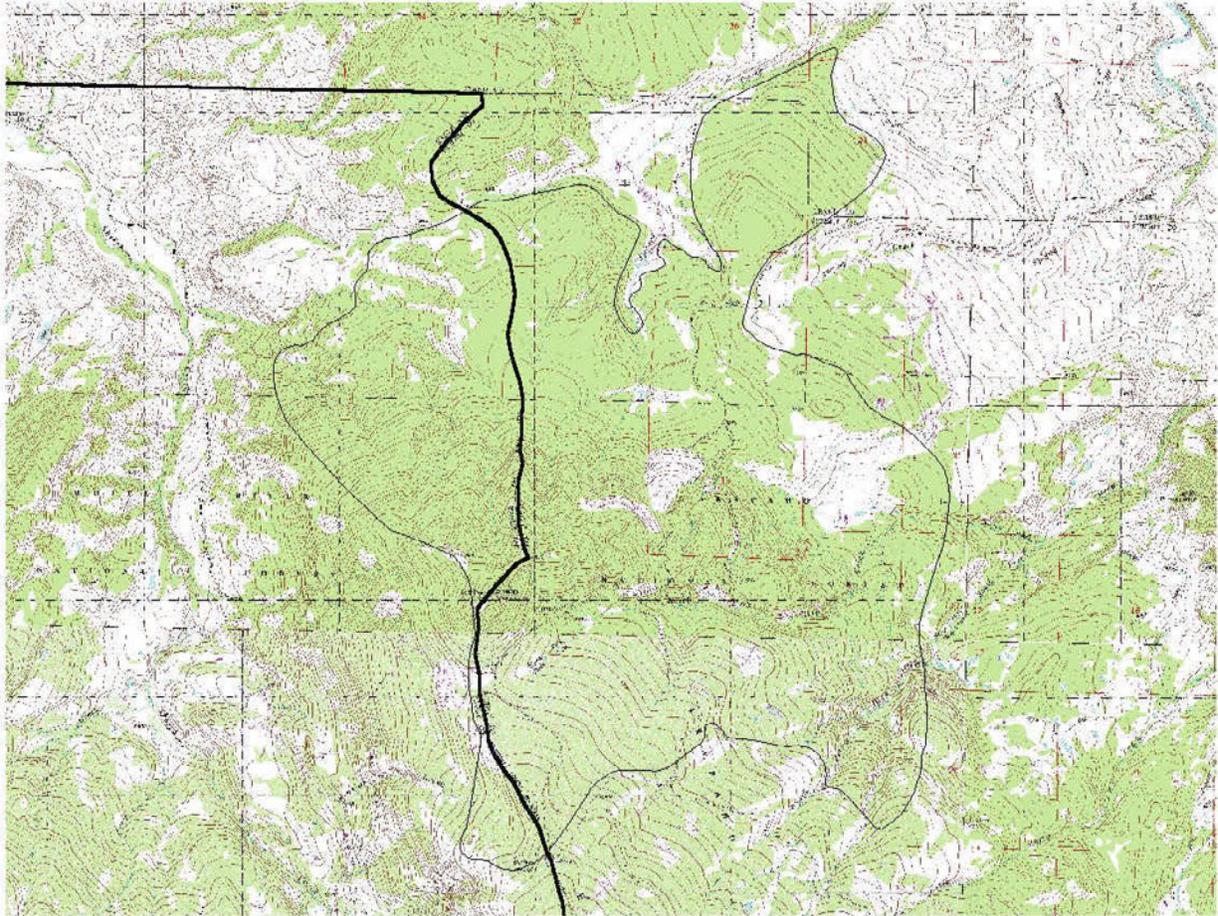
*EO = Element Occurrence

Boundary Justification: This boundary merely follows the occurrence boundary of the rare orchid. The occurrence is so large and the habitat common that adjacent suitable habitat was not included.

Management and Protection Comments: This site includes lands that are publicly owned and managed by the U.S. Forest Service and the Bureau of Land Management, as well as some private parcels. Special area designation should not be necessary for protection if management issues are adequately addressed. There is a timber sale proposed for a quarter of the inventoried population of the rare orchid. Although the timber is not sold yet, the logging was proposed to take place during the summer of 1997. The USFS has established 75 plots to determine the effects of timber activity on the population of orchids. Surveys are planned for 1-3, 3-5, 10, 15, and 25-year intervals after logging. There are U.S. Forest Service and other roads throughout the site, but many have been closed to motor vehicles. Cattle enter the area late and stay only a short time. This creates a light grazing intensity. Recreational use in the area is light also. Timothy (*Phleum pratense*) and other hay grasses are abundant on the roadsides, particularly at the lower elevations in the site. Management plans that aim to curb the spread of these and other exotic plant species would help ensure the persistence of the rare orchid.

General Description: Lodgepole pine (*Pinus contorta*), quaking aspen (*Populus tremuloides*), and Engelmann spruce-subalpine fir (*Picea engelmannii-Abies lasiocarpa*) communities are scattered across the slopes of Sheep Mountain and the Deep Creek drainage. This site includes 7,816 acres, and ranges in elevation from about 8,200 feet to the summit of Sheep Mountain at 11,089 feet.

North Fork Deep Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.



Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

North Fork Fryingpan

Location: Pitkin and Eagle counties, headwaters of the North Fork of the Fryingpan River and the full Cunningham Creek drainage

U.S.G.S. 7.5 minute quadrangle: Nast

Legal Description: T8S R82W S7-30, 32-36; T8S R83W S12-14, 23-25; T9S R82W S2, 3.

Biodiversity Rank: B3

Biodiversity Rank Justification: The PCA includes an extensive, good quality occurrence of a riparian community that is globally vulnerable. This community, dominated by Drummond's willow and Canada reedgrass (*Salix drummondiana/Calamagrostis canadensis*), has been documented in only 24 locations in Colorado. Further, a three-mile stretch of an excellent occurrence of a globally secure plant community, a pristine occurrence of a common wetland, a county record for a state-rare fern, and a good occurrence of a globally-vulnerable plant subspecies were documented in this PCA. Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) have been documented in two places in this PCA. One of these was last observed in 1981 and has been assigned an historical element occurrence rank by CNHP. The other was last observed in 1995. This subspecies is considered Sensitive by the U.S. Forest Service and is on the State Special Concern list. One of the wet meadows supports a globally vulnerable plant subspecies. Additionally, a county record for a state-rare fern was located in the PCA in an upland spruce-dominated (*Picea engelmannii*) forest.

Natural Heritage element occurrences at the North Fork Fryingpan PCA

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | EO* Rank |
|---|--------------------------------|-------------|------------|-----------------------|----------|
| <i>Salix drummondiana/ Calamagrostis canadensis</i> | lower montane willow carr | G3 | S3 | | B |
| <i>Abies lasiocarpa-Picea engelmannii/ Alnus incana</i> | montane riparian forest | G5 | S3S4 | | A |
| <i>Carex aquatilis/ Carex utriculata</i> | montane wet meadow | G4 | S4 | | A |
| <i>Eriophorum altaicum</i> var. <i>neogaeum</i> | Altai cottongrass | G4T3 | S3 | | B |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | | C |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | | H |
| <i>Cystopteris montana</i> | mountain bladder fern | G5 | S1 | | B |

*EO=Element Occurrence

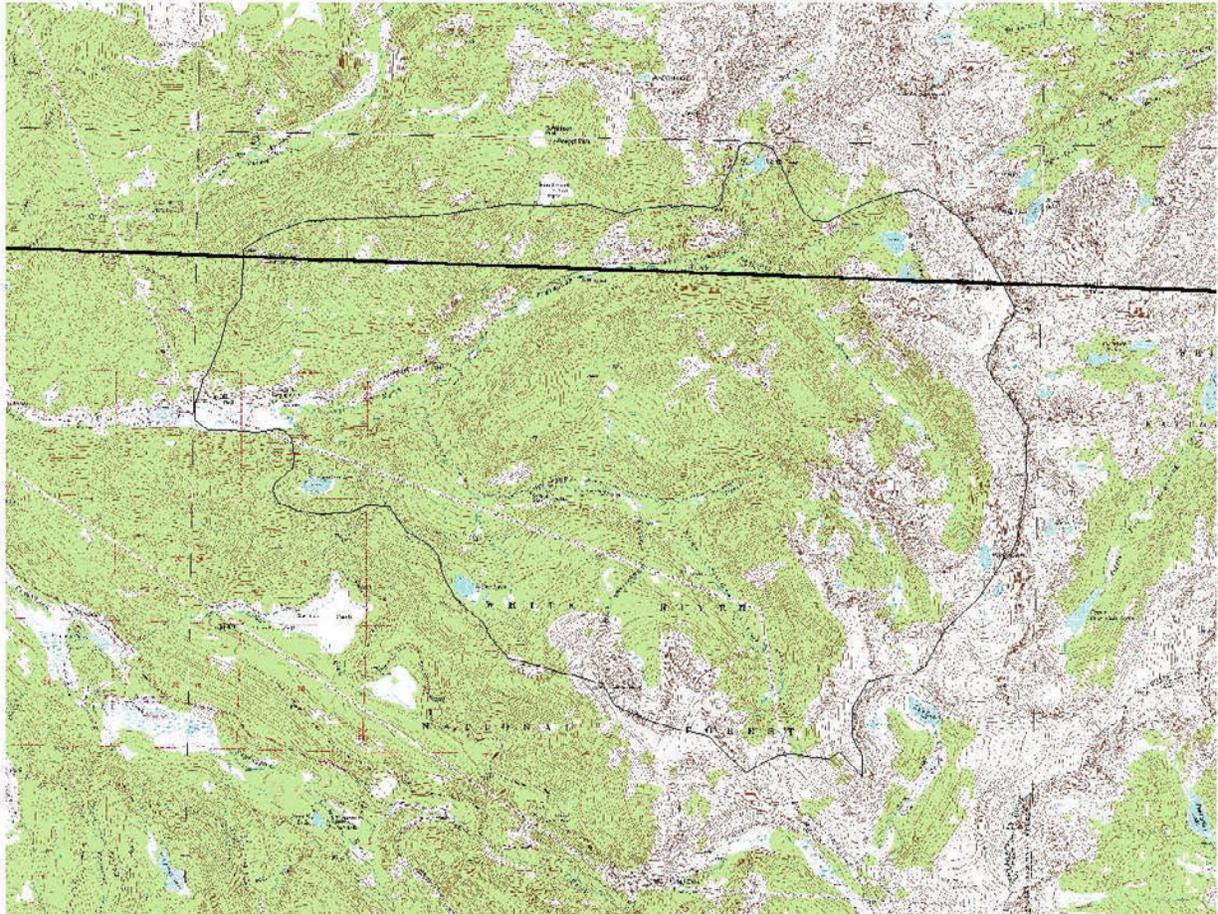
Boundary Justification: The headwaters of the North Fork of the Fryingpan River and the full Cunningham Creek drainage are included in this PCA. This delineation emphasizes the potential for activities within the watershed to impact the elements of biodiversity present and also allows for the migration of the elements over time.

Management and Protection Comments: This PCA includes public lands managed by the White River National Forest, including Wilderness Area property, and a small private inholding. The private lands are being developed. Recreational use is very high in this area including a campground, four-wheel drive and off-road vehicle use, fishing, hiking, and camping. In order to address the most important biological features of this area, recreational management would do best to focus on the impacts of trails and campsites in the riparian areas and along the river corridors in general. Some portions of the PCA are used for cattle grazing. Where this is the case, it is important to discourage cattle use of the riparian areas, particularly those stretches that support communities of concern. Non-native species including dandelion (*Taraxacum officinale*), timothy (*Phleum pratense*), Kentucky bluegrass (*Poa pratensis*) and orchard grass (*Dactylis glomerata*) were found at lower elevations and along roads. Management

goals that address biodiversity would do well to strive to prevent the spread of these and other exotic species. The reservoir downstream of the PCA could change the hydrology of the Elk Wallow willow carr. There is an altered hydrologic cycle in this drainage because of many diversions. Land managers could work with the Bureau of Reclamation to mimic natural flooding regime.

General Description: This PCA includes the full drainages of Cunningham Creek and the North Fork of the Fryingpan River down to and including the Elk Wallow willow carr. The headwaters of this basin support alpine systems. Further downstream (10,000 feet) the vegetation is dominated by spruce-fir (*Picea engelmannii-Abies lasiocarpa*) and lodgepole pine (*Pinus contorta*) forests with small willow carrs and wet meadows. Elevation range within the PCA is about 8,800 to almost 12,500 feet. A total of 13,477 acres are included in the PCA boundaries.

North Fork Fryingpan Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.



Approximate location
of PCA within
Eagle County



Map created 24 February
by T. L. Davis

Pitkin/Booth Creeks

Location: Eagle County, approximately 4 miles east of Vail just north of Interstate 70

U.S.G.S. 7.5 minute quadrangles: Vail East

Legal Description: T4S R79W S18-20, 29-32; T4S R80W S13,14,23-26,35,36; T5S R80W S1-3, 10-12

Biodiversity Rank: B3

Biodiversity Rank Justification: This area supports two good occurrences of the Colorado River cutthroat trout, a globally rare subspecies, and a breeding population of boreal toads. The site also supports the occurrence of a globally rare plant community and nesting habitat for the black swift, a state rare bird.

Natural Heritage elements at the Pitkin/Booth Creeks site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|--|--------------------------------|-------------|------------|-----------------------|----------|
| <i>Salix monticola/ Calamagrostis canadensis</i> | montane willow carr | G3 | S3 | | C |
| <i>Cypseloides niger</i> | black swift | G4 | S3B | FS | H |
| <i>Cypseloides niger</i> | black swift | G4 | S3B | FS | D |
| <i>Cypseloides niger</i> | black swift | G4 | S3B | FS | C |
| <i>Bufo boreas</i> | boreal toad | G4T1Q | S1 | FS/C/ E | C |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | | B |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | | B |

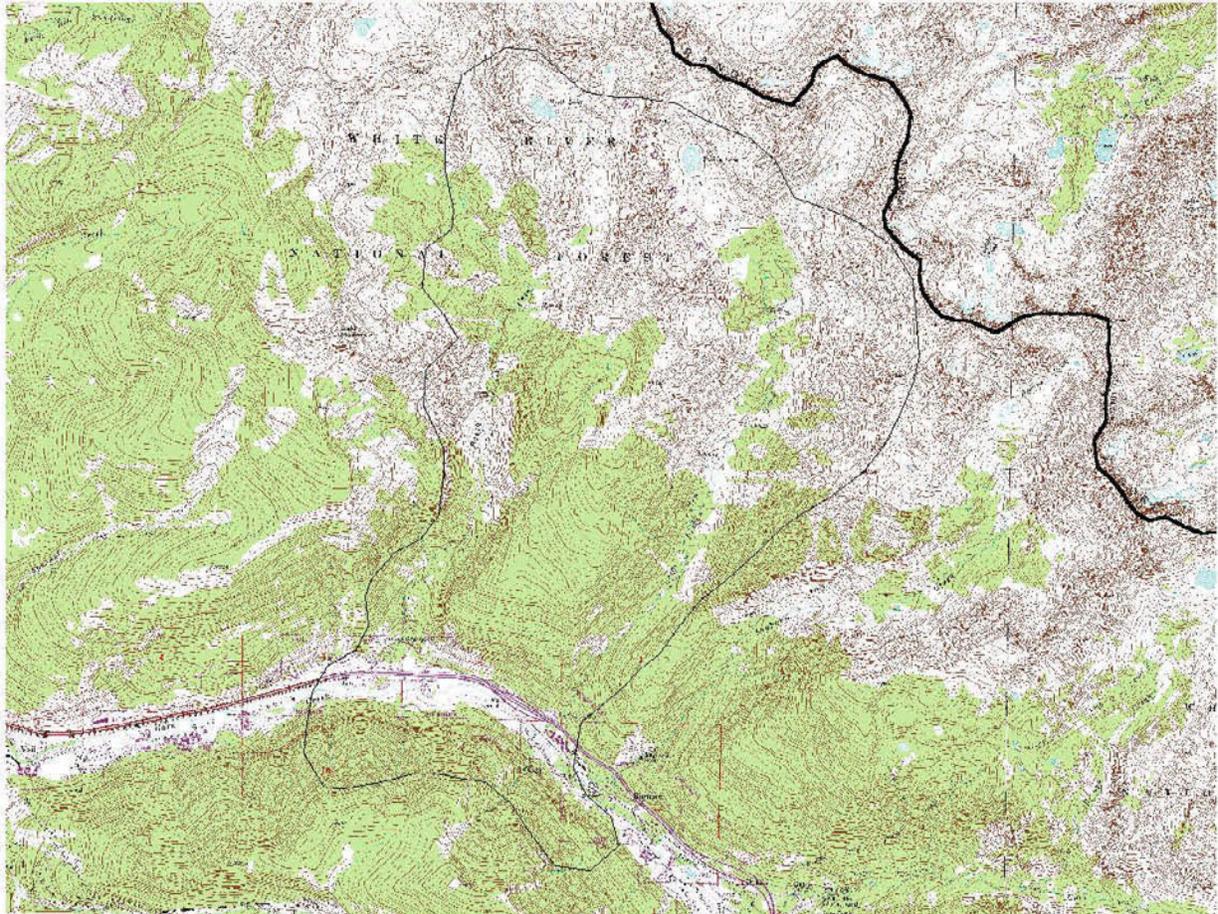
*EO = Element Occurrence

Boundary Justification: The full extent of the watersheds immediate to Pitkin and Booth Creeks was included to indicate that activities within these watersheds have the potential to impact the local hydrology and therefore the cutthroat trout and vegetation communities present. The boundaries were extended across I-70 at the southern end to encompass the nesting locations of black swifts and Katos Pond, where boreal toads breed. While activities on Gore Creek upstream of Katos Pond have the potential to affect the toads, the boundaries were not extended to include that watershed, but this potential is noteworthy.

Management and Protection Comments: This site includes lands managed by the USFS, including portions of the Eagle's Nest Wilderness Area, as well as some tracts of private land. In the southern portions of the site, boreal toads breed in a beaver pond near a golf course. Monitoring the productivity of this population over time will help to provide an indication of the population trend. Should populations show significant signs of decline, mitigative measures may become necessary. Without a monitoring program, however, we cannot know what impacts current management activities may have on the population. The cutthroat trout population in Pitkin creek would suffer should brook trout breach the culvert barrier at I-70. In order to minimize the chances of this occurring, the barrier at I-70 may require further maintenance. There exists a 60-foot waterfall on Booth Creek that provides a suitable barrier against upstream migration by exotic trout in this drainage. Additionally, a waterfall approximately three miles up Pitkin Creek may provide a barrier to upstream migration.

General Description: The headwaters of Pitkin and Booth Creeks originate high in the Gore Range and are defined by alpine habitat. The creeks flow down through subalpine and montane habitats to the confluence with Gore Creek, where I-70 bisects this site. The southern arm of this site is marked by cliffs that provide waterfalls through a mesic microclimate in an aspen forest. The site covers 6,721 acres and ranges in elevation from 8,300-12,600 feet.

Pitkin/Booth Creeks Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Polk Creek

Location: Eagle County, east of Interstate 70 just below Vail Pass
 U.S.G.S. 7.5 minute quadrangles: Vail Pass, Red Cliff
 Legal Description: T5S R79W S15-17,20-23,26-29,33-35; T6S R79W S3,4

Biodiversity Rank: B3

Biodiversity Rank Justification: This conservation area includes the watersheds of both Polk and Miller Creek; Polk Creek supports a globally rare riparian community in excellent condition. The globally rare Colorado River cutthroat trout occurs in both Polk and Miller Creeks, although there is some indication of hybridization in these populations. Additionally, northern goshawks nest within the boundaries.

Natural Heritage elements at the Polk Creek site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|--|--------------------------------|-------------|------------|----------------------|----------|
| <i>Picea pungens/ Alnus incana</i> | montane riparian forest | G3 | S3 | | A |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | | B |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | | B |
| <i>Accipiter gentilis</i> | Northern goshawk | G5 | S3B | FS/BLM | |

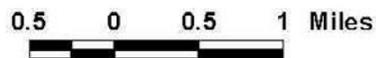
*EO = Element Occurrence

Boundary Justification: The boundaries encompass the immediate watershed in which the Colorado River cutthroat trout occur. The immediate watershed is included to illustrate that activities occurring within this area have the potential to impact both the fishery and the riparian vegetation community.

Management and Protection Comments: This area includes lands managed primarily by the USFS, includes some portion of the Eagles Nest Wilderness Area. Current management practices are compatible with the element occurrences at the site. Further measures to help ensure the persistence of the trout might include the preclusion of exotic trout from the system. This could be accomplished by bolstering barriers to upstream migration by exotic trout in the lower reaches of the system.

General Description: Polk Creek flows through subalpine and montane habitats and includes 4,519 acres ranging in elevation from 9,200-12,400 feet.

Polk Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 24 February
by T. L. Davis

Red Dirt Creek

Location: Eagle and Garfield County, tributary flowing from the west to the Colorado River between Derby Junction and Sweetwater

U.S.G.S. 7.5 minute quadrangles: Sugarloaf Mountain, Burns South, Sweetwater Lake, Dome Peak

Legal Description: T2S R86W S16-23,25-36; T2S R87 S13,23-26,34-36; T3S R86W S1-7 ,11 ,12; T3S R87W S1-3,10-12

Biodiversity Rank: B5

Biodiversity Rank Justification: This large area supports a number of state-rare elements, including nesting areas for northern goshawk and Barrow's goldeneye, while the eastern portion supports a common riparian community in excellent condition. The streams within this area support two moderately hybridized populations of Colorado River cutthroat trout, a globally rare subspecies. The occurrence of Barrow's goldeneye is noteworthy as it represents the only area of Eagle County from which they are known. Further, although Barrow's goldeneye was reportedly very common throughout central Colorado in the late 1800's, breeding is now restricted to a small area of the Flat Tops. This potential conservation area supports the southeastern limit of the current-day breeding range in Colorado.

Natural Heritage elements at the Red Dirt Creek site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|---|--------------------------------|-------------|------------|-----------------------|----------|
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | | B |
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | | H |
| <i>Bucephala islandica</i> | Barrow's goldeneye | G5 | S2B | BLM/SC | C |
| <i>Bucephala islandica</i> | Barrow's goldeneye | G5 | S2B | BLM/SC | E |
| <i>Accipiter gentilis</i> | Northern goshawk | G5 | S3B | FS/BLM | C |
| <i>Abies lasiocarpa- Picea engelmannii/ Mertensia ciliata</i> | Montane riparian forest | G5 | S5 | | A |

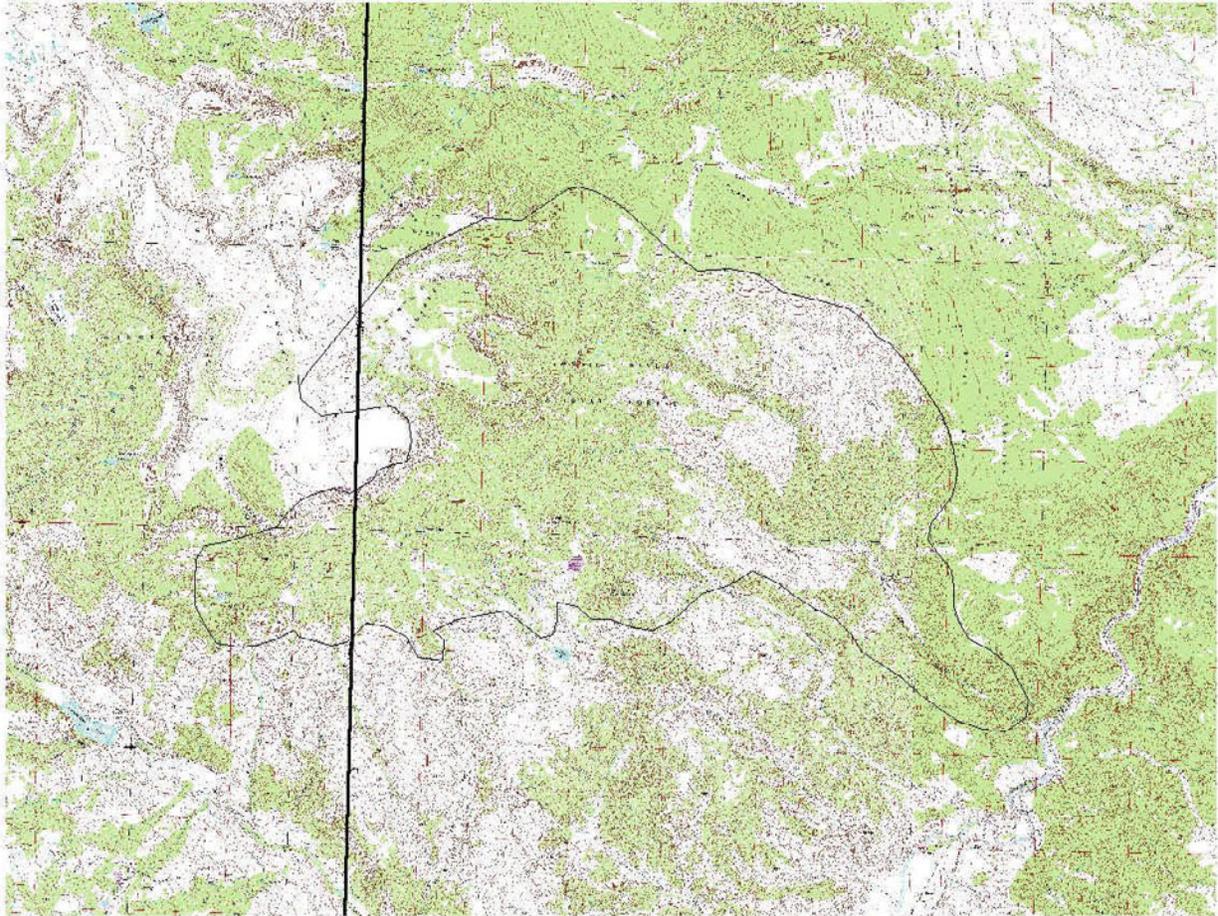
*EO = Element Occurrence

Boundary Justification: Since the majority of the elements present at this site depend exclusively on the local hydrology for their life needs, the extent of the watershed was included from the headwaters along the eastern cliffs of the Flat Tops to the confluence of Red Dirt Creek and the Colorado River. Activities within these boundaries have the potential to impact the local hydrology and dependent ecology.

Management and Protection Comments: This site includes properties of Flat Tops Wilderness Area, White River National Forest, Bureau of Land Management as well as some private lands interspersed throughout. Current activities are mostly compatible with the persistence of the elements present, but careful consideration should be given any project that seeks to divert more water from the system, as this would impact the trout fishery and the riparian community. Significantly, it should be noted that the Barrow's goldeneye feeds on aquatic macroinvertebrates and does not compete well with trout for this resource, if limited. The lakes that serve as foraging areas for the local goldeneye are free from trout. Measures to ensure that they stay that way would benefit the birds.

General Description: Spectacular scenery marks the western portions of this site, where cliffs tower above a mixed forest of a subalpine and montane nature. Red Dirt Creek winds its way down from here through a pinyon-juniper forest at the eastern end of the site. The boundaries of this potential conservation area encircle 17,407 acres that range in elevation from 6,400-11,300 feet.

Red Dirt Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.



Approximate location
of PCA within
Eagle County



Map created 24 February
by T. L. Davis

Red Hill

Location: Eagle County, between Cottonwood Creek, Gypsum Creek and the Eagle River
 U.S.G.S. 7.5 minute quadrangles: Gypsum, Dotsero, Suicide Mountain, Cottonwood Pass
 Legal Description: T5S R86W S1,8-17,21-28,34; T5S R85W S19

Biodiversity Rank: B3

Biodiversity Rank Justification: Harrington's beardtongue (*Penstemon harringtonii*) is a globally vulnerable plant species that is restricted to Colorado and is found almost exclusively in sagebrush habitat. This species is only known from approximately 37 locations, all of which are centered near Edwards in Eagle County. In general, Harrington's beardtongue and its habitat are highly threatened from residential development. These threats in addition to a restricted range emphasize the urgent need for protection. Harrington's beardtongue populations are known to fluctuate in population numbers from year to year. Therefore, this specific location may be a higher priority than the current information reflects. This site is one of ten that has been designed around the best locations of this species.

Natural Heritage elements at the Red Hill site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|-------------------------------|--------------------------|-------------|------------|-----------------------|----------|
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | B |

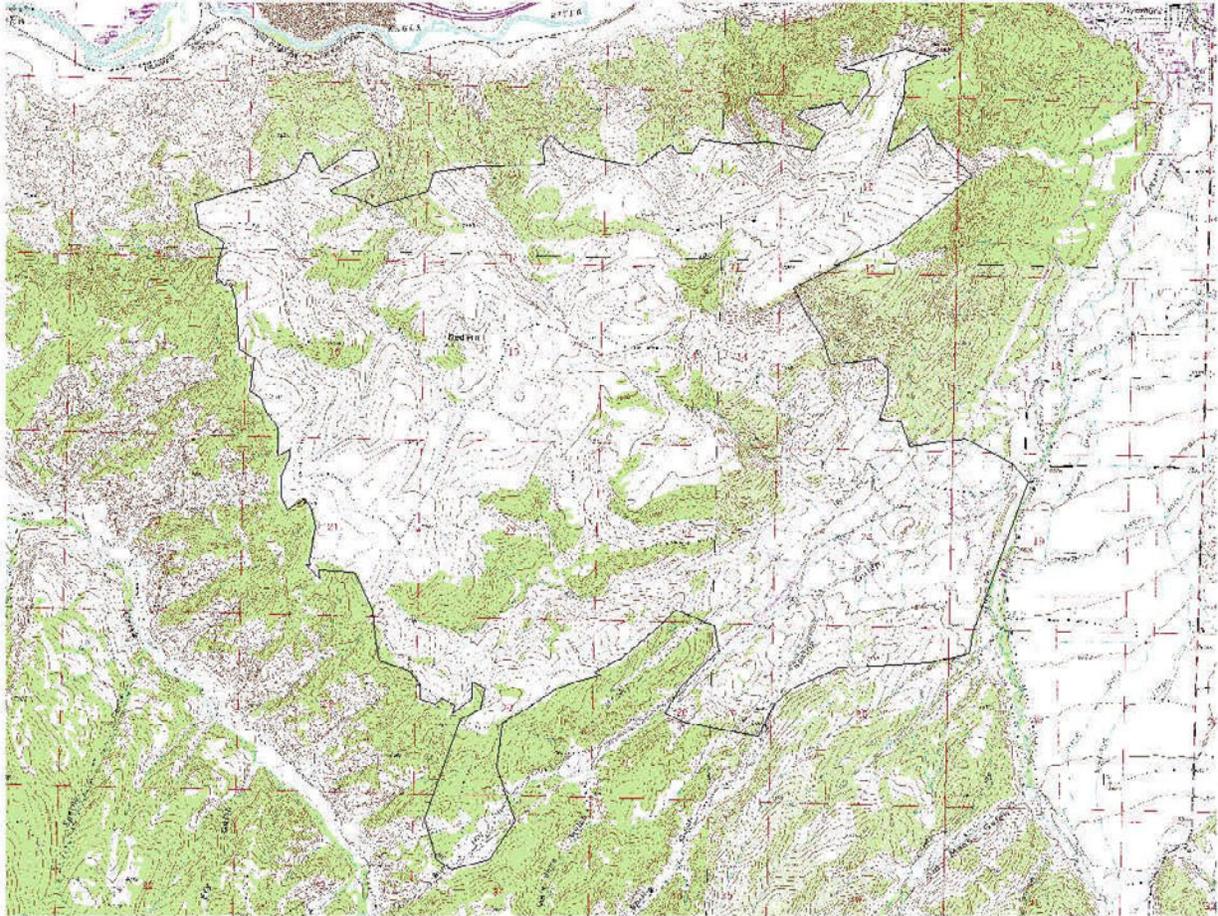
*EO = Element Occurrence

Boundary Justification: The Red Hill site includes the scattered individuals of Harrington's beardtongue and the unoccupied potential habitat that lies between them.

Management and Protection Comments: Public land managed by the Bureau of Land Management comprises most of this site. A small portion occurs on private property. Grazing is the predominant land use. Plants have been reportedly nipped off and trampled by cattle or elk. Potentially, trampling and nipping of Harrington's beardtongue, especially during flowering season, may reduce the reproductive success in that year. There are several dirt roads crossing the site; future developments are not recommended. We recommend that monitoring of the "A" and "B" ranked Harrington's beardtongue occurrences under different management practices become part of the BLM's management plan.

General Description: Rolling sagebrush hills with scattered pinyon and juniper dominate this landscape. The area historically supported a population of sage grouse, but no birds have been observed in recent years (B. Heicher pers. comm.). Should sage grouse still be present in this area, they would most likely be the newly described species colloquially known as the Gunnison sage grouse. The Potential Conservation Area encompasses 7,214 acres and ranges in elevation from 6,600-8,180 feet.

Red Hill Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 24 February
by T. L. Davis

Seven Hermits

Location: Eagle County, includes two unconnected areas: between the Seven Hermits and the Town of Eagle and east of Eagle and south of Interstate 70

U.S.G.S. 7.5 minute quadrangles: Seven Hermits, Eagle, Fulford, Wolcott

Legal Description: T4S R83W S31; T4S R84W S25-27,33-36; T5S R83W S6,7,18,19; T5S R84W S1-3,11-13,24; T5S R84W S10, 14,15,22,23,26,27,35; T6S R84W S1

Biodiversity Rank: B3

Biodiversity Rank Justification: Harrington's beardtongue (*Penstemon harringtonii*) is a globally vulnerable plant species that is restricted to Colorado and is found almost exclusively in sagebrush habitat. This species is only known from approximately 37 locations, all of which are centered near Edwards in Eagle County. In general, Harrington's beardtongue and its habitat are highly threatened from residential development. These threats in addition to a restricted range emphasize the urgent need for protection. Harrington's beardtongue populations are known to fluctuate in population numbers from year to year. Therefore, this specific location may be a higher priority than the current information reflects. This site is one of ten that has been designed around the best locations of this species.

Natural Heritage elements at the Seven Hermits site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|-------------------------------|--------------------------|-------------|------------|--------------------------|----------|
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | B |

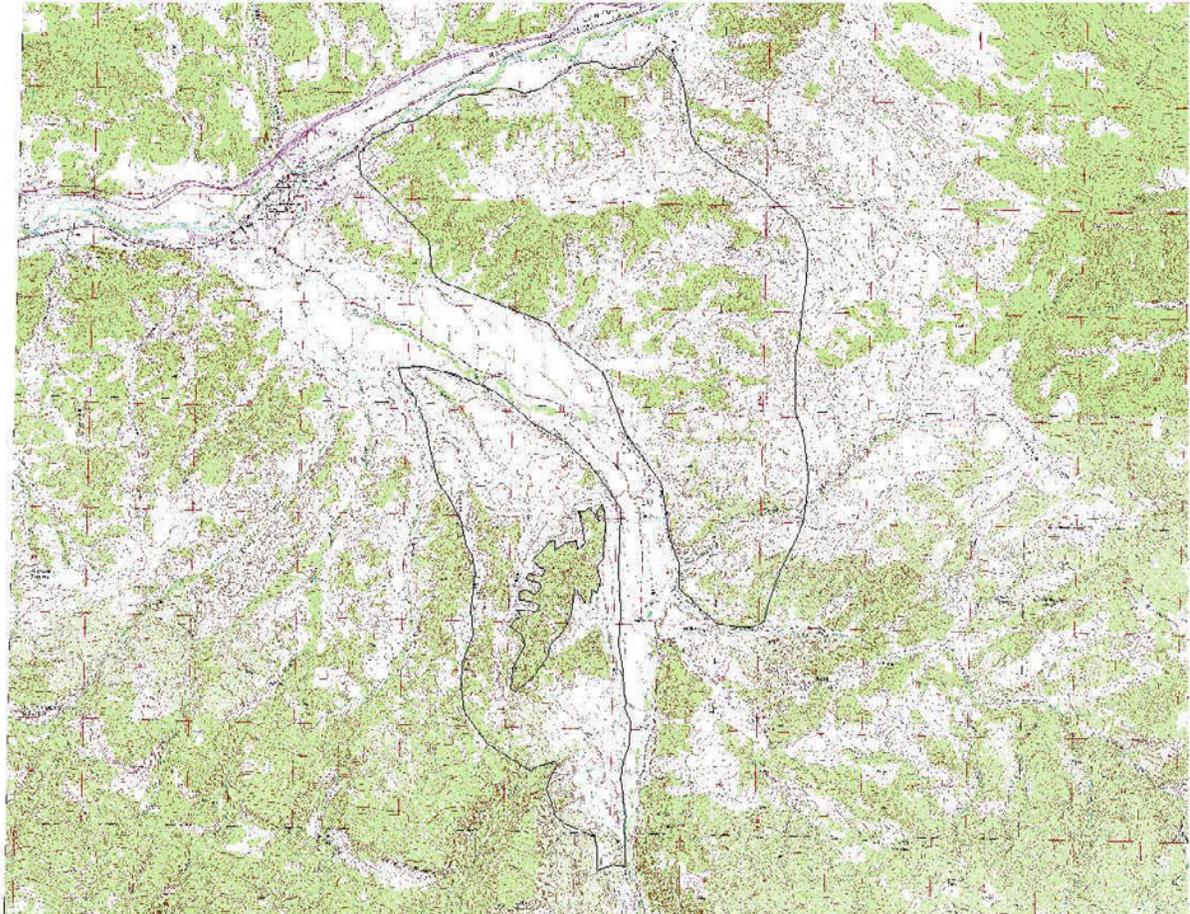
*EO = Element Occurrence

Boundary Justification: The boundary was drawn in two unconnected sections to eliminate the wide valley of Brush Creek, which has mostly been converted for agriculture. The site boundary includes all of the scattered individuals documented that occur outside of the developments of Eagle.

Management and Protection Comments: This site includes Bureau of Land Management, State Land Board and private properties. Off-road vehicle use in the area harbors the potential to negatively affect the occurrence of Harrington's beardtongue.

General Description: Sagebrush dominated hills with scattered pinyon and juniper typify this site. Sage grouse have been observed in the area as recently as the early 1990's, but no recent observations have been documented. Since this area is south of the Eagle River, the sage grouse, should they occur here, would be the newly described species colloquially known as the Gunnison sage grouse. The area spans 10,501 acres and ranges in elevation from 6,600-8,400 feet.

Seven Hermits Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 24 February
by T. L. Davis

Sheep Creek Uplands

Location: Eagle and Garfield Counties, north of Sweetwater Creek and west of the Colorado River
 U.S.G.S. 7.5 minute quadrangles: Sugarloaf Mountain, Sweetwater Lake
 Legal Description: T3S R86W S5-8,18-20,29,30; T3S R87W S10-14,24

Biodiversity Rank: B2

Biodiversity Rank Justification: Harrington's beardtongue (*Penstemon harringtonii*) is a globally vulnerable plant species that is restricted to Colorado and is found almost exclusively in sagebrush habitat. This species is only known from approximately 37 locations, all of which are centered near Edwards in Eagle County. In general, Harrington's beardtongue and its habitat are highly threatened from residential development. These threats in addition to a restricted range emphasize the urgent need for protection. Harrington's beardtongue populations are known to fluctuate in population numbers from year to year. Therefore, this specific location may be a higher priority than the current information reflects. This site is one of ten that have been designed around the best locations of this species.

Natural Heritage elements at the Sheep Creek Uplands site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|-------------------------------|--------------------------|-------------|------------|----------------------|----------|
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | A |
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | B |

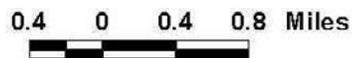
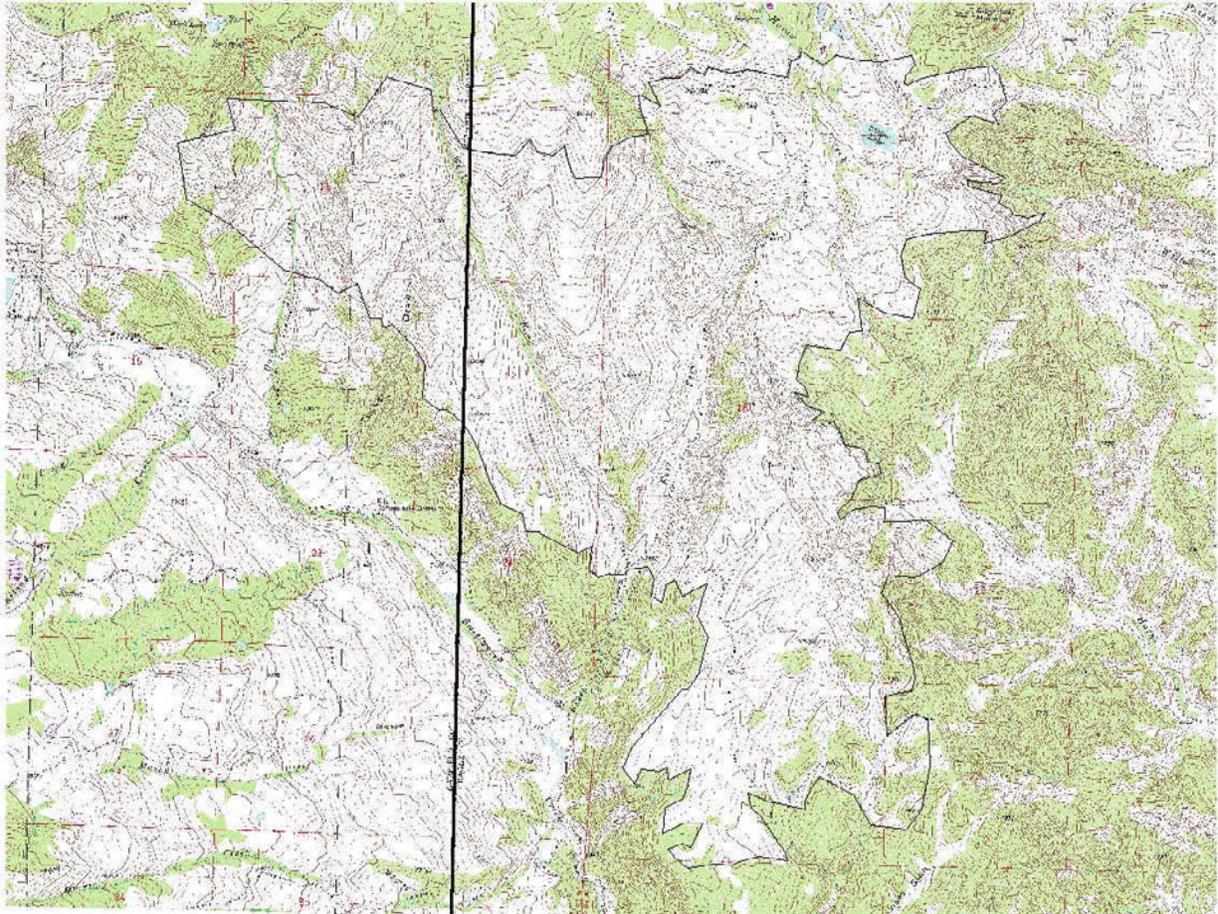
*EO = Element Occurrence

Boundary Justification: This boundary includes the occurrences of the rare plant and the unoccupied potential habitat that lies between them. There is further surrounding potential habitat that is not included.

Management and Protection Comments: This site occurs predominantly on public land managed by the Bureau of Land Management, however there are private properties included also. The current management appears adequate. Grazing is the main land use.

General Description: The Sheep Creek Uplands site includes a sage park with scattered snowberry, serviceberry, pinyon and juniper. The site totals 6,018 acres and lies between 7,500 and 9,800 feet elevation.

Sheep Creek Uplands Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Sweetwater Creek Uplands

Location: Eagle County, north of Dotsero, south-facing slope above Sweetwater Creek
 U.S.G.S. 7.5 min. quadrangle (s): Sugarloaf Mountain, Dotsero
 Legal Description: T3S R86W S30,31;T3S R87W S24,25; T4S R86W S4-6,9

Biodiversity Rank: B3

Biodiversity Rank Justification: The manystem stickleaf is found widely around Eagle County along roadsides. The roadcuts seem to imitate this species unique habitat. The Norman Creek site is one of only four locations in the county that support this species in natural surroundings.

Natural Heritage elements at the Sweetwater Creek Uplands site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|------------------------------|--------------------|-------------|------------|----------------------|----------|
| <i>Nuttallia multicaulis</i> | Manystem stickleaf | G3 | S3 | | B |

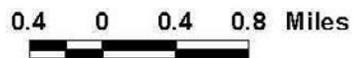
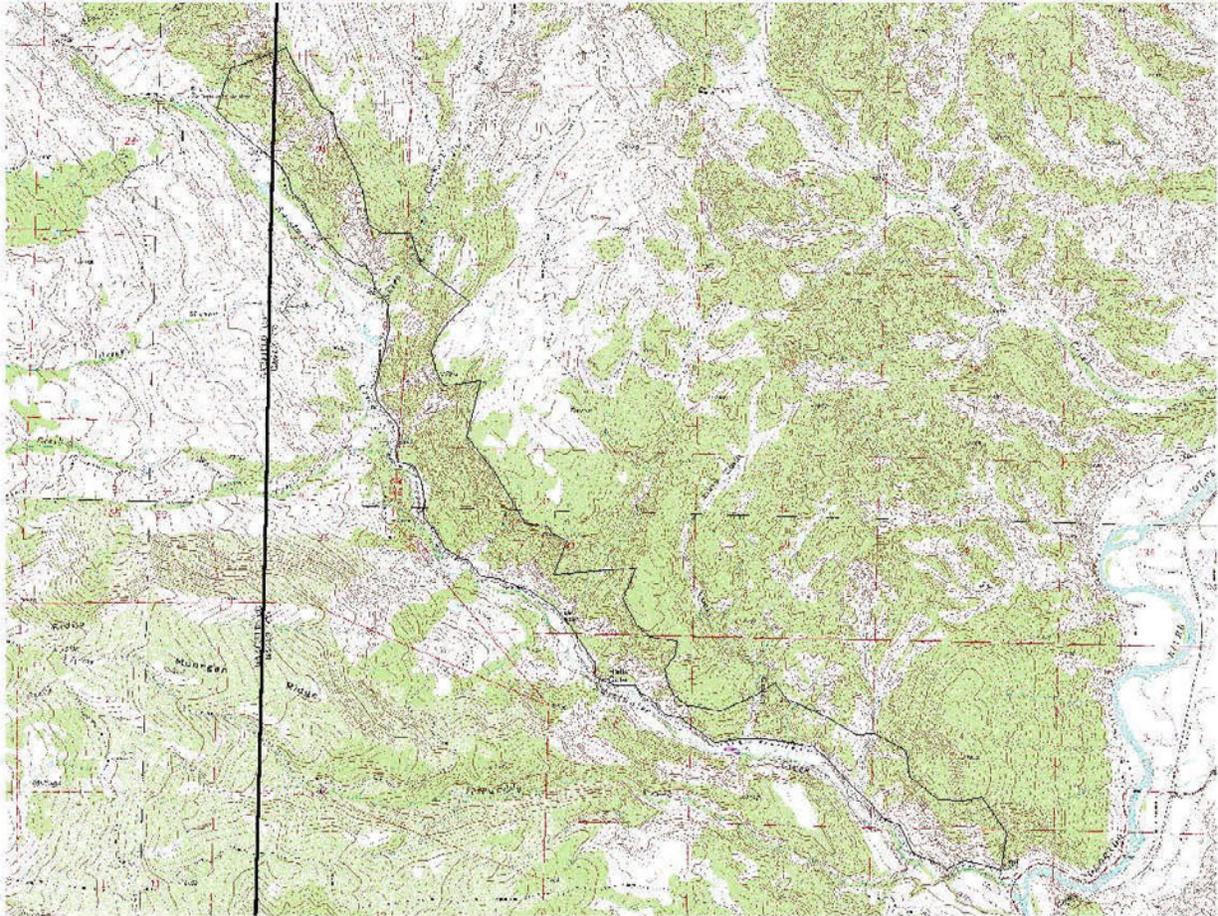
*EO = Element Occurrence

Boundary Justification: The boundary encompasses the full extent of available potential habitat within the scattered known individuals.

Management and Protection Comments: The site occurs on a mix of private and public land. The public land is managed by the Bureau of Land Management. The site is located immediately above a well traveled dirt road. The spread of exotic plant species will negatively affect the plant occurrence. Little other management is necessary, as the steep slopes are not likely to be utilized.

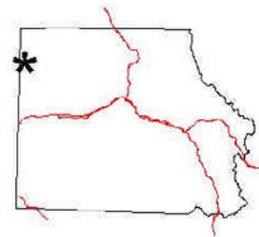
General Description: Steep barren outcrops support the rare plant. These outcrops occur within pinyon-juniper and sagebrush habitats. This site encompasses 1,303 acres and ranges in elevation from 6,400-8,200 feet.

Sweetwater Creek Uplands Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 25 February
by T. L. Davis

Taylor Creek

Location: Eagle County, about a half mile to one mile upstream from Taylor Creek's confluence with the Frying Pan River, between Red Table Mountain and the Frying Pan River.

U.S.G.S. 7.5 minute: Toner Reservoir quadrangle.

Legal Description: T8S R86W S1.

Biodiversity Rank: B4

Biodiversity Rank Justification: Harrington's beardtongue (*Penstemon harringtonii*) is a globally vulnerable plant that is restricted to Colorado and is found almost exclusively in sagebrush habitat. This species is only known from approximately 38 locations centered around the town of Edwards in Eagle County. In general, Harrington's beardtongue and its habitat are highly threatened due to residential and recreational development. These threats in addition to its restricted range create an urgent need for protection. Harrington's beardtongue populations are known to fluctuate in population numbers from year to year. Although only about 100 individuals have been documented within this PCA, it may be a higher priority than the current information reflects.

Natural Heritage element occurrences at Taylor Creek PCA.

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | EO* Rank |
|-------------------------------|--------------------------|-------------|------------|-----------------------|----------|
| <i>Penstemon harringtonii</i> | Harrington's beardtongue | G3 | S3 | FS/BLM | C |

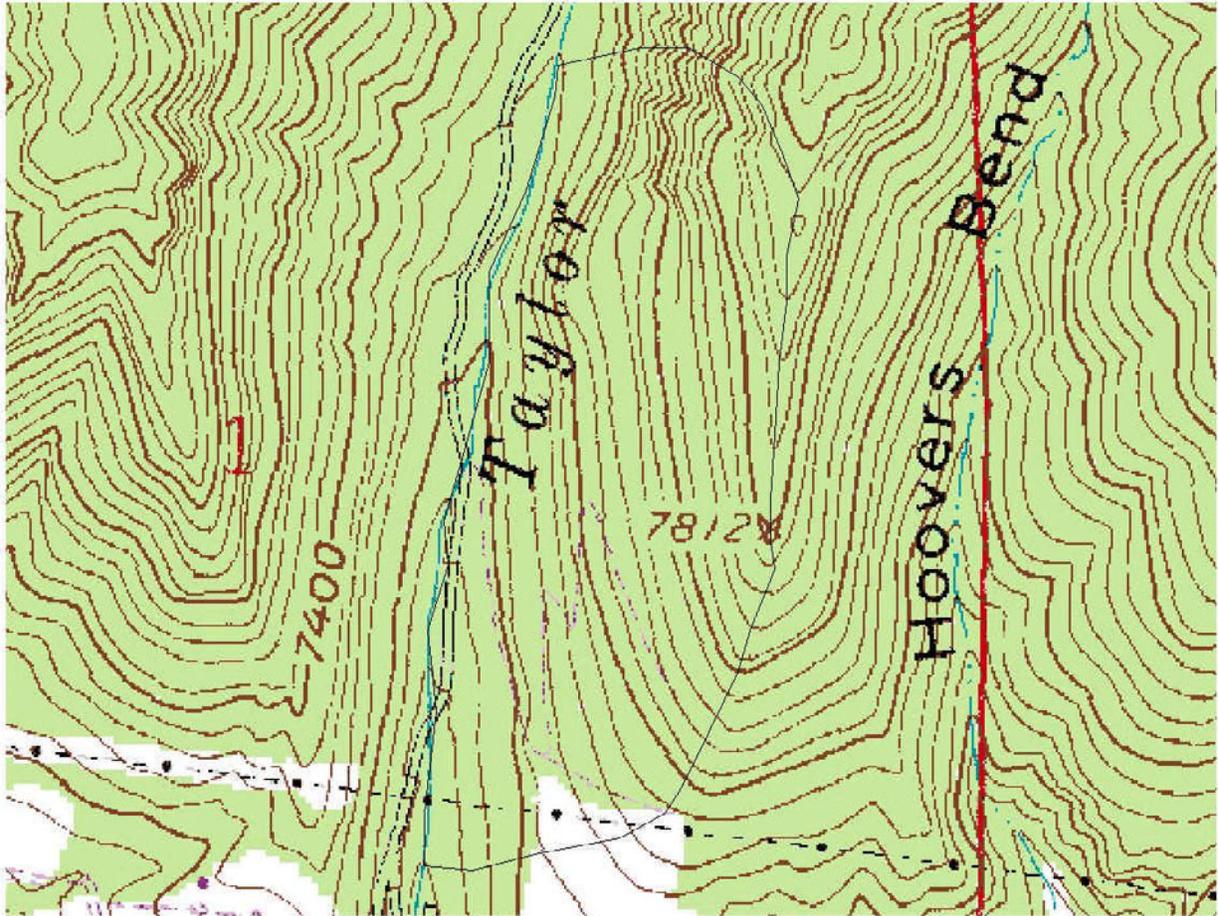
*EO=Element Occurrence

Boundary Justification: This PCA includes the mosaic of community types in which the element occurrences are found. The surrounding high quality habitat is included to act as a buffer to direct disturbances, such as trampling, and indirect disturbances, including unnatural erosion. The PCA also provides additional suitable habitat to allow for natural migration of the rare plants.

Management and Protection Comments: This PCA is publicly owned and managed by the U.S. Forest Service with the exception of a small portion of private property. Residential and recreational development pressures are high in this area. Any developments may threaten this PCA. The U.S. Forest Service is aware of Harrington's beardtongue at this location, but a management plan for this species has not been developed. Recreation is currently the main land use. Elk were noted to use this area and may be browsing the rare penstemon. Grazing has been noted on Harrington's beardtongue but probably is not heavily affecting the quality and condition of this occurrence. There are roads in the PCA which are acting as conduits for weeds, such as Kentucky bluegrass (*Poa pratensis*), Bromus inermis, Yellow sweet-clover (*Melilotis officinale*), dandelion (*Taraxacum officinale*), and cheatgrass (*Bromus tectorum*). *Poa pratensis* is dominant within the sagebrush. One of the best defenses against the spread of these exotic species is to discourage future trails/roadways. An old two-track road switches back through the occurrence. A powerline passes over the southern end of the PCA. Management actions could include road closures or restrictions regarding hiking, biking and motor vehicles, an exotic plant eradication program, and grazing restrictions. This small PCA is in good condition overall, however there are two small two track roads in the PCA, one that follows Taylor Creek at the western edge of the PCA, and another that passes through the occurrence. A power line passes through the southern end of the PCA. The activity along these thorough-ways is creating erosion and weed problems. Osterhout's beardtongue (*Penstemon osterhoutii*), a much more common species, which is endemic to Colorado and can be confused with *Penstemon harringtonii* was also noted at this PCA.

General Description: The PCA ranges in elevation from about 7,200 feet just upstream of the confluence of Taylor Creek and the Frying Pan River to 7,800 feet, following the low ridge to the east of Taylor Creek. The PCA is characterized by pinyon-juniper (*Pinus edulis-Juniperus osteosperma*) woodlands, mixed shrublands Gambel's oak (*Quercus gambelii*) and mountain mahogany (*Cercocarpus montanus*), and sagebrush (*Artemisia tridentata*) shrublands. A total of 67 acres are included in the PCA boundaries.

Taylor Creek Potential Conservation Area



0.08 0 0.08 0.16 Miles



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 24 February
by T. L. Davis

Two Elk Trail

Location: Eagle County, just west of I70 and Black Gore Creek between Vail Pass and Gore Creek Campground
 U.S.G.S. 7.5 min. quadrangle (s): Red Cliff
 Legal Description: T5S R79W S19,30; T5S R80W S24,25

Biodiversity Rank: B5

Biodiversity Rank Justification: This site includes two state rare orchid species. The purple lady's slipper is only found in two other locations (North Fork Deep Creek and Grouse Creek) in the county. This is the only viable location known in the County for the northern twayblade.

Natural Heritage elements at the Two Elk Trail site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|---------------------------------|-----------------------|-------------|------------|----------------------|----------|
| <i>Listera borealis</i> | Northern twayblade | G4 | S2 | BLM | E |
| <i>Cypripedium fasciculatum</i> | purple lady's slipper | G4 | S3 | FS | B |

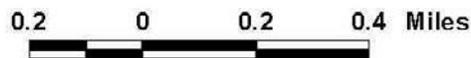
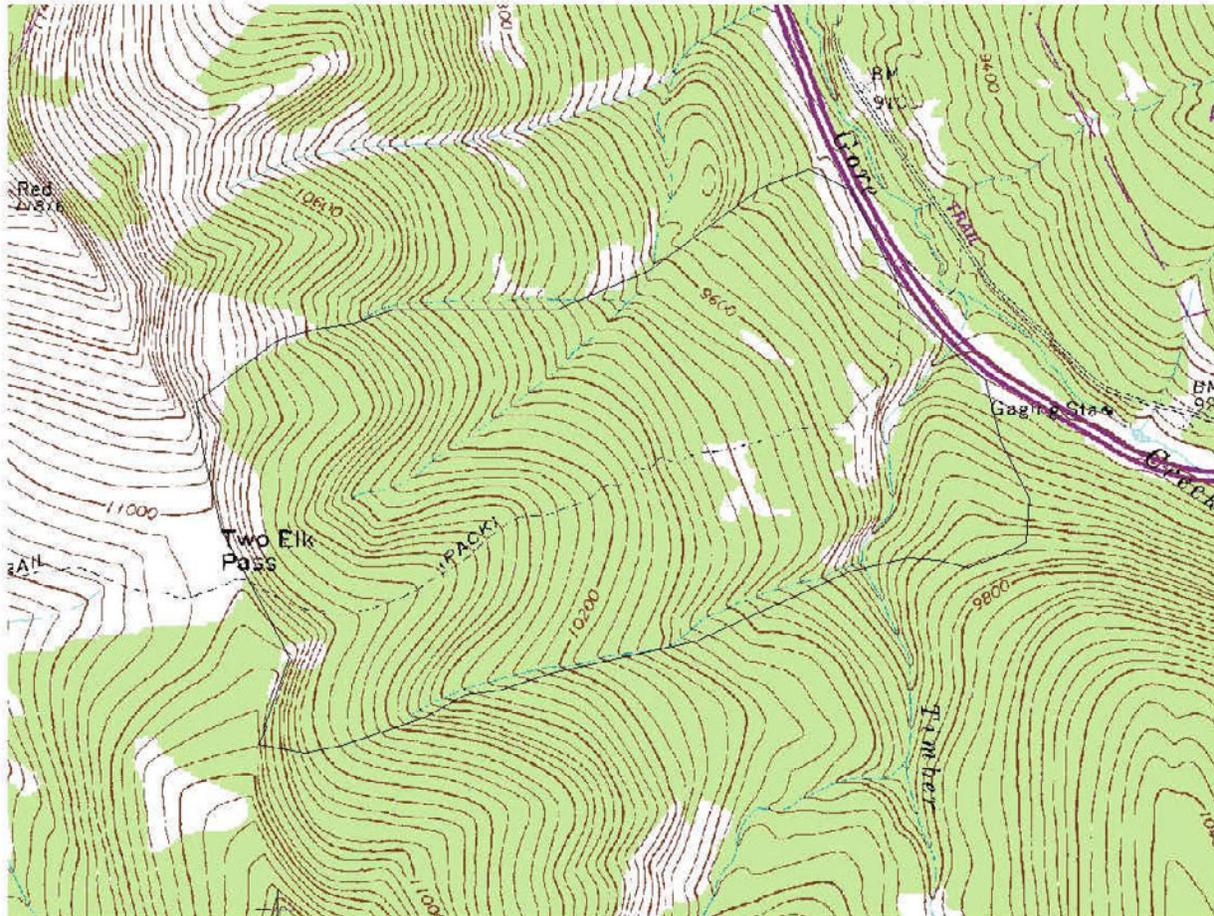
*EO = Element Occurrence

Boundary Justification: The site is drawn to include the immediate suitable habitat for these two orchid species. Habitat for both species is relatively common within this montane habitat; the site does not include all nearby suitable habitat.

Management and Protection Comments: This site occurs on National Forest Service property. A popular Forest Service hiking/biking trail is adjacent to both populations. Trampling and collecting should be considered threats to these populations.

General Description: This site is comprised of spruce-fir and lodgepole habitats. The elevation range is 9,200-11,200 feet and the site includes 563 acres.

Two Elk Trail Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 24 February
by T. L. Davis

West Lake Creek

Location: Eagle County, south of Edwards heading toward the Holy Cross Range
 U.S.G.S. 7.5 min. quadrangle (s): Fulford, Grouse Mountain, Mount Jackson
 Legal Description: T6S R82W S6, 7, 11-14, 18,19,23-25,30,31,36; T7S R83W S1

Biodiversity Rank: B5

Biodiversity Rank Justification: This area supports a population of Colorado River cutthroat trout, a globally rare subspecies. The genetic purity and origin of this population are unknown at this time, but the supporting habitat is in good condition and there appear to be barriers sufficient to preclude the upstream migration of exotic trout species into the area.

Natural Heritage elements at the West Lake Creek site

| Element | Common Name | Global Rank | State Rank | Federal/State Status | *EO Rank |
|--|--------------------------------|-------------|------------|----------------------|----------|
| <i>Oncorhynchus clarki pleuriticus</i> | Colorado River cutthroat trout | G4T3 | S3 | S/BLM/ S(| B |

*EO = Element Occurrence

Boundary Justification: Since the Colorado River cutthroat trout depend on the local hydrology of this area, the boundaries were developed to circumscribe the full extent of the immediate watershed. Activities within this watershed have the potential to impact the local hydrology and dependent cutthroat trout.

Management and Protection Comments: The boundaries include mostly lands managed by the USFS, including portions of the Holy Cross Wilderness Area. The boundaries also include some private lands adjacent to and within the USFS properties. Current management of the area is compatible with the persistence of the trout. Exotic brook trout were observed in West Lake Creek outside the boundaries of this PCA, but there appear to be barriers suitable to prevent upstream migration by these brook trout into the higher elevations where the cutthroat trout occur.

General Description: This area includes 4,444 acres of subalpine and montane habitats that range in elevation from 9,200-13,300 feet. Limestone and karst outcroppings are scattered throughout the area.

West Lake Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 24 February
by T. L. Davis

Yarmony Creek

Location: Eagle County, approximately 1 mile south of McCoy, along Yarmony Creek just above the confluence with the Colorado River

U.S.G.S. 7.5 min. quadrangle (s): McCoy

Legal Description: T2S R83W S4, 8, 9

Biodiversity Rank: B3

Biodiversity Rank Justification: This site includes a globally rare plant community in fair condition.

Natural Heritage elements at the Yarmony Creek site

| Element | Common Name | Global Rank | State Rank | Federal/ State Status | *EO Rank |
|--|-------------------------|-------------|------------|--------------------------|----------|
| <i>Populus angustifolia</i> - <i>Juniperus scopulorum</i> | Montane riparian forest | G2G3 | S2 | | C |

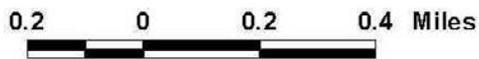
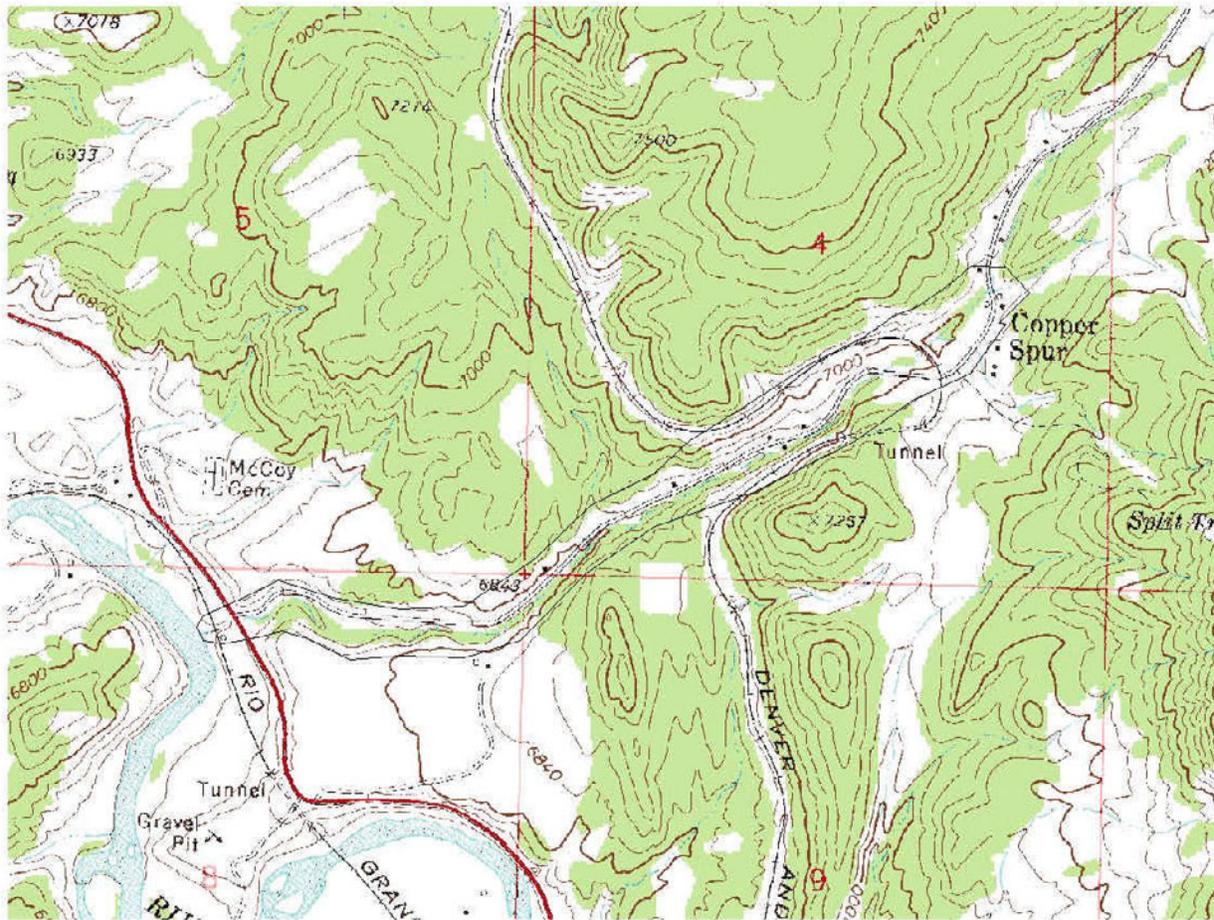
*EO = Element Occurrence

Boundary Justification: The riparian occurrence is included but the boundary is not extended much farther. The upstream hydrology is important in maintaining the current condition and should be considered before any manipulations or changes take place.

Management and Protection Comments: This occurrence is mainly on private property (only viewed from the road), it also crosses public lands managed by the Bureau of Land Management. Development pressures are increasing in this currently remote area. A road to the small town of Copper Spur parallels the creek and crosses it in several places. Future development would do well to consider staying clear of the riparian area. The understory species along the creek include several weeds (mostly Kentucky bluegrass and smooth brome). The spread of other exotic species into the riparian area would degrade the occurrence.

General Description: Yarmony Creek is an intermittent creek that runs southwest to the Colorado River. The creek has a low gradient and is dominated by narrowleaf cottonwood (*Populus angustifolia*) and Rocky Mountain juniper (*Juniperus scopulorum*). The creek is surrounded by pinyon-juniper and sagebrush habitat. This section of the creek ranges in elevation of 6,680-7,000 feet and includes approximately 107 acres.

Yarmony Creek Potential Conservation Area



Data current as of
12 February 2000
CNHP maintains a
dynamic data set
subject to change
as additional information
becomes available. Map
boundaries carry no legal
implications and are meant
for planning purposes only.

Approximate location
of PCA within
Eagle County



Map created 24 February
by T. L. Davis

Literature Cited

- 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.
- Andrews, R.R. and R.R. Righter. 1992. Colorado birds. Denver Museum of Natural History, Denver. 442 pp.
- 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.
- Armstrong, D.M., R.A. Adams, and J. Freeman. 1994. Distribution and ecology of bats of Colorado. Natural History Inventory of Colorado No. 15. University of Colorado Museum, Boulder. 83 pp.
- 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 Colorado Field Office, The Nature Conservancy, 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.
- Barbour, Michael G. and William D. Billings. 1988. North American Terrestrial Vegetation. Cambridge University Press, Cambridge, England.
- Behnke, R. J. 1992. Native trout of western North America. American fisheries Monograph 6. XX + 275 pp.
- Binkley, D. 1986. Forest Nutrition Management. John Wiley & Sons, Inc., New York, NY.
- Bourgeron, P.S. and L.D. Engelking, eds. 1994. A preliminary vegetation classification of the western United States. Western Heritage Task Force, The Nature Conservancy, Boulder, 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.
- Brownell, V.R. and P.M. Catling. 1987. Notes on the distribution and taxonomy of *Cypripedium fasciculatum* Kellogg ex Watson (Orchidaceae). *Lindleyana* 2(1): 53-57.
- Buckner, D. L. and J. E. Bunin. 1992. Final report: 1990/91 Status Report for *Penstemon harringtonii*. Unpublished Report Prepared for Colorado Natural Areas Program, Denver, CO by Esco Associates, Inc., Boulder, CO.
- Burger, W. L., Jr., and A. N. Bragg. 1947. Notes on *Bufo boreas* (B. and G.) from the Gothic region of Colorado. *Proceedings of the Oklahoma Academy of Science* 27:61-65.
- Campbell, J. B. 1976. Environmental controls on boreal toad populations in the San Juan Mountains. Pages 289-295 in *Ecological impacts of snowpack augmentation in the San Juan Mountains, Colorado*, H. W. Steinhoff and J. D. Ives, eds. Final Report, San Juan Ecology Project. Colorado State University Publications, Fort Collins.
- Carey, C. 1976. Thermal physiology and energetics of boreal toads, *Bufo boreas boreas*. Ph.D. dissertation, University of Michigan, Ann Arbor.
- 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.
- Colorado Breeding Bird Atlas (CBBA). 1998. Hugh Kingery, ed. Colorado Bird Atlas Partnership and Colorado Division of Wildlife. 636 pp.
- Colorado Division of Wildlife (CDOW). 1984. The bats of Colorado: shadows of the night. Colorado Division of Wildlife, Denver, CO.
- Colorado Division of Wildlife (CDOW). 1986. Colorado Stream Data Bank, Second Edition. December 1986. Colorado Division of Wildlife, Denver.
- Colorado Division of Wildlife (CDOW). 1987. Colorado Lake Data Bank, First Edition. January 1987. Colorado Division of Wildlife, Denver.
- Colorado Natural Heritage Program (CNHP). 1997. Biological and Conservation Data (BCD) System. Data from field surveys. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.
- Colorado Natural Heritage Program (CNHP). 1997. Conservation status of the rare and imperiled vertebrates of Colorado. Unpubl. 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. Holy Cross Wilderness Defense Fund Technical Report #2. No place.
- Cooper, D.J. 1990. Ecology of Wetlands in Big Meadows, Rocky Mountain National Park, Colorado. US Fish and Wildlife Service Biological Report 90(15). US Fish and Wildlife Service, Washington, DC.
- Cooper, D.J. 1993. Wetlands of the Crested Butte region: mapping, functional evaluation, and hydrological regime. Report submitted to the town of Crested Butte and the Environmental Protection Agency, Region VIII, Denver, CO.
- Cooper, D.J. and T.R. Cottrell. 1990. Classification of riparian vegetation in the northern Colorado Front Range. Report submitted to the Colorado Field Office, The Nature Conservancy, Boulder, CO.
- Cooper, S.V., P. Lesica, and D. Page-Dumroese. 1997. Plant Community Classification for Alpine Vegetation on the Beaverhead National Forest, Montana. USDA Forest Service General Technical Report INT-362. Intermountain Research Station, Ogden, UT.
- Cronquist, A., A. H. Holmgren, N. H. Holmgren, J. L. Reveal and P. K. Holmgren. 1977. Intermountain Flora Vascular Plants of the Intermountain West, USA: vol. 6. New York Botanical Garden, Bronx, NY.
- 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.
- DeByle, N.V. and R. Winokur, eds. 1985. Aspen: Ecology and Management in the Western United States. USDA Forest Service General Technical Report RM-119. Rocky Mountain Forest and Range Experiment Station, Ft. Collins, CO.
- 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.
- Dix, R. L. 1974. Regional ecological systems of Colorado. Pages 7-17 in Foss, P. O., ed., Environment and Colorado: a handbook. Environmental Resources Center, Colorado State University, Fort Collins.
- 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.
- Jackson, W.H., Fielder, J. and E. Marston. 1999. Colorado : 1870-2000, Englewood, Colo. : Westcliffe Publishers
- Fitzgerald, J. P., C. A. Meaney, and D. M. Armstrong. Mammals of Colorado. 1994. University Press of Colorado. Niwot, Colorado. 467 pp.
- Flora of North America Editorial Committee. 1993. Flora of North America North of Mexico: Vol. 2. Oxford University Press, NY.
- Girard, M., D.L. Wheeler, and S.B. Mills. 1995. Classification of riparian communities on the Bighorn National Forest. USDA Forest Service draft manuscript. Rocky Mountain Region, Lakewood, CO.
- Goebel, A. M. 1996. Systematics and conservation of bufonids in North America and in the *Bufo boreas* group. Ph.D. dissertation, University of Colorado, Boulder.
- Goettl, J.P. (editor) and The Boreal Toad Recovery Team. 1997. Boreal Toad (*Bufo boreas boreas*) (Southern Rocky Mountain Population), Recovery Plan. Colorado Division of Wildlife, Denver.
- Hammerson, G. A. 1999. Amphibians and Reptiles in Colorado. Second edition. University Press of Colorado. Niwot, Colorado. 484 pp.
- 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., 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.
- Hansen, P.L., R.D. Pfister, K. Boggs, B.J. Cook, J. Joy, and D.L. Hinckley. 1995. Classification and Management of Montana's Riparian and Wetland Sites. Montana Forest and Conservation Experiment Station Miscellaneous Publication No. 54. The University of Montana, Missoula, MT.

- Hermann, F.J. 1970. Manual of the Carices of the Rocky Mountains and Colorado Basin. Agriculture Handbook No. 374. USDA Forest Service, Washington, DC.
- Hess, K. And C.H. Wasser. 1982. Grassland, shrubland, and forestland habitat types of the White River-Arapaho National Forest (with pages 20-22 rewritten by Barry C. Johnston, July 1987). Report submitted to the USDA Forest Service, Rocky Mountain Region, Lakewood, CO.
- Hubbard, J. D. 1972. Some aspects of geographic variation in the boreal toad, *Bufo boreas boreas*. *Journal of the Colorado-Wyoming Academy of Science*. 7 (2):65-66
- Humphrey, S. R. and T. H. Kunz. 1976. Ecology of a Pleistocene relict, the western big-eared bat (*Plecotus townsendii*) in the southern Great Plains. *Journal of Mammalogy*. 57:470-494.
- Johnston, B.C. 1987. Plant Associations of Region Two. 4th ed. USDA Forest Service R2-ECOL-87-02. Rocky Mountain Region, Lakewood, CO.
- Johnston, B.C., L. Huckaby, T.J. Hughes, and J. Pecor. 1999. Ecological types of the Upper Gunnison Basin: Vegetation-soil-landsform-geology-climate-water land classes for natural resource management. Technical Report Unnumbered, 874 pp. Lakewood, CO: USDA Forest Service.
- 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.
- Kettler, S. M., N. D. Lederer, D. Bacher, and S. Spackman. 1993. Pike and San Isabel National Forests and Comanche and Cimarron National Grasslands Plants of Special Concern. Prepared by the Colorado Natural Heritage Program.
- Kettler, S. and A. McMullen. 1996. Routt National Forest riparian vegetation classification. Report submitted to Routt National Forest. Colorado Natural Heritage Program, Colorado State University, Ft. Collins, CO.
- Kittel, G.M. and N.D. Lederer. 1993. A preliminary classification of the riparian vegetation of the Yampa and San Miguel/Dolores River Basins. Report submitted to the Colorado Department of Health and the Environmental Protection Agency, Region VIII. The Nature Conservancy's Colorado Program, Boulder, CO.
- Kittel, G., R. Rondeau, and S. Kettler. 1995. A classification of the riparian vegetation of the Gunnison River Basin, Colorado. Report submitted to the Colorado Department of Natural Resources and the Environmental Protection Agency, Region VIII. Colorado Natural Heritage Program, Colorado State University, Ft. Collins, CO.
- Kittel, G., R. Rondeau, N. Lederer, and D. Randolph. 1994. A classification of the riparian vegetation of the White and Colorado River Basins, Colorado. Report submitted to the Colorado Department of Natural Resources and the Environmental Protection Agency, Region VIII. Colorado Natural Heritage Program, University of Colorado, Boulder, 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 and the Environmental Protection Agency, Region VIII. Colorado Natural Heritage Program, Colorado State University, Ft. Collins, CO.
- Kittel, Gwen M., Erika VanWie, Mary Damm, Renée Rondeau, Steve Kettler, and John Sanderson. 1999. A Classification of Riparian Plant Associations of the Rio Grande and Closed Basin Watersheds, Colorado. Prepared for: The Colorado Department of Natural Resources and the Environmental Protection Agency, Region VIII Denver, Colorado. The Colorado Natural Heritage Program, Colorado State University, Ft. Collins, CO.
- Kittel, G. M, R. J. Rondeau, S. Kettler and J. Sanderson. 1999. A Classification of Riparian Plant Associations of Colorado. In prep.
- Komarkova, V. 1976. Alpine vegetation of the Indian Peaks area, Front Range, Colorado Rocky Mountains. Dissertation. University of Colorado, Boulder, CO.
- Komarkova, V. 1986. Habitat types on selected parts of the Gunnison and Uncompahgre National Forests. Report submitted to the USDA Forest Service. Rocky Mountain Forest and Range Experiment Station, Fort Collins, CO.
- Kovalchik, B.L. and W. Elmore. 1992. Effects of cattle grazing systems on willow-dominated plant associations in central Oregon. In W.P. Clary, E.D. McArthur, D. Bedunah, and C.L. Wambolt, compilers. Proceedings-

- Symposium on Ecology and Management of Riparian Shrub Communities. USDA Forest Service General Technical Report INT-289. Intermountain Research Station, Ogden, UT.
- Kovalchik, B.L. 1987. Riparian Zone Associations, Deschutes, Ochoco, Fremont, and Winema National Forests. USDA Forest Service R6 ECOL-TP-279-87. Pacific Northwest Region, Bend, OR.
- Kunz, T.H. and P.A. Racey. 1998. Bat Biology and Conservation. Smithsonian Institution Press, Washington and London. 365 pp.
- Lack, D. 1956. A review of the genera and nesting habits of swifts. *Auk* 72:1-32.
- Manning, M.E. and W.G. Padgett. 1989. Preliminary Riparian Community Type Classification for Nevada. Draft manuscript. USDA Forest Service Intermountain Region, Ogden, UT.
- Manning, M.E. and W.G. Padgett. 1995. Riparian Community Type Classification for Humboldt and Toiyabe National Forests, Nevada and Eastern California. USDA Forest Service R4-ECOL-95-01. Intermountain Region, Ogden, UT.
- Navo, K.W., J.A. Gore, and G.T. Skiba. 1992. Observations on the spotted bat, *Euderma maculatum*, in northwestern Colorado. *Journal of Mammalogy*, 73:547-551.
- National Geographic Society (NGS). 1997. Field guide to the Birds of North America, 2nd edition. National Geographic Society, Washington, DC. 464 pp.
- Padgett, W.G., A.P. Youngblood, and A. H. Winward. 1989. Riparian Community Type Classification of Utah and Southeastern Idaho. USDA Forest Service R4-ECOL-89-01. Intermountain Region, Ogden, UT.
- Page L.M. and B.M. Burr. 1991. A field guide to freshwater fishes: North America north of Mexico. Houghton Mifflin Co., Boston.
- Peet, R.K. 1981. Forest vegetation of Colorado Front Range: composition and dynamics. *Vegetatio* 45:3-75.
- Peet, R. K. 1988. Forests of the Rocky Mountains. Pages 64-101 in M.G.Barbour and W.D. Billings, eds., North American Terrestrial Vegetation. Cambridge University Press, Cambridge New York.
- Penland, C.W.T. 1958. Two New Species of Penstemon in Colorado. *Madrono*. 14:153-160.
- Phillips, C.M. 1977. Willow carrs of the upper Laramie River Valley, Colorado. Thesis. Colorado State University, Ft. Collins, CO.
- Pierson, E.D., M. C. Wackenhut, J. S. Altenbach, P. Bradley, P. Call, D. L. Genter, C. E. Harris, B. L. Keller, B. Lengus, L. Lewis, B. Luce, K. W. Navo, J. M. Perkins, S. Smith, and L. Welch. 1999. Species coservation assessment and strategy for Townsend's big-eared bat (*Corynorhinus townsendii townsendii* and *Corynorhinus townsendii pallescens*). Idaho Conservation Effort, Idaho Department of Fish and Game, Boise, Idaho.
- Proebstel, D. S. 1994. Taxonomic identification of Colorado River cutthroat trout (*Oncorhynchus clarki pleuriticus*) in Colorado. Draft report. Progress Report October 1994.
- Reynolds, R.T. 1983. Management of western coniferous forest habitat for nesting *Accipiter* hawks. General Technical Report. Rm-102. U.S. Forest Service, Rocky Mountain Forest and Range Experimental Station, Fort Collins.
- Richard, C., G. Kittel, and S. Kettler. 1996. A classification of the riparian vegetation of the San Juan National Forest. Draft 1 to be submitted to the San Juan National Forest. Colorado Natural Heritage Program, Colorado State University, Ft. Collins, CO.
- Rocky Mountain/Southwestern Peregrine Falcon Recovery Team. 1977. American Peregrine Falcon, Rocky Mountain and Southwest population, recovery plan. U.S. Fish and Wildlife Service, Washington, DC.
- Rollins, R.C. 1993. The Cruciferae of Continental North America: systematics of the mustard family from the Arctic to Panama. Stanford Univ. Press, Stanford, California. 976 pp.
- Rondeau, R.J., M.B. Wunder, A. Meredith, C.A. Pague, and S. Spackman. 1997. Biological survey of Naval Oil Shale Reserve No. 1 (NOSR-1). Report submitted to the Department of Energy. Colorado Natural Heritage Program, Colorado State University, Ft. Collins, CO.
- Rosgen, D. 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, CO.
- Ryke, N., D. Winters, L. McMartin and S. Vest. 1994. Threatened, Endangered and Sensitive Species of the Pike and San Isabel National Forests and Comanche and Cimarron National Grasslands. May 25, 1994.
- Sanderson, J. and S. Kettler. 1996. A preliminary wetland vegetation classification for a portion of Colorado's West Slope. Report submitted to the Colorado Department of Natural Resources and the U.S. Environmental Protection Agency. Colorado Natural Heritage Program, Colorado State University, Ft. Collins, CO.
- Sanderson, J. and M. March. 1996. Extreme rich fens of South Park, Colorado: their distribution, identification, and natural heritage significance. Report submitted to Park County, the Colorado Department of Natural

- Resources, and the U.S. Environmental Protection Agency. Colorado Natural Heritage Program, Colorado State University, Ft. Collins, CO.
- Spackman, S., B. Jennings, J. Coles, C. Dawson, M. Minton, A. Kratz, and C. Spurrier. 1997. Colorado Rare Plant Field Guide. Prepared for the Bureau of Land Management, the U.S. Forest Service and the U.S. Fish and Wildlife Service by the Colorado Natural Heritage Program.
- Stiles, F.G. and A.J. Negret. 1994. The nonbreeding distribution of the Black Swift: A clue from Colombia and unsolved problems. *Condor* 96:1091-1094.
- Stokes, D.W. and L.Q. Stokes. 1996. Stokes field guide to birds: western region. Little, Brown, and Company, Ltd., Boston.
- The Nature Conservancy. 1992. Upper Colorado River Basin Bioserve Strategic Plan. Unpublished report. Colorado Field Office, The Nature Conservancy, Boulder, Colorado.
- The Nature Conservancy. 1996. Yampa River site conservation plan. The Nature Conservancy, Boulder, CO.
- Trotter, P. C. 1987. Cutthroat: native trout of the west. Colorado Associated University Press. Boulder, Colorado. 219 pp.
- USDA, NRCS 1999. The PLANTS database (<http://plants.usda.gov/plants>). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.
- 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.
- Weber, W.A. 1990. Colorado Flora: Eastern Slope. University Press of Colorado, Niwot, CO.
- Weber, W.A. and R.C. Wittmann. 1996. Colorado Flora: Western Slope. University Press of Colorado, Niwot, CO.
- Wilson, H. C. 1969. Ecology and successional patterns of wet meadows, Rocky Mountain National Park, Colorado. Unpublished dissertation, University of Utah, Salt Lake City. 99 pp.
- Woodling, J. 1985. Colorado's little fish: a guide to the minnows and other lesser known fishes in the state of Colorado. Colorado Division of Wildlife publication. 77 pp.
- 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. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 32 pp.
- Youngblood, A.P., W.G. Padgett, and A.H. Winward. 1985. Riparian Community Type Classification of Eastern Idaho-Western Wyoming. USDA Forest Service R4-ECOL-85-01. Intermountain Region, Ogden, UT.

Appendix

Colorado's Natural Heritage Program

CNHP is the state's primary comprehensive biological diversity data center, gathering information and field observations to help develop state-wide 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 U.S.G.S. maps and enter it into the Biological and Conservation Data System. The data are also stored in a geographic information system (Arc/INFO and ArcView GIS). A continually updated locational database and priority-setting system such as that maintained by CNHP provides an effective, proactive land-planning tool.

CNHP is part of an international network of conservation data centers that use the Biological and Conservation Data System (BCD) developed by The Nature Conservancy. 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.

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.