

NATURAL HERITAGE RESOURCES
OF
SELECTED DENVER WATER PROPERTIES
AND THEIR CONSERVATION

A report to

Denver Water Environmental Planning

by

T.M. Stephens, S.M. Kettler,
S.C. Spackman, K. Fayette, C. Flemming, and P. Pineda
Colorado Natural Heritage Program
254 General Services Building
College of Natural Resources
Colorado State University
Ft. Collins, CO 80523

January 31, 1997

REPORT ORGANIZATION

This report is divided into 3 sections. Each section contains a table of contents, list of tables, and list of figures (when necessary). The first section (red tabs) presents the executive summary, recommendations, and a summary of Denver Water conservation and survey sites. The second section (blue tabs) presents the project's background, conservation status of Front Range Montane Ecosystems, major impacts, methods, and Colorado Natural Heritage Program description. The third section (green tabs) contains characterization abstracts of communities, plants, and animals targeted in the ecological inventory. The literature cited and field form examples are located at the end of the report. It is hoped that this organization will be helpful to all who will use this report.

EXECUTIVE SUMMARY

The Colorado Natural Heritage Program (CNHP) was contracted by Denver Water Board Environmental Planning Department to conduct an assessment of existing ecological values on selected properties and prioritize them on a global and state wide basis. The goal of the project was to accumulate and examine existing biological data, incorporate appropriate portions into CNHP's Biological Conservation Database (BCD), and with appropriate field surveys, identify significant natural heritage resources (rare and imperiled plant and animal species or significant natural communities).

This report summarizes extensive research in area herbaria, museums, and libraries, discussions with appropriate resource management agencies (state and federal), scientific experts and local naturalists, and one field season of surveys. It compares the recorded ecological elements with similar occurrences from around the region to give an overall assessment of the ecological condition of Denver Water properties. Management recommendations are included to protect identified elements of biodiversity. Other items contained in this report include a discussion of conservation issues (such as habitat destruction, degradation and fragmentation), and maps indicating the location of selected element occurrences and conservation sites.

Four sites were inventoried in the 1996 field season. Overall, the concentration of rare and imperiled species and significant natural communities indicates that conservation on Denver Water lands will have state wide as well as global consequences. The Cheesman Lake site contains some of the best habitat for the globally endangered Pawnee Montane Skipper, as well as the one of the best examples of an old growth ponderosa pine (*Pinus ponderosa*) community in the Front Range. Because of the high natural heritage significance of the Cheesman Lake site, CNHP is recommending that it be designated a conservation site.

The conservation sites typically identified in this type of study may be considered as core areas for the protection of the full range of biological diversity. A basic premise in the landscape management approach starts with the delineation of core protected areas that can be represented by special designations. Where possible, these should be connected through corridors and appropriately buffered. Buffer areas should include the ecological processes supporting the diversity of the core area. This is the basis for the development of preliminary conservation planning boundaries.

The partnerships developed between CNHP, the Denver Water Board, and agency personnel during this project are valuable and strong. These relationships should be furthered by promoting sound natural resource management and wise land-use planning as the Front Range continues to grow.

REPORT RECOMMENDATIONS

1. Encourage proper management of significant elements of natural diversity that exist within Denver Water properties.

The first step in accomplishing this recommendation would be the appropriate designation of the identified Cheesman Lake conservation site. In doing so, the development of management plans would be a necessary component of the site designation. Several organizations and agencies are available for consultation in the development of Management Plans for significant natural lands (e.g., Colorado Natural Areas Program, The Nature Conservancy, and CNHP). We would also encourage the development of partnerships that could research and develop techniques for maintaining or restoring conservation sites to aid in the preservation of rare, threatened, or endangered species or significant natural communities (e.g., Colorado Division of Wildlife, Colorado Native Plant Society, The Nature Conservancy, and various academic institutions). Because some of the most serious threats to land owned by the Denver Water Board are large-scale (fire related issues, residential encroachment, exotic species invasion, altered hydrology), these partnerships become essential to the long term protection of the area.

2. Develop an implementation plan for designation and protection of the Cheesman Lake conservation site.

- Incorporate the latest scientific knowledge on old-growth ponderosa pine ecosystems.
- Support further research on ecosystem processes, structure, and function, and the contribution of old-growth forests to biodiversity.
- Work in cooperation with the US Forest Service to develop a plan that will allow fire to play its natural role in the ecosystem.
- Continue current management practices that protect this site.

3. Incorporate the information included in this report in the review of activities in or near areas identified as significant.

The areas identified in this study are known to support unique or exemplary natural communities and rare and imperiled species. As proposed activities within Denver Water property are considered, they may be compared to the maps presented herein. Should any proposed project potentially impact these sites, planning personnel can decide if it is desirable to contact persons, organizations, or agencies with expertise. The Colorado Natural Heritage Program, Colorado Natural Areas Program, and Colorado Division of Wildlife routinely conduct environmental reviews state wide and should be considered available resources.

4. Promote cooperation among landowners, state and federal agencies, and pertinent organizations in the protection of natural diversity at the landscape scale.

- Seek out partners with expertise or special interest in fire ecology, restoration ecology, weed control, conservation biology, and local environmental or citizens groups in developing management plans for Denver Water properties.
- An example of such a cooperative approach to landscape level ecosystem management is the Boulder County Forest Health and Fuels Mitigation plan. Gross Reservoir and the Lower Boulder County properties owned by the Denver Water Department fall within its scope. CNHP recommends that the Denver Water Environmental Planning Department actively participate in the development of this plan, and consider initiating similar efforts for its other properties.

5. Increase public awareness of the benefits of protecting areas determined to be significant to Colorado and the Nation's natural diversity.

Natural lands are becoming ever more scarce especially in near proximity to densely populated metropolitan areas. Rare and imperiled species will continue to decline if not given appropriate protective measures. Increasing the public's knowledge of the remaining significant areas will build support for the programmatic initiatives necessary to protect them. Such activities could be done through interpretive facilities, conferences or meetings to stimulate public involvement, and information pamphlets. Finally, it would be desirable for the Denver Water Board to publicize significant conservation actions taken to build awareness of the Denver Water Board's commitment to the protection of sites of national ecological significance.

6. Conduct further inventory efforts to assess other natural heritage resources.

ACKNOWLEDGMENTS

CNHP would like to acknowledge its debt to the recent groundbreaking research on old-growth and biodiversity at the Cheesman Lake site by Dr. Phil Robertson of Southern Illinois University, Dr. Merrill Kaufmann of the Rocky Mountain Forest and Range Experiment Station, and Dr. Tom Stohlgren at Colorado State University. CNHP would also like to recognize the excellent fieldwork and comprehensive report on the Pawnee montane skipper produced by ERT (A Resource Engineering Company, Fort Collins CO) consulting firm.

The Colorado Natural Heritage Program would like to sincerely thank the following individuals and organizations for their assistance in completing this project: The Colorado Division of Wildlife, especially Dave Weber; Dr. Ray Stanford; other staff of the CNHP who

contributed to field work; and of course all of the helpful and concerned Denver Water personnel who participated in this natural heritage survey.

TABLE OF CONTENTS

SECTION 1

REPORT ORGANIZATION	1
EXECUTIVE SUMMARY	3
REPORT RECOMMENDATIONS	4
ACKNOWLEDGMENTS	5
TABLE OF CONTENTS	7
LIST OF TABLES	9
LIST OF MAPS AND FIGURES	8
DEFINITIONS	10
CONSERVATION AND SURVEY SITES	10
THE CONSERVATION SITE PROFILE	12
COLORADO NATURAL HERITAGE PROGRAM RANKS	13
DENVER WATER ECOLOGICAL INVENTORY SITE PROFILES	18
CHEESMAN LAKE CONSERVATION SITE	18
GROSS RESERVOIR SURVEY SITE.....	29
LOWER BOULDER COUNTY PROPERTIES	38
CHERRY CREEK GALLERY SURVEY SITE	41

SECTION 2

CONSERVATION STATUS OF FRONT RANGE MONTANE ECOSYSTEMS: LANDSCAPE LEVEL CONSERVATION ISSUES	44
HUMAN ALTERATION OF OLD-GROWTH PONDEROSA PINE ECOSYSTEM STRUCTURE AND PROCESSES	45
EXOTIC SPECIES	46
FRAGMENTATION.....	47
COLORADO NATURAL HERITAGE PROGRAM	49
THE NATURAL HERITAGE NETWORK AND BIODIVERSITY	50
WHAT IS BIODIVERSITY?	51
NATURAL HERITAGE METHODOLOGY	52
1. COLLECT EXISTING INFORMATION	52

2 IDENTIFY POTENTIAL NATURAL HERITAGE RESOURCES.	53
3 FIELD SURVEY PHASE.	58
4. DELINEATE PRELIMINARY CONSERVATION PLANNING BOUNDARY.....	60

SECTION 3

**HIGH PRIORITY RARE AND IMPERILED ELEMENTS OF BIODIVERSITY
TARGETED IN CNHP ECOLOGICAL INVENTORY AND FIELD SURVEYS.....61**

PREBLE’S MEADOW JUMPING MOUSE (<i>ZAPUS HUDSONIUS PREBLEI</i>)	61
PAWNEE MONTANE SKIPPER (<i>HESPERIA LEONARDUS MONTANA</i>)	64
UTES LADY TRESSES (<i>SPIRANTHESE DILVUVIALIS</i>).....	65
FRONT RANGE OLD-GROWTH PONDEROSA PINE NATURAL COMMUNITIES (EX. <i>PINUS PONDEROSA</i> / <i>MUHLENBERGIA MONTANA</i>).....	66

REFERENCES.....68

FIELD FORM EXAMPLES72

APPENDIX 1. CONTACTS FOR MORE INFORMATION73

LIST OF FIGURES

Figure 1. Pawnee montane skipper on its exclusive host plant, blue grama grass.....	27
Figure 2. Pawnee montane skipper on its preferred nectar source plant, dotted gayfeather.	27
Figure 3. Ponderosa pine/ mountain muhly (Foothills ponderosa pine savanna) old-growth.....	28
Figures 4 and 5. Heavy tree insect mortality on the west side of Gross reservoir.	36
Figure 6. Winniger ridge (purple flowers in the foreground are Canada and musk thistle).	37
Figure 7. Densely stocked ponderosa pine typical of the southern and western sides of Gross Reservoir.....	37

LIST OF MAPS

Map 1	General Locations of Denver Water Conservation and Survey Sites	11
Map 2	Cheesman Lake Conservation Site	26
Map 3	Gross Reservoir and Lower Boulder County Survey Sites.....	35
Map 4	Cherry Creek Gallery Survey Site	43

LIST OF TABLES

Table 1.	Colorado Natural Heritage Program Ranks.	14
Table 2.	Federal and State Agency Designations.....	15
Table 3.	Natural Heritage elements at the Cheesman Lake conservation site.	21
Table 4.	Potentially Occurring Rare and Imperiled Butterflies at Cheesman Lake.	22
Table 5.	Rare and imperiled elements known to occur at Gross Reservoir.	31
Table 6.	Rare and imperiled species known from the area surrounding Gross Reservoir and tracked by CHNP, but not targeted in the Ecological inventory due to inappropriate season of the survey.	31
Table 7.	Species with Federal and State Agency Special Designations Potentially Occurring at the Gross Reservoir Survey Site.....	32
Table 8.	Potentially Occurring Rare and Imperiled Elements Targeted in the Lower Boulder County Ecological Survey	40
Table 9.	Targeted elements at the Cherry Creek site.	41

DEFINITIONS

Conservation and Survey Sites. (Map 1)

In order to successfully protect populations or occurrences, it is necessary to delineate **conservation sites**. These conservation sites focus on capturing the ecological processes that are necessary to support the continued existence of a particular element occurrence. Conservation sites may include a single occurrence of rare element or a suite of rare elements or significant features.

The goal of the process is to identify a land area that can provide the habitat and ecological processes upon which a particular element or suite of elements depends for their continued existence. The best available knowledge of each species' life history is used in conjunction with information about topographical, geomorphological, and hydrological features, vegetative cover, as well as current and potential land uses. The proposed boundary does not automatically exclude all activity. It is a hypothesis in that some activities will prove degrading to the rare or significant resource 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 imperiled or significant resources on which the conservation unit is based.

In some cases, these elements are globally rare (such as Pawnee montane skipper) and their conservation is of global importance. In other words, the protection of these species and natural communities on Denver Water property will have major consequences across their ranges. Some sites are relative "hotspots" of biological diversity, containing both globally and state rare organisms within a relatively large and intact habitat complex. The Cheesman Lake site, for example, supports the globally rare Pawnee montane skipper and old-growth ponderosa pine/ mountain muhly grass (*Pinus ponderosa* / *Muhlenbergia montana*) Front Range foothills savannas communities.

CNHP Survey Sites were lands inventoried by CNHP scientists that did not meet the criteria for recommended designation as a conservation site. It is in no way implied that other areas not designate as Conservation Sites are not of importance in terms of conserving natural values. Ideally, these sites could serve as core natural areas that are surrounded by adequate buffer zones and connected to other core sites with well designed corridors. Therefore, it will be necessary to adequately plan and protect lands beyond those recommended here if these highly significant sites are to retain their full natural value. Furthermore, other sites may be worthy of conservation actions based on other values such as aesthetics or recreation. Unlike the Conservation Sites here, however, those sights typically contain species and natural communities that are relatively common and found at many other sites as well.

Map 1 General Locations of Denver Water Conservation and Survey Sites

The Conservation Site Profile

The conservation site is described in a standard site report which reflects data fields in CNHP databases. The sections of this report and the contents are outlined and explained below.

SIZE: The approximate acreage included within the conservation planning boundary for the conservation site.

BIODIVERSITY RANK: The overall significance of the conservation site in terms of rarity of the natural heritage resources and the quality (health, abundance, etc.) of their occurrences. These ranks range from B1 (Outstanding Significance) to B5 (General Biodiversity Significance).

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

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

LOCATION: The USGS 7.5' quadrangles that include the Conservation Site.

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

NATURAL HERITAGE RESOURCE SIGNIFICANCE: A synopsis of the rare species and significant natural communities that occur on the conservation site.

CURRENT STATUS: A summary of the ownership, degree of protection currently afforded the conservation site, and threats to the site or natural heritage resources as determined to date.

BOUNDARY JUSTIFICATION: The preliminary conservation planning boundary delineated in this report includes all known occurrences of natural heritage resources and the adjacent lands required for their protection.

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

Colorado Natural Heritage Program Ranks

Each of the species and plant communities tracked by CNHP is an element of natural diversity. Each element is assigned a rank which indicates its relative degree of imperilment on a five-point scale (1 = critically imperiled; 5 = abundant; Table 1). Federal and state ranks are explained in Table 2.

The primary criterion for ranking elements is the number of occurrences, or in other words, the number of known distinct localities or populations. The number of individuals at each locality or, for highly mobile organisms, the total number of individuals is also of great importance. Other considerations include the condition of the occurrences, the number of protected occurrences, and threats. The ranks are assigned both in terms of the element's imperilment within Colorado (State or S-rank) and the element's imperilment over its entire range (Global or G-rank). Taken together, these two ranks give an instant picture of the conservation status of the element. Although most species protected under state or federal endangered species laws are imperiled, not all rare and imperiled species are listed as endangered or threatened. **Natural Heritage ranks should not be interpreted as legal designations.**

Two other Natural Heritage Program ranks apply to the location where an element is found. Element occurrence ranks (EO ranks) indicate the quality, condition, defensibility, and viability of any one location of a particular element. The definitions are as follows:

quality: size, connectedness to surrounding natural ecosystems, productivity, vigor, regeneration relative to other examples of the same element.

condition: abundance of non-native plant species, degree of soil compaction, degree of degradation, ability to recover.

viability: whether intrinsic and extrinsic biological factors are in place for the long-term persistence of the element.

defensibility: likelihood of long-term survival of the element based on social/political/biophysical factors, vulnerability.

Biodiversity ranks (B-ranks) indicate the relative natural heritage significance of a site occurrence. B-ranks are a function of both rarity ranks and element occurrence ranks. Explanations of Natural Heritage Program ranks are given in Table 1.

Table 1. Colorado Natural Heritage Program Ranks.

<p>Global rarity ranks are similar to state ranks, but refer to a species' rarity throughout its range. State and Global ranks are denoted, respectively, with an "S" or a "G" followed by a character. Note that GA and GN are not used and GX means extinct. These ranks should not be interpreted as legal designations.</p>	
<p>Rarity Ranks (applied to an element only)</p>	
G/S1	Critically imperiled; usually 5 or fewer occurrences in the state; or may be a few remaining individuals; often especially vulnerable to extirpation.
G/S2	Imperiled; usually between 5 and 20 occurrences; or with many individuals in fewer occurrences; often susceptible to becoming endangered.
G/S3	Vulnerable; usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
G/S4	Common; usually > 100 occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
G/S5	Very common; demonstrably secure under present conditions.
G/SU	Status uncertain; often because of low search effort or cryptic nature of the element.
T	Trinomial; specifies the rank of that species and sub species.
S#B	Refers to the breeding season imperilment of elements that are not permanent residents.
S#H	Historically known from the state, but not verified for an extended period, usually more than 15 years; this rank is used primarily when inventory has been attempted recently.
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 ZN is used.
SZ	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected.
Notes:	When a question mark follows a numerical rank (e.g., S2?), it indicates uncertainty about the accuracy of this rank. When two numbers appear in a state or global rank (e.g., S2S3), the actual rank of the elements falls between the two numbers. When a 'Q' follows a rank, it indicates uncertainty about the taxonomic status of the element.
<p>Element Occurrence ranks (EO ranks) (applies to the site where an element(s) occurs)</p>	
A	The occurrence is relatively large, pristine, defensible, and viable.
B	The occurrence is small but in good condition, or large but removed from its natural condition and/or not viable and defensible.
C	The occurrence is small, or in poor condition, but restorable.
D	The occurrence is of questionable viability and could be restored only with great effort.
<p>Biodiversity ranks (applies to the site where an element(s) occurs).</p>	
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 Significance</u> : good example of a community type, excellent or good occurrence of state-rare species.
B5	<u>General Biodiversity Significance</u> : good or marginal occurrence of a community type, S1, or S2 species.

Table 2. Federal and State Agency Designations

Federal Status:	
U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993)	
LE	Endangered; taxa formally listed as endangered.
LT	Threatened; taxa formally listed as threatened.
P	Proposed E or T; taxa formally proposed for listing as endangered or threatened.
C	Candidate: taxa 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.
(C1)	FORMERLY: Notice of Review, Category 1: taxa for which substantial biological information exists on file to support proposing to list as endangered or threatened.
(C2)	FORMERLY : Notice of Review, Category 2: taxa for which current information indicates that proposing to list as endangered or threatened is possible, but appropriate or substantial biological information is not on file to support an immediate rulemaking.
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.
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 C1 and C2 candidate species.
State Status:	
Colorado Division of Wildlife	
E	Endangered
T	Threatened
SC	Special Concern

Protection urgency ranks (P-ranks) refer to the time frame in which conservation protection must occur. In most cases, this rank refers to the need for a major change of protective status (e.g., agency special area designations or ownership). The ranks range from P1 (immediate urgency; within a one year time frame) to P5 (no known urgency). The urgency for protection rating reflects the need to take legal, political, or other administrative measures to alleviate threats that are related to land ownership or designation. The following codes are used to indicate the rating which best describes the urgency to protect the area:

P1 --Immediately threatened by severely destructive forces within 1 year of rank date.

P2 --Threat expected within 5 years.

P3 --Definable threat but not in the next 5 years.

P4 --No threat known for foreseeable future.

P5 --Land protection complete or adequate reasons exist not to protect the site; do not act on this site.

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

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

Management urgency ranks (M-ranks) indicate the time frame in which a change in management of the element or site must occur. Using best scientific estimates, this rank refers to the need for management in contrast to protection (e.g., increased fire frequency, decreased herbivory, weed control, etc.). The ranks range from M1 (immediate urgency, within one year) to M5 (no known urgency). The urgency for management rating focuses on land use management or land stewardship action required to maintain element occurrences at the potential conservation area. The following codes are used to indicate the action needed to be taken at the area:

M1 -- Management action required immediately or element occurrences could be lost or irretrievably degraded within one year; or ongoing annual management action must continue or element occurrences could be lost or irretrievably degraded within one year.

- M2 -- New management action will be needed within 5 years to prevent the loss of element occurrences; or ongoing, recurring management action must continue within 5 years to prevent loss of element occurrences.
- M3 -- New management action will be needed within 5 years to maintain current quality of element occurrences; or ongoing, recurrent management action must continue within 5 years to maintain current quality of element occurrences.
- M4 -- Although not currently threatened, management may be needed in the future to maintain the current quality of element occurrences.
- M5 -- No serious management needs known or anticipated at the site.

A management action may include biological management (prescribed burning, removal of exotics, mowing, etc.) or people and site management (building barriers, rerouting trails, patrolling for collectors, hunters, or trespassers, etc). Management action does not include legal, political, or administrative measures taken to protect a potential conservation area.

▪

DENVER WATER ECOLOGICAL INVENTORY SITE PROFILES

Cheesman Lake Conservation Site

SIZE: Approximately 8,000 acres of Land + 1,000 water surface = 9,000 acres (ha) total.

BIODIVERSITY RANK: B2 (Very High Significance)- Cheesman Lake Conservation Site encompasses one of the largest and most ecologically intact occurrences of a Front Range old-growth ponderosa pine ecosystem known in Colorado. The site also represents a significant proportion of the limited range of the globally rare Pawnee Montane Skipper butterfly (*Hesperia leonardus montana*).

PROTECTION URGANCY RANK: P2P3 - Definable threat from potential increased recreation.

MANAGEMENT URGENCY: M3 - Management strategy revisions will be needed within 5 years to maintain current quality of the element occurrence

LOCATION: Douglas and Jefferson Counties Colorado, approximately four miles south east of the town of Deckers. The site extends for approximately 1.25 miles of land on either side of Cheesman Lake on the upper South Platte River. Elevation of the surface of the reservoir is 6,842 ft. Cheesman Lake USGS Quadrangle: T10 S, R70 W, Sections 19, 30; T10 S, R71 W, Sections 1, 2, 11, 12, 14.

GENERAL DESCRIPTION

The Cheesman Reservoir was created at the turn of the century by flooding approximately 5 miles of the upper Platte River Canyon. On the moderate to steep hillsides above the lake, coarse and shallow soils are often exposed. Pikes Peak granite frequently outcrops, sometimes forming massive cliffs.

Property owned and managed by the Denver Water Board has been protected from logging and grazing. The major recreational use is fishing, which is concentrated on the east side of the lake north of the dam, and to the south along Turkey Creek. There is one dirt road that follows the

north, east, and south perimeter of the lake. Motorized vehicle use is restricted to Denver Water and US Forest Service personnel, and other official use.

Upland Vegetation: The Cheesman Lake site is on the drier end of the moisture gradient for naturally occurring ponderosa pine (*Pinus ponderosa*) communities. Rainfall averages 16 inches (138 cm.) a year (USDA Soil Survey 1992). Because of the low rainfall and soil moisture capacity, net primary production is estimated to be low.

Ponderosa woodlands form open park-like stands with an abundant grass/forb component. The forest is a patchwork mosaic of plant associations including *Pinus ponderosa/Cercocarpus montanus* (Foothills ponderosa pine scrub woodlands), and *Pinus ponderosa/Muhlenbergia montana* (Foothills ponderosa pine savannas) communities (Hess and Alexander 1986; Johnson 1987).

The specific characteristics of a late successional ponderosa pine stands depends on elevation, orientation, and soil type. On dryer slopes with a southern exposure, trees are more widely spaced and the understory is composed of more xeric species such as blue grama grass (*Bouteloua gracilis*), muhly grasses (*Muhlenbergia* spp.) little bluestem (*Schizachyrium scoparium*), sun sedge (*Carex heliophila*), geranium (*Geranium caespitosum*), sulphur flower (*Eriogonum* sp.), whiskbroom parsley (*Harbouria trachypleura*), and hairy golden aster (*Heterotheca villosa*). Common trees and shrubs associated with dryer sites include Spanish bayonet (*Yucca glauca*), fringed sage (*Artemisia frigida*), mountain mahogany (*Cercocarpus montanus*), wax current (*Ribes cereum*), Douglas-fir (*Pseudotsuga menziesii*) and Rocky Mountain juniper (*Juniperus scopulorum*). Patches of grass meadows and dry shrubland communities blend into the ponderosa pine stands. In general, the more open stands supports a greater diversity of understory plant species and a more diverse animal community than dense ponderosa pine woodlands (Mutel and Emerick 1992).

On more mesic microsites with a northern aspect or deeper soils, denser mixed stands of ponderosa pine/ Douglas-fir occur. Ponderosa pine dominates the overstory where soils are dry and have a low moisture holding capacity. The overall density of trees and relative abundance of Douglas-fir increases with an increase in the effective moisture. Kinnikinnik (*Arctostaphylos uva-ursi*), common juniper (*Juniperus communis*), and waxflower (*Jamesia americana*) are common associates.

Occasional patches of non-native smooth and Japanese brome grasses (*Bromus inermis* and *B. japonicus*) can be found on the east side near roads or areas that have been disturbed historically. Other exotic species of concern are toadflax (*Linaria vulgaris*) and musk thistle (*Carduus nutans*).

The overall pattern of age and structural distribution is characteristic of an old-growth landscape (fig. 3). There is a patchwork mosaic of small stands of even aged trees, resulting in a diverse uneven aged forest. Widely spaced clumps of old-growth trees grow within a matrix of younger trees and openings. There is evidence of frequent lightning strikes to trees or snags in the overstory. Singed bark and burned lower branches suggest that groundfires are still common.

Dr. Kaufmann and his team have concluded that this is the only forest on the front range where the natural fire regime has remained virtually intact (Kaufmann 1996 unpublished data). Dwarf mistletoe (*Arceuthobium vaginatum*) infection was occasionally observed.

Riparian Areas: Goose and Turkey Creek: The riparian areas generally have more exotic species than the surrounding uplands. This is primarily because of their close proximity to roads and associated disturbance, natural flood disturbance, concentration of recreational impact, and more mesic conditions.

The tree and shrub component includes Rocky Mountain maple (*Acer glabrum*), water birch (*Betula fontinalis*), chokecherry (*Prunus virginiana*), and aspen (*Populus tremuloides*). Bluejoint and purple reed grass (*Calamagrostis canadensis* and *C. purpurascens*), are common grasses, as are bluebunch wheatgrass (*Agropyron spicatum* cultivar sp.) and the non natives smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*). Forb species include golden-glow (*Rudbeckia ampla*), avens (*Geum macrophyllum*), toadflax (*Linaria vulgaris*), yellow and white sweet clover (*Melilotus officinale* and *M. albus*), Canada thistle (*Cirsium arvense*) and dock (*Rumex sp.*).

Fauna: Animal density varies in ponderosa pine and Douglas-fir ecosystems, increasing as the woodlands become more open and as understory diversity and richness increases (Mutel and Emerick 1984). Ecotones, or the transition areas between different habitat types, also tend to have a higher diversity because of the greater variety in available cover and food.

Large ungulates such as mule deer (*Odocoileus hemionus*), and elk (*Cervus elephus*) are all well known in the area, as are coyote (*Canis latrans*), black bear (*Ursus ameriacanus*), and mountain lion (*Felis concolor*). Smaller mammals such as porcupine (*Erethizon dorsatum*), Abert's squirrel (*Sciurus aberti*), chipmunks (*Tamias quadrivittatus* and *T. minimus*) and Nuttall's cottontails (*Sylvilagus nuttallii*) are common.

Birds are abundant throughout the year. Species with montane affinities such as Steller's jays (*Cyanocitta stelleri*), pygmy nuthatches (*Sitta pygmaea*), red crossbill (*Loxia curvirostra*), western tanager (*Piranga ludoviciana*), hairy woodpeckers (*Picoides villosus*), and common ravens (*Corvus corax*) are often present. Pygmy nuthatches breed almost exclusively in ponderosa pine forests. Great horned owls (*Bubo virginianus*), goshawks (*Accipiter gentilis*), red-tailed hawk (*Buteo jamaicensis*) and cooper's hawks (*Accipiter cooperii*) are common avian predators.

Disturbance History: The area south of the dam to Sand Draw seems to have received the majority of disturbance related to reservoir construction at the turn of the century. A brief survey turned up evidence of past stone quarrying, skid trails and labor camps. However, most of the historical logging on the property occurred lower in the canyon and is now flooded. Several two-track unimproved roads branch off of the main road on the east side, and approximately two miles of high voltage power line cuts across the south east corner of the property. Because of the relative ease of access for fire crews, this area has also been subject to fire suppression efforts since the early 1900's. The moderate spread of exotic species has been facilitated by the higher road density, and disturbance associated with erecting the high voltage power lines.

NATURAL HERITAGE SIGNIFICANCE

Table 3. Natural Heritage elements at the Cheesman Lake conservation site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Hesperia leonardus montana</i>	Pawnee montane skipper	G4T1	S1	LT			A
<i>Pinus ponderosa-Muhlenbergia montana</i>	Foothills ponderosa pine savanna	G5	S2S3				A

*EO=Element Occurrence

CNHP has determined that the Cheesman Lake Conservation Site contains one of the most important occurrences of an old-growth ponderosa pine ecosystem in the Front Range. (please refer to section 2 of this report for a detailed discussion of the ecology and conservation status of Front Range old-growth ponderosa). Characteristics taken into consideration in this determination include the large extent of the occurrence, its exceptional condition, the extreme rarity of late successional *Pinus ponderosa* plant communities, and the suite of natural elements and processes which continue to play their natural role in the system. Our initial assessment has been repeatedly confirmed by other scientists and experts working on old-growth in Colorado.

In 1994, Dr. Phil Robertson and his team sampled 328 plots throughout the ponderosa pine zone in the Front Range and the southern mountains of Colorado (Robertson 1996 in press). It was his conclusion that the Cheesman Lake Conservation Site contains one of the best occurrence of Front Range old-growth ponderosa pine in the state (P. Robertson pers. com.).

Dr. Merrill Kaufmann has located a site on nearby Pike National Forest lands that appears to be physiographically identical to the Cheesman enclosure. The two sites differ dramatically in forest species composition and structure. This comparison strongly suggests that land use differences such as the absence of logging and grazing on Denver Water property is responsible for their excellent condition (M. Kaufmann pers. com.).

Dr. Tom Stohlgren and his crews sampled biodiversity in the understory within the Cheesman lake enclosure and compared it to adjacent Pike National Forest land (Stohlgren 1996 unpublished data). Initial analysis of their data indicates that there is a much greater species richness and diversity inside the Cheesman enclosure than can be found on the neighboring Pike National Forest: 35 species were found to be unique to the Cheesman enclosure, while only 12 species were unique to the Pike National Forest.

Generally, the west side of Cheesman Lake has not experienced the same level of road construction and visitor disturbance as the east side. The understory component is free of invasive exotic plant species. Exclusion from grazing and limited recreational use has made a

significant contribution to the excellent condition of the understory. Because of difficult terrain and lack of roads fire suppression has not been effective or practical. These factors appear to have preserved a near natural fire regime of lightning ignited high frequency low intensity fires that is necessary to maintain the open park-like forest composition and structure characteristic of presettlement old-growth ponderosa stands.

The Cheesman Lake Site occurrence of old-growth montane forest displays many of the structural, compositional, and functional characteristics representative of the “desired future condition” of low elevation ponderosa pine forests across the Front Range. An understanding of these properties is paramount to our efforts to restore ecosystem health state wide. However, there are pronounced gaps in our knowledge of the interaction between biotic and abiotic processes in old-growth ponderosa pine ecosystems.(Kaufmann *et.al.* 1992). This is not surprising, given the rarity and degraded or fragmented condition of existing Front Range old-growth stands.

The Cheesman Lake Conservation Site is the best, and maybe only, large scale working model of an old-growth ponderosa pine ecosystem we have. **Therefore, the importance of the Cheesman Lake Conservation Site, and its potential to make a significant contribution to the ecological restoration and sustainable development of the entire Front Range cannot be overemphasized. It provides the best, if not the only, opportunity to explore the interactions between landscape level processes, forest structure, and patterns of biodiversity in old-growth montane ecosystems.**

Riparian areas are of critical importance to biodiversity in the semi-arid West (Johnson 1989). The destructive effects of cattle grazing in riparian areas is well documented (Fleishner 1994). It is extraordinary to find a lower montane riparian area that has escaped livestock impacts. Of even greater significance, the Cheesman Lake riparian areas are thought to be the only example found in the front range where the near pre-settlement condition of the uplands contributes to the hydrological function of the riparian areas. The riparian areas within the Cheesman Lake exclosure provide the only known benchmark for comparing the effects of human alteration of the upland landscape on riparian areas.

One important indicator species testifying to the excellent ecological condition of the ecosystem is the Federally listed **Pawnee montane skipper** (*Hesperia leonardus montana*). From extensive occurrence data, Denver Water properties around Cheesman Lake represent some of the best habitat for the Pawnee montane skipper in its limited range (refer to section 3, species ecology and CNHP methodology). Surveys have consistently found peak densities as high as 6 individuals/ acre or higher in the Cheesman Lake exclosure. These were the highest densities found throughout its entire 37.9 mi.² South Platte River Canyon range (ERT 1986, 1988; CNHP 1996). Cheesman Lake also contains potential habitat for two other rare and imperiled butterflies, Moss’s elfin (*Callophrys mossii*), and the Hop-feeding azure (*Celastrina sp. 1*). CNHP did not target these butterflies in its fall survey because they are only detectable in the spring.

Table 4. Potentially Occurring Rare and Imperiled Butterflies at Cheesman Lake.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.
<i>Callophrys mossii</i>	Moss's elfin	G4T3	S2S3			
<i>Celastrina sp. 1</i>	Hop-feeding azure	G2	S2			

CURRENT STATUS

Human activities have had a minimal impact on the uplands surrounding the Cheesman Lake site since they have been under the management of the Denver Water Board. Cheesman Lake has been protected from grazing and logging since the turn of the century. Although active fire suppression has to some extent dampened the frequency of fire, there are still small ignitions, and the total effect of fire suppression up to the present is not outside the natural range of variability (Kaufmann 1996 unpublished data). Disturbance related to recreational use has been limited by current management practices to the northeast and southeast lake shore areas. The west side of Cheesman Lake is rarely visited by fishermen or recreationists.

Threats: Increased recreation poses a serious threat by introducing the possibility of a fire frequency regime much higher the natural range of variation. An increased risk of human caused ignitions could alter the natural fire regime that is critical for maintaining the ecological integrity of the system, and high quality of habitat for the Pawnee montane skipper. Permitting water-craft recreation would increase the total number of recreational users, and facilitate visitor access to areas that are presently restricted to occasional hikers. Dispersed recreation can carry seed into areas now free of exotic plant species. The Pawnee montane skipper may be sensitive to disturbance during the critical periods of mating and egg laying, inhibiting the butterfly from completing its life cycle.

BOUNDARY JUSTIFICATION

The preliminary conservation planning boundary delineated in this report includes all known occurrences of old-growth ponderosa pine and the most suitable habitat for the Pawnee montane skipper. Consideration was also given for a rational unit to contain a natural fire regime; however, experts in fire management should be consulted in developing a management plan to allow a natural fire regime, which may result in minor boundary modifications.

The Pawnee montane skipper's habitat is very open and dry ponderosa pine woodlands at 6,000 to 7,600 ft, with sparse vegetation and the presence of its exclusive larval food plant, blue grama (*Bouteloua gracilis*), as well as the presence of a nectar source, preferably dotted gayfeather (*Liatris punctata*) (figs. 1 and 2). The Pawnee montane skipper is very rare in pine woodlands with tall understory shrubs or where young dense conifers dominate the stand. Slopes are gently undulating to steep, and mostly sunny, with exposed granitic soil.

Virtually all of the Cheesman Lake Conservation Site below 7,600 ft. is suitable habitat. This represents approximately 8,000 acres, or about one-third of its total range. In an average to good year, the Cheesman Lake Conservation Site can support an estimated 48,000 potentially breeding

individuals. In a drastically poor year, with an hypothesized peak density of only 1 butterfly/acre, the Conservation Site could still support 8,000 individuals. This core population should be enough to ensure the short term continued survival of the species in the face of a stochastic event that might temporarily make the rest of its habitat unsuitable (such as the 1996 Buffalo Creek fire, that burned an estimated 12.5 mi.² of forest land ten miles to the north), providing a potential source for recolonization.

The large size and relative high quality of the area provides habitat for viable populations of numerous species that are typical of lower montane natural communities. This supports biodiversity at the landscape level by lessening biogeographic or island effects typical of smaller natural areas or preserves (Macarthur and Wilson 1967). In addition to the rare and imperiled Pawnee montane skipper, the Cheesman Lake Conservation Site could support viable substantial populations of the more common elements of biodiversity. For example, we estimate that Denver Water property in an average year could provide habitat for approximately 240 breeding pairs of Pygmy nuthatches (*Sitta pygmaea*), a species that breeds almost exclusively in ponderosa pine woodlands, as well as potential habitat for 100-200 breeding pairs of Western tanagers (*Piranga ludoviciana*).

PROTECTION AND MANAGEMENT RECOMMENDATIONS

- Develop a comprehensive and fully integrated adaptive forest management plan with the Pike National Forest that would allow fire to play its natural role in the landscape. Special consideration should be given to improving Pawnee montane skipper habitat, and to monitoring forest treatment effects on its biology.
- Seek special designation as a Colorado Natural Area. Contact Janet Coles and Cathy Carsey at the Colorado Natural Areas Program, phone # (303) 866-3203.
- Continue to support scientific research. Incorporate findings into the adaptive management plan.
- Conduct additional surveys for the rare and imperiled butterflies, Moss's elfin (*Callophrys mossii*), and the Hop-feeding azure (*Celastrina sp. 1*) during the appropriate season.
- Initiate a noxious weed monitoring program to evaluate the need for control measures. Controlled burning and limited herbicide application may be used to reduce the vigor and competitive ability of exotics, allowing natives to increase in the few places where exotics are presently established. Consideration should be given to effects of weed control programs on nectar source plants utilized by the Pawnee montane skipper.
- Current activities are compatible with the survival of the elements. Increased development or recreational use could negatively impact the elements by altering the natural fire regime. There is also a risk of disturbing the Pawnee montane skipper during sensitive breeding and egg laying periods from July through September. Recreation has also been demonstrated to affect breeding songbird density along frequented trails (Knight and Gutzwiller 1995). The risks posed by increasing recreational opportunities to the natural biodiversity of this highly unique and significant conservation site greatly outweigh the limited benefits.
- Publicize the extraordinary conservation value of the Cheesman Lake conservation site, and the benefits Denver Water Board's conservation stewardship has made to the preservation of Colorado's natural heritage, and to ecosystem restoration for the Front Range.

Map 2 Cheesman Lake Conservation Site

Figure 1. Pawnee montane skipper on its exclusive host plant, blue grama grass.

Figure 2. Pawnee montane skipper on its preferred nectar source plant, dotted gayfeather.

Figure 3. Ponderosa pine/ mountain muhly (Foothills ponderosa pine savanna) old-growth.

Gross Reservoir Survey Site

SIZE: Approximately 1,000 acres (405 ha) of land.

BIODIVERSITY RANK: B5 (General Biodiversity Significance) - Common plant communities in typical condition for the Front Range.

PROTECTION URGANCY RANK: P3P4 - No threat known for the foreseeable future.

MANAGEMENT URGENCY: M3 - New management needed within the next five years to prevent further resource degradation, or minimize the risk of resource loss.

LOCATION: . Located in southern Boulder County, two miles from the Jefferson County line, approximately five miles west of the city of Boulder, Colorado. Elevation of the reservoir surface is 7,282 ft. USGS Eldorado Springs and Tungsten Quadrangles: T 1 S, R 71 W, Sections 19, 20, 29, 30.

GENERAL DESCRIPTION:

The forested lands surrounding the reservoir are a patchwork mosaic of ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) plant associations. The terrain is mostly moderate to steeply undulating hillsides, with considerable amounts of exposed soil and outcropping rock. The shallow coarse textured granitic soils hold little moisture, and are highly susceptible to erosion. Annual rainfall averages 18 to 24 inches (45.7 to 61.0 cm) (USDA Soil Survey 1975).

North : The northern parameter of Gross Reservoir consist of a narrow strip of south facing steep hillside with exposed soil and granitic rock outcrops. There are several developed picnic areas and a network of formal and informal trails used by fishermen and hikers to access the lake. In some places there is moderate gulling and erosion associated with these trails.

Pinus ponderosa/ Muhlenbergia montana Front Range foothills savanna is the major plant community. The overstory is dominated by open grown ponderosa pine (*Pinus ponderosa*), with occasional Rocky Mountain juniper (*Juniperus scopulorum*) and Douglas-fir (*Pseudotsuga menziesii*). The shrub strata includes fringed sage (*Artemisia frigida*), wax current (*Ribes cereum*), Fendler bush (*Ceanothus fendleri*) and Spanish bayonet (*Yucca glauca*). Important native graminoids are muhly grasses (*Muhlenbergia* spp.), blue grama (*Bouteloua gracilis*), with patches of sedges (*Carex* spp.) and King's fescue (*Leucopoa kingii*). Major forbs are hairy

golden aster (*Heterotheca villosa*), sulphur flower (*Eriogonum umbellatum*), and wild geranium (*Geranium caespitosum*).

Many aggressive exotic plant species were found. Cheat grass (*Bromus tectorum*), Japanese brome (*Bromus japonicus*), and quack grass (*Elytrigia repens*), were widely distributed. Cultivated hybrid species of bluebunch and crested wheat grasses (*Agropyron spicatum*, *A. cristatum* var. *cultivar*) planted in reclamation efforts have since spread to adjacent areas. Canadian thistle (*Cirsium arvense*), alyssum (*Alyssum parviflorum*), and yellow and white sweet clover (*Melilotus officinale*, *M. albus*) are also wide spread.

East and South Gross Reservoir: Vegetation is a patchwork mosaic of mixed ponderosa pine and Douglas-fir stands. Associated plant community types blend into each other as soils, slope, and aspect change. Dense stands of young to mature Douglas-fir dominate more mesic sites. There is moderate to heavy insect mortality and accumulated dead and down material in the thicker stands. Plant associations on these sites include phases of Douglas-fir/waxflower (*Pseudotsuga menziesii*/*Jamesia americana*) and Douglas-fir/ross sedge (*Pseudotsuga menziesii*/*Carex rossii*) lower montane woodlands (Hess and Alexander 1986). Associated trees and shrubs include Rocky Mountain maple (*Acer glabrum*) common juniper (*Juniperus communis*), kinnikinnik (*Arctostaphylos uva-ursi*), fringed sage (*Artemisia frigida*), snowberry (*Symphoricarpos albus*), wild rose (*Rosa woodsii*), and chokecherry (*Prunus virginiana*). The grass/forb understory is sparse, particularly in denser stands of living trees. Common plants include sedges (*Carex* spp.), blue grama grass (*Bouteloua gracilis*), squirrel tail (*Sitanion hystrix*), King's fescue (*Leucopoa kingii*) and Muhly grasses (*Muhlenbergia* spp.).

West Side: Front Range foothills savanna (*Pinus ponderosa*/*Muhlenbergia montana*) is the dominant plant association on south facing slopes, and denser lower montane woodlands (*Pseudotsuga menziesii*/*Jamesia americana* and *Pseudotsuga menziesii*/*Carex rossii*) dominate more mesic sites. Whole hillsides have incurred very heavy insect mortality. Aggressive exotic weeds are widespread. Cheatgrass and Japanese brome grass (*Bromus tectorum*, *B. japonicus*), Kentucky bluegrass (*Poa pratensis*), Canada and musk thistle (*Cirsium arvense*, *Carduus nutans*) are the dominant plants in some areas on Winiger ridge (fig. 6). This area is used by recreational off road or four wheel drive vehicles. It also appears that the area was logged for firewood in the recent past, but the treatment was not effective for thinning or fuel reduction. There is ample regeneration in cut areas, and there are large amounts of slash on the ground.

CURRENT STATUS

In many ways the Gross Reservoir site typifies the condition of lower montane ecosystems near large urban centers along the Front Range. Forests are densely stocked (fig. 7). Under physiological stress, trees have an increased susceptibility to bark beetle and spruce budworm epidemics, which have caused locally heavy mortality within the last twenty five years (figs. 4 and 5). Potential for catastrophic fire is very high. (US Forest Service, 1996). Four miles to the north, 2,000 acres of forest lands in similar condition burned in the "Black Tiger" fire in 1989.

Aggressive exotic plant species are commonly found throughout the understory, and are especially abundant on the western ridges. Residential development is encroaching along the northern border of Denver Water lands, and pressure from recreational use is increasing. Dispersed foot travel along the northern parameter of Gross Reservoir is causing serious erosion. The western peninsulas are also experiencing severe erosion and gulying due to off road vehicle use.

NATURAL HERITAGE SIGNIFICANCE

Gross Reservoir contains three major common to vulnerable natural communities that are in poor but restorable condition. No rare or imperiled species were identified during CNHP field surveys. However, ten rare and imperiled species are known from the area surrounding Gross Reservoir. These elements were not targeted in the Ecological inventory due to the inappropriate season of the field survey. The west side of Gross Reservoir is known to be important winter habitat for Elk.

Table 5. Rare and imperiled elements known to occur at Gross Reservoir.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Pinus ponderosa-Muhlenbergia montana</i>	Foothills ponderosa pine savanna	G5	S2S3				B/C
<i>Pseudotsuga menziesii/ Carex rossii</i>	lower montane woodlands	G5	S4				B/C
<i>Pseudotsuga menziesii / Jamesia americana</i>	Lower montane forests	G3G4	S3				B/C

*EO=Element Occurrence

Table 6. Rare and imperiled species known from the area surrounding Gross Reservoir and tracked by CHNP, but not targeted in the Ecological inventory due to inappropriate season of the survey.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.
<i>Contopus borealis</i>	Olive sided flycatcher	G5	S3S4B	(C2)		FS
<i>Picoides tridactylus</i>	Three-toed woodpecker	G5	S3S4			
<i>Accipiter gentilis</i>	Northern Goshawk	G5	S3BS4N	(C2)		FS
<i>Pyrgus ruralis</i>	Two-banded skipper	G4	S3			
<i>Celastrina sp. 1</i>	Hop-feeding azure	G2	S2			
<i>Paratrytone snowi</i>	Snow's skipper	G4	S3			
<i>Promenetus exacuus</i>	Sharp sprite	G?	S2			
<i>Lilium philadelphicum</i>	Wood lily	G5	S3			
<i>Liatris ligulistylis</i>	Gay-feather	G5	S1S2			
<i>Pyrola Picta</i>	Pictureleaf wintergreen	G4G5	S2			

**POSSIBLE FEDERAL ENERGY RELICENSING COMMISSION (FERC)
ISSUES IDENTIFIED FOR GROSS RESERVOIR**

Table 7. Species with Federal and State Agency Special Designations Potentially Occurring at the Gross Reservoir Survey Site

<u>Species</u>	<u>CNHP rank</u>		<u>Fed. Status</u>	<u>Fed. Sens.</u>	<u>State</u>	<u>Colorado Dept. of Wildlife (CDOW) or lit search notes</u>
	<u>Global</u>	<u>State</u>				
Boreal toad <i>Bufo boreas</i>	G5T2Q	S1	(C)	FS	E	CDOW does not believe it occurs within the FERC boundary, but may be in the area. There are historical records from adjacent properties.
Northern leopard frog <i>Rana pipiens</i>	G5	S3		FS	SC	CDOW and CNHP have no records of occurrences on property. Fluctuating reservoir is not good habitat.
Bald eagle <i>Haliaeetus leucocephalus</i>	G4	S1B S3N	LT		T	Accidental to area, or very rare use for winter roost. Deep lake makes foraging difficult, not enough surface fish to attract eagles in significant numbers.
Ferunginous hawk <i>Buteo regalis</i>	G4	S3B S5N	(C2)	FS	SC	Accidental to area, or very rare transient use.
Mexican spotted owl <i>Strix occidentalis lucida</i>	G3T3	S1B	LT		T	Judged to be out of natural range, or no suitable habitat. No surveys have been conducted by agency personnel.
Northern Goshawk <i>Accipiter gentilis</i>	G5	S3B S4N	(C2)	FS		Relatively common in the area, but thought to be declining. ² A nest has been documented on adjacent land. ¹ Gross property unsurveyed. Too late to look for nests CNHP 1996 inventory. Recommend a field survey in appropriate season.
Olive sided flycatcher <i>Contopus borealis</i>	G5	S3S4B	(C2)	FS		Neotropical migrant commonly seen in the area. Number of sightings varies year to year. ² Recommend a field survey in the appropriate season.
Osprey <i>Pandion halieatus</i>	G5	S1B SZN		FS		Accidental to area. Same restrictions as Bald eagle
American Peregrin falcon <i>Falco peregrinus anatum</i>	G4T4	S2N	LE		T	2 occupied nests within 5 miles. Birds hunt in the area. Lake is good foraging habitat.

(Table 7. continued)

<u>Species</u>	<u>CNHP rank</u>		<u>Fed. Status</u>	<u>Fed. Sens.</u>	<u>State</u>	<u>Colorado Dept. of Wildlife (CDOW) or lit search notes</u>
	<u>Global</u>	<u>State</u>				
Purple martin <i>Progne subis</i>	G5	S3B		FS		Winters in South America. Suitable habitat. Status in area unknown. Recommend survey at appropriate time.
Three-toed woodpecker <i>Picoides tridactylus</i>	G5	S3S4		FS		Lower elevational extent of range, but will take advantage of beetle kill food source and suitable habitat. Has regularly been seen in area by local naturalists. ² Recommend a field survey in the appropriate season.
Greenback cutthroat trout <i>Oncorhynchus clarki stomias</i>	G4T2	S2	LT		T	Extirpated from entire drainage.
Pygmy shrew <i>Sorex hoyi montanus</i>	G5T2	S1		FS		Status unknown. Possible habitat. CNHP data base indicates historical occurrence in the area. Recommend a field survey in the appropriate season.
Barrens daggermoth <i>Acronteta albarufa</i>	G3G4	SH	(C2)	FS		No records from area in BCD
Regal fritillary <i>Speyeria idalia</i>	G3	S1	(C2)	FS		No records from area in BCD
Stevens' tortricid moth <i>Decodes stevensi</i>	G?	S1	(C2)	FS		No records from area in BCD

Additional sources:

¹ Dave Halleck, Biological Consultant. Ph# (303) 258-3672.

² Sheri Long, local naturalist with Preserve Unique Magnolia Association (PUMA). Ph# (303) 447-0922

PROTECTION AND MANAGEMENT RECOMMENDATIONS

- Actively participate in the Boulder County Forest Health and Fuels Mitigation plan development and implementation. A “community of interest approach” where all interested parties in the local community are invited to participate in planning and implementation of a forest health and fuels management program has been initiated. The major objectives of the plan are:

To organize, develop, implement, and monitor an ecologically based, sustainable forest health and fuels management program in Boulder County which will reduce the probability of catastrophic insect, disease and fire events, provide potentially safer fire fighting areas, and where possible, improve forest health and ecological integrity.

To seek innovative opportunities and develop partnerships with federal, county, state, city, and private land managers which complement multi-agency forest health and fuels management projects in threatened areas of Boulder County.

Winiger ridge has been given the highest priority for fuel mitigation treatments of all targeted sites in Boulder County . Four thousand acres of USFS land on Winiger ridge is scheduled for treatment spring and summer of 1997. CNHP recommends that the Denver Water Environmental Planning Dept. coordinate its land management efforts with this ecosystem-based, landscape-level forest health/fuels management program.

Contact: Bill Anthony, District Ranger, Boulder Ranger District. US Forest Service and
Becky Parmenter, Wildlife biologist, Boulder Ranger District. Ph# (303) 444-6600

- Conduct field surveys at the appropriate times for those elements identified as potentially occurring within the FERC boundary, but not targeted in the 1996 CNHP inventory (e.g., Northern goshawk, Three-toed woodpecker, Boreal toad, Olive sided flycatcher).
- Develop and implement a travel management plan, with special consideration given to the north and west sides. Keep recreational foot travel on designated trails, and close to the waters edge where most activities are concentrated.
- Post interpretive signs informing the public of fire danger, damage caused by off trail travel, and the Denver Water Board’s efforts to restore ecosystem health.
- Develop and implement a weed monitoring and management program in cooperation with the US Forest Service.

Map 3 Gross Reservoir and Lower Boulder County Survey Sites

Figures 4 and 5. Heavy insect mortality on the west side of Gross reservoir.

Figure 6. Winniger ridge (purple flowers in the foreground are Canada and musk thistle).

Figure 7. Densely stocked ponderosa pine typical of the southern and western sides of Gross Reservoir.

Lower Boulder County Properties

SIZE: Approximately one and one-half miles long by 100-200 feet wide, in two major segments.

BIODIVERSITY RANK: B5 - General biodiversity significance.

MANAGEMENT URGENCY: M4 - No immediate threat, but new management strategies are needed to include Denver Water properties in landscape level management plan for Boulder County forests and natural areas.

PROTECTION URGENCY RANK: P4 - No threat in the foreseeable future

LOCATION: Located in southern Boulder County Colorado, one mile north of the Jefferson County line, approximately five miles southwest of the city of Boulder. USGS Eldorado Springs Quadrangle

1. Boulder Canal Diversion Property : T1S R70W Sec. 31. Elevation 6,200 ft.
2. Rattlesnake Gulch: 0.2 mi. south of Eldorado Canyon State Park. West of Walker Ranch Park. T1S R71W no section established. Elevation 6,400-6,600 ft.

GENERAL DESCRIPTION:

1. **Boulder Canal Diversion**: A narrow strip of land (100 to 200 feet wide), adjacent to the diversion canal and pipeline was surveyed. The site is located at the abrupt contact of the upthrusted foothills and the piedmont section of the great plains. The uplands consist of sedimentary ridges with shallow stony soils that grade into more gentle rolling hills with deeper stony surfaced soils on quaternary alluvial outwash fans.

Young to mature ponderosa pine (*Pinus ponderosa*) woodlands cover the slopes with an understory of mid to tall grasses. Poverty oat grass (*Danthonia spicata*) was the most common grass along the canal. It is thought to be an early seral species, and may be dominant on the site due to frequent disturbance in the function and maintenance of the canal. Other native grasses include: big bluestem (*Andropogon*

gerardii), needle and thread grass (*Stipa columbiana*), Canada wildrye (*Elymus canadensis*), and mountain muhly (*Muhlenbergia montana*) which increased in frequency further from the canal. Non-native grasses that were documented along the diversion include: Timothy grass (*Phleum pratense*), Japanese brome and cheatgrass (*Bromus japonicus*, *B. tectorum*). Other non-native species of concern in the area are: Ragweed (*Ambrosia psilostachya*), Canada thistle (*Cirsium arvense*), chicory (*Cichorium intybus*), yellow and white sweet clover (*Melilotus officinale* and *M. albus*), clover (*Trifolium repens*), dandelion (*Taraxacum officinale*), dock (*Rumex sp.*), and houndstoungue (*Cynoglossum officinale*).

The land that Denver Water property crosses is currently managed by Boulder County Open Space (BCOS), and receives frequent recreational use from horseback riders, hikers, wildlife viewers and naturalists. A brief survey of the surrounding BCOS land revealed abundant wildlife sign including black bear, mule deer, and wild turkey.

Judging from the uniform size class of the forest, and from historical photographic evidence of the area, this was probably an open grassland in presettlement times. Ponderosa stands were only established just before the turn of the century (Veblen 1991). A gravel access road runs parallel to the canal section for most of its length and spurs lead to the “clay pit” and old stone quarry noted on the USGS quadrangle map. In addition to small scale mining, cattle ranching was also an historical land use.

2. **Rattlesnake Gulch**: A one-quarter mile long by 100 foot wide narrow strip of land that follows a heavily used hiking trail that begins in Eldorado Canyon state park. The overstory in the bottom of the drainage is Douglas-fir, with basswood (*Tilia americana*) and balsam poplar (*Populus balsamifera*), Rocky Mountain maple (*Acer glabrum*), wax currant (*Ribes cereum*), wax flower (*Jamesia americana*), and thinleaf alder (*Alnus tenuifolia*). Climbing out of the gulch, the trail contours along the west side of the canyon up a steep slope. Drier sites support a dominant Douglas-fir overstory with scattered ponderosa pine. Understory species include: snowberry (*Symphoricarpos albus*), Rocky Mountain juniper (*Juniperus scopulorum*), sumac (*Rhus glabra*), and Spanish bayonet (*Yucca glauca*). Canada bluegrass (*Poa compressa*) was the dominant grass. More mesic microsites support a higher density of Douglas -fir with a few aspen (*Populus tremuloides*) and Rocky Mountain maple (*Acer gallium*). Hairy golden aster (*Heterotheca villosa*) was ubiquitous in the gulch, as were the exotic Canada and bull thistle (*Cirsium arvense* and *C. vulgare*), wormwood (*Artemisia biennis*), hoary alyssum (*Berteroa incana*), and yellow and white sweetclover (*Melilotus officinale* and *M. albus*).

NATURAL HERITAGE SIGNIFICANCE

Table 8. Potentially Occurring Rare and Imperiled Elements Targeted in the Lower Boulder County Ecological Survey

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Spiranthes diluvialis</i>	Ute ladies' tresses	G2	S2	LT			
<i>Zapus hudsonius preblei</i>	Preble's meadow jumping mouse ³	G5T2	S2				
<i>Gaura neomexicana coloradoensis</i>	Colorado butterfly plant	G4T4	S1	(C2)	SC		
<i>Sisyrinchium pallidum</i>	Pale blue-eyed grass	G2G3	S2				

*EO=Element Occurrence

CNHP scientists conducted a thorough survey of the Lower Boulder County sites for these elements. (A summary of species life history, conservation status, field survey methodology, and survey results for high priority targeted elements, is found in section 3 of this report.) CNHP did not find any evidence of these targeted rare and imperiled elements on the survey site.

Protection and Management Recommendations

Because of the high proportion of edge to area in these long narrow sites, it does not make sense ecologically to discuss the management of Denver Water's biological resources in themselves. The properties need to be considered within the context of their surroundings. The diversion canal site is in effect a corridor of disturbance, fragmenting the larger parcels of BCOS. Management should be integrated with BCOS goals and objectives as is compatible with the primary function of the canal for water supply.

Cherry Creek Gallery Survey Site

SIZE: Approximately 30 acres (12 ha).

BIODIVERSITY RANK: B5 (General biodiversity significance) - The site is too small and degraded to merit special conservation designation.

PROTECTION URGANCY RANK: P3P4 - No threat known for the foreseeable future.

MANAGEMENT URGENCY: M4 - Management should be initiated to restore natural values.

LOCATION: South east metropolitan Denver area, three miles northwest of Cherry Creek Reservoir State Recreation Area.

GENERAL DESCRIPTION: The Cherry Creek site is a small, highly disturbed parcel of land surrounded by commercial and residential development. Concrete blocks, riprap, and other abandoned construction materials litter the site. Frequently used foot and bicycle trails crisscross the property. The hydrology of the system has been permanently altered by urban development. Large old cottonwoods are dying on the upper remnant flood plains. Willow (*Salix* sp.) grow along the creek, along with a few young cottonwoods and alder. The entire floodplain has been taken over by exotic weedy species. Among those species are: Chinese elm (*Ulmus pumila*), yellow and white sweet clover (*Melilotus officinale* and *M. albus*), clover (*Trifolium repens*), thistle (*Cirsium* sp.), dock (*Rumex* sp.), wormwood (*Artemisia biennis*), Kentucky bluegrass (*Poa pratensis*), timothy grass (*Phleum pratenses*), knapweed (*Centaurea* sp.), kochia (*Kochia scoparia*), and bindweed (*Convolvulus arvensis*).

Natural Heritage Significance

CNHP Botanists conducted a thorough survey for *Spiranthes diluvialis*. No evidence of its occurrence was found. Because of the highly degraded condition of the property, habitat is poor to unsuitable.

Table 9. Targeted elements at the Cherry Creek site.

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.
<i>Spiranthes diluvialis</i>	Ute ladies' tresses	G2	S2	LT		

Urban wildlife may venture up the riparian corridor from Cherry Creek State Recreation Area (e.g. red fox). Songbirds utilize the willows and remaining cottonwood trees along the stream bank. Remains of a white tailed deer were found. A small colony of black tailed prairie dogs occupies the upper bench in the north east corner of the property.

Protection and Management Recommendations

Designate the area as an Urban Open Space and Urban Natural area. Manage the riparian area for songbird habitat. Consideration should be given to control of exotic species, and rehabilitation of the native vegetation as much as is possible given the altered hydrologic regime. Involve the community in clean up and restoration projects.

Map 4 Cherry Creek Gallery Survey Site

CONSERVATION STATUS OF FRONT RANGE MONTANE ECOSYSTEMS: LANDSCAPE LEVEL CONSERVATION ISSUES

Low elevation montane ecosystems have been altered significantly since settlement. The natural heritage importance of lands owned or managed by the Denver Water Board must be understood within the greater context of landscape change.

The prominent historical impacts of logging, grazing, fire suppression, and road building have been augmented by the recent acceleration of subdivision and residential development of mountain property along the Front Range as the human population grows at unprecedented rates. Ecosystem structure, composition, and function have changed drastically. Habitat alteration, destruction, fragmentation, and invasion by exotic species pose direct and serious threats to natural biodiversity.

During the last century, natural disturbance regimes were judged by land managers and the public in general to be in conflict with human economic and social well being. A great expenditure of resources was directed toward minimizing these processes in an attempt to maintain a “stable” ecosystem. The role that lightning caused fire, drought, flooding, insects and diseases played in maintaining the natural range of ecosystem variability was not widely appreciated. The clear lesson from a century of imposing human based social values on natural systems is that the more we strive to achieve stability, the less likely we are to realize this misguided goal.

Disequilibrium in ecosystem processes and function has created an increased risk to both natural and human values from large scale catastrophic disturbance well outside the natural range of variation. Past fire suppression has resulted in dense, close canopied, mature forests with dangerously high fuel accumulations. During the last several decades forests in the northern Front Range of Colorado have incurred massive forest pest and disease epidemics resulting in thousands of acres of tree mortality. Catastrophic wildfires have resulted in the loss of millions of dollars in property, resource damage, and the loss of lives fighting fire in the wildland-urban interface.

An ecosystem based, landscape level forest health plan is needed for the entire Front Range. The primary goal of such a plan should be to improve forest health and restore ecological integrity. Because of the landscape level of the problem, strategic partnerships need to be formed with private, county, state, and federal owners, agencies, and public interest groups. Decisions on specific actions should be made using the best available scientific knowledge and ecologically sound techniques. Several organizations and agencies are available for consultation in the development of Management Plans for significant natural lands (e.g., Colorado Natural Areas Program, The Nature Conservancy, Colorado Division of Wildlife, Colorado Native Plant Society, CNHP, and various academic institutions).

Human alteration of old-growth ponderosa pine ecosystem structure and processes.

When European settlers first arrived in the Front Range, low elevation old-growth ponderosa pine forest was the rule rather than the exception (Jack 1899). High frequency, low intensity discontinuous ground fires were a natural component of ponderosa pine ecosystems, and played an important role in maintaining an open structure characteristic of old-growth (Harrington and Sackett 1992. Covengton and Moore 1992). Protected by a thick layer of bark, mature ponderosa pine trees are relatively immune to low intensity fire, but such fires are fatal to seedlings, and the less fire resistant young Douglas-fir (Biswell *et al.* 1973). At the stand level or smaller, there was little vertical diversity, but at the larger landscape level, there was a patchwork mosaic of even aged trees, that resulted in an uneven aged forest (Mehl 1992; Cooper 1960) Widely spaced clumps of old trees grew within a matrix of younger trees and openings. Frequent ground-fires also release nutrients and limits litter build up that might suppress understory herbaceous growth. At low elevations, fires burned as often as every 12-25 years. Fire occurred less frequently at higher elevations, possibly every 25-40 years. (Laven 1980; Veblen and Lorenze 1992; Veblen and Hadley 1993).

Because of its easy accessibility and the great utility of large timber, ponderosa old-growth forests were harvested to fuel the explosion of human economic development around the turn of the century. Intensive grazing by livestock reduced the lush understory grass/forb component and altered its composition, thus compromising its ability to carry a low intensity ground fire fatal to ponderosa pine and Douglas-fir seedlings (Cooper 1960).

As tree regeneration increased, understories became clogged with pole and sapling sized trees. With an increase in canopy closure, shade tolerant Douglas-fir can out compete ponderosa pine, which requires open stand structure for vigorous growth (Schubert 1974). Vegetation on the forest floor decreases in abundance as tree density increases. Pole and sapling sized trees can act as ladder fuels carrying the less frequent fires up into the crown overstory. Active fire suppression initiated in the first part of this century only increased the build-up of potential fuels, further increasing the chances of high intensity stand replacing fires (Biswell *et al.* 1973). These hotter fires are usually fatal even to late successional ponderosa (Harrington and Sacket 1992).

Primarily because of intensive harvesting and fire suppression, old-growth ponderosa pine stands along the front range are now extremely rare (Robertson 1992; Lowry 1992). Where they do exist, they occur mostly in pockets of several acres that were too small or hard to reach to be economically harvested (Mehl 1992). The Arapaho-Roosevelt National Forest conducted an intensive two year inventory of its forest for old growth (Lowry 1992). Out of 996,000 total forested acres, 136,000 acres are classified as ponderosa pine. Only 1,300 acres are classified as old-growth ponderosa (US Forest Service Arapaho-Roosevelt Draft EIS 1996). In other words, less than 1% of ponderosa pine forests in the inventory are recognized as old-growth.

Exotic Species

The problem of invasive exotic plants and animals is one of the greatest threats facing native habitats and the conservation of biological diversity (Primack 1986; Soule 1990). Such invasive aliens can have a number of impacts on natural systems (Bratton 1982; DeLoach 1991; Harty 1986; Hester 1991). Exotic organisms that become established in natural areas often displace the native plants and animals, altering the composition of native communities, and affecting any other organisms that may have relied on these native communities. In some cases, the species being displaced are rare and imperiled plants and animals (Moore and Keddy 1988).

Since most invasive exotic organisms are adapted to habitats that have been disturbed in some way, the greatest impacts tend to occur in areas that have experienced the greatest landscape modification (White *et al.* 1993). This disturbance can take the form of soil removal, severe livestock grazing, changes in the regime of water fluctuations, adjacent forest clearance, fire suppression, and many others.

The origins of exotic plants and animals on Denver Water property are varied. Many plants have been brought to this continent for use as garden and landscaping ornamentals, but have since "escaped" and established themselves in the wild. An example is yellow toadflax (*Linaria vulgaris*). Certain agricultural practices have also resulted in large scale exotic introductions. Pasture "improvements" have taken place which seeded with various exotic grasses meant to increase the forage value for domestic livestock. The results are large areas dominated by a few exotic grasses and very few natives. Hay fields are typically monocultures of exotic grasses which, aside from displacing the former grassland or wetland, serve as a source of seeds for invasion of surrounding areas. These hay grasses, and any other weeds that may grow in the hay fields, are also spread by livestock.

The control of excess erosion is essential to preventing the loss of topsoil and the maintenance of good water quality. However, methods used in the control of erosion are often at the expense of native species, a serious problem in itself. Typically, areas such as ditches and roadcuts are reseeded with a seed mix recommended for our climate and soils. Unfortunately, these mixes rarely contain seeds of the locally native vegetation, instead containing "hardy" exotic species that are chosen for their ability to thrive in this area. This has been the fate of nearly every reseeded area in the counties surrounding Denver Water properties, which are now dominated by various exotic grasses. Furthermore, these areas serve as a source for the subsequent invasion of adjacent areas.

Efforts to minimize the ecological damage done by invasive exotic plants on Denver Water property should attempt to prevent new introductions, contain small or recent infestation, and attempt to control exotic species populations especially in significant conservation areas.

Fragmentation

Habitat fragmentation, also presented separately in this report, is a major result of rural development. Roads and fences can create significant barriers to dispersal for both large animals such as elk and deer, and also smaller ones such as rodents and even butterflies. Furthermore, these same barriers may also act as corridors for dispersal of other species including exotic plants and animals (references in Schonewald-Cox and Beuchner 1993). Increased mortality from roads also affects certain species.

By using natural resources, building towns and cities and their suburbs, and creating new agricultural land, human beings gradually create patches of natural habitats within human dominated landscapes. Conservation biologists term this breaking up of natural habitats "fragmentation." Many scientists consider fragmentation one of the greatest threats to biological diversity (Noss and Cooperrider 1994). Wilcove *et al.* (1986) describe fragmentation as a decrease of a habitat type, and a breaking up of remaining habitat into smaller, more isolated pieces.

Currently, the greatest mechanism of fragmentation adjacent to Denver Water property is rural and suburban housing development and concurrent road and highway development. In the past, agricultural field and pasture development likely fragmented the Denver Water landscape. Rural and suburban housing development divides the landscape with roads, fences, new homes, and artificial landscaping.

In forest environments, fragmentation often allows more light into the forest interior, changing the plant species that can live there, and allowing more weedy species to colonize. Animal species that prefer open habitats will often be able to invade, displacing those species adapted to the forest interior. While these changes might be less obvious in a grassland or shrubland, the same processes occur. Exotic species are able to invade, displacing the natives, often reducing the total number of species able to survive. Animal species associated with native grasslands and shrublands may not be able to survive in an area with only exotic, weedy vegetation.

Roads that accompany housing development often act as impenetrable barriers to animals, especially small animals, and may encourage the spread of weedy plant species along them. There may also be significant mortality on roads, especially where animals formerly used the area where the road now exists. Fences may also act as barriers to animals

Fragmentation is a process that occurs through many means, and usually occurs over several months, years, or decades. The fragmentation process may not result in immediate loss of plants, animals, and natural communities from an area, but an area may experience gradual turnover of plant and animal species able to survive. In some cases the results of fragmentation are not seen for several years as species gradually leave or die off within a fragment. The

fragment size and surrounding landscape greatly influence the impacts on living things within the fragment.

Small patches of natural habitat, such as those created by large scale suburban development or large scale conversion of land to agriculture, will probably house few large animals, and will be unable to support plants and animals dependent on large areas of contiguous habitat. These small fragments may also experience a change in species composition, supporting more weedy plant and animal species. While the number of species may remain the same, small habitat fragments surrounded by suburban or agricultural development will likely experience species turnover and end up with more common and even pest plants and animals.

Large habitat fragments are less vulnerable to complete change in species composition. However, even a large habitat area can experience loss of native, habitat specific plants and animals, especially on its edges. Intensive urban and suburban development at the edges of even a large natural area may cause changes in the species able to survive within the natural area.

Fragmentation threatens the significant natural features of land adjacent to Denver Water properties. Only concerted and well informed development and conservation planning are likely to save the remaining high quality natural areas. The negative effects of fragmentation can be reduced by: concentrating housing and road development, leaving some areas relatively free from such pressures; planting only native species in lawns and gardens; leaving large buffers of open space around nature preserves, and discouraging the building of roads within these buffers; planning for large fragments as opposed to small ones; and educating local residents about impacts of fragmentation on the natural world.

COLORADO NATURAL HERITAGE PROGRAM

The Colorado Natural Heritage Program is building on a solid base of biodiversity information. In 1992, after 14 years of operation with the Division of Parks and Outdoor Recreation, CNHP was relocated in the University of Colorado Museum. Quickly outgrowing available space, CNHP transferred its offices to Colorado State University's College of Natural Resources in September 1994. CNHP has established itself as a statewide repository for information on rare and imperiled species and significant natural communities in Colorado. The multi-disciplinary team of scientists gather information and information managers continually incorporate these data into CNHP databases. 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). Concentrating on site-specific data for each element of natural diversity, the accurate status of each element is known. Maps of the data contained in BCD illustrate sites that are important to the conservation of Colorado's natural heritage. By using the element ranks and the quality of each occurrence, priorities can be established for the protection of the most sensitive sites. This updated locational database and priority-setting system provides CNHP with effective, proactive land-planning tools.

The Natural Heritage Network and Biodiversity

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

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

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

The Heritage Methodology is utilized by Heritage Programs throughout North, Central, and South America, forming an international database network. The Natural Heritage Network currently includes 85 primary data centers, which cover all 50 U.S. states, 5 provinces of Canada, and 13 countries in Latin 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 focussing conservation efforts.

What is Biodiversity?

The term *biodiversity* has multiple meanings depending on the biological scale to which the term is being applied. Most commonly, biological diversity refers to the full range of *species* on Earth, including single-celled organisms such as bacteria, viruses, and protista, as well as multicellular organisms such as plants, animals, and fungi. At finer levels of organization, biological diversity includes the genetic variation within species, both among geographically separated populations and among individuals within single populations. On a wider scale, biological diversity includes variations in the biological communities in which species live, the ecosystems in which communities exist, and the interactions among these levels. The continued survival of species and natural communities require the preservation of biodiversity at all of these scales.

Given these various scales of biodiversity, the biological diversity of an area can be described at four levels:

1. Genetic Diversity -- the genetic variation within a population and among populations of a plant or animal species. The genetic makeup of a species is variable between populations of a species within its geographic range. Loss of a population results in a loss of genetic diversity for that species and a reduction of total biological diversity for the region. This unique genetic information cannot be reclaimed. This level of biodiversity is critical in order for a species to adapt to changing circumstances and to continue to evolve in the most advantageous direction for that species.
2. Species Diversity -- the total number and abundance of plant and animal species and subspecies in an area.
3. Community Diversity -- the variety of natural communities or ecosystems within that area. These communities may be representative of or even endemic to an area. It is within these ecosystems that all life dwells.
4. Landscape Diversity -- the type, condition, pattern, and connectedness of natural communities or ecosystems within a landscape. Fragmentation of landscapes, loss of connections and migratory corridors, and loss of natural communities all result in a loss of biological diversity for a region. Humans and the results of their activities are integral parts of most landscapes.

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

NATURAL HERITAGE METHODOLOGY

Overview

The Heritage Methodology operates at several different levels. First, *elements of natural diversity* are ranked according to their rarity. These *elements* consist of species, subspecies and significant natural communities. The relative rarity of the various elements is based upon the scientific biological information and population locations known currently. As new information is acquired, element ranks can be modified.

The second level of the Heritage Methodology is the ranking of the populations or *occurrences* of a particular element. Since it is frequently impossible to protect all populations of a particular species, subspecies, or natural community, attempts are made to evaluate the relative quality of various occurrences of these elements so that conservation efforts can be focused on the best representatives of the elements and the healthiest, most viable populations.

The third level of the Heritage Methodology is the delineation of potential conservation areas and the ranking of the land units according to the rarity and quality of the elements and their occurrences contained within the unit boundaries. This enables conservation efforts to focus on assemblages of rare elements as well as on the elements themselves. Taken together, these three levels at which the Heritage Methodology is applied provides a comprehensive, scientific approach to preserving species.

Inventory methods

The methods for assessing and prioritizing conservation needs over a large area are necessarily diverse. This study follows a general method that the Colorado Natural Heritage Program has and continues to develop specifically for this purpose.

The Natural Heritage Inventory was conducted in several steps:

1. Collect existing information.

Black and white, and color aerial photographs of the entire study area were reviewed in conjunction with 1:24,000 scale topographic maps. These photographs were provided by the Denver Water Environmental Planning department (photo dates and scale: 1976 Cheesman Lake 1:14,000, 1982 Gross Reservoir 1:12,000, 1993 Cherry Creek 1:500.).

CNHP databases were updated with information regarding the known locations of species and significant natural communities within Denver Water property. Sources included museum collections, scientific literature, and local naturalists and biologist. The Colorado Division of Wildlife provided extensive data on Gross Reservoir FERC issues.

Other information was gathered to help locate additional occurrences of natural heritage resources. Such information covers basic species and community biology including range, habitat, phenology (timing), food sources, and substrates. This information was used to refine the potential element list and to refine our search areas.

2 Identify potential natural heritage resources.

Rare and imperilled species and significant natural communities potentially occurring on Denver Water property were identified using known range and life history information, as well as known locations within Denver Water property and the surrounding region

The amount of effort given to the survey for each of these elements is prioritized according to the element's rank. Globally rare (G1 - G3) elements are given highest priority, state rare elements are second.

Table 1. Rare or imperilled vertebrates potentially occurring on Denver Water property

AMPHIBIANS

Common Name	Scientific Name	Global Rank	State Rank	Federal Status	State Status	Federal Sensitive
Boreal toad	<i>Bufo boreas</i>	G5T2Q	S1		C	FS
Northern leopard frog	<i>Rana pipiens</i>	G5	S3S4		SC	FS

BIRDS

Common Name	Scientific Name	Global Rank	State Rank	Federal Status	State status	Federal Sensitive
American peregrine falcon ¹²³	<i>Falco peregrinus</i>	G3	S2B, SZN	LE	T	
American redstart	<i>Setophaga ruticilla</i>	G5	S1?B,SZN			
Ferruginous hawk	<i>Buteo regalis</i>	G4	S3B,S5N	(C2)	SC	FS
Loggerhead shrike	<i>Lanius ludovicianus</i>	G4	S3B,SZN	(C2)		FS
Mexican spotted owl	<i>Strix occidentalis lucida</i>	G3T3	S1B	LT	T	
Osprey	<i>Pandion Haliaeetus</i>	G5	S1B, S4N			FS

(Rare and imperiled birds continued)

Common Name	Scientific Name	Global Rank	State Rank	Federal Status	State status	Federal Sensitive
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>	G5	S2B			
Bobolink	<i>Dolichonyx oryzivorus</i>	G5	S3B, SZN			
Cedar waxwing	<i>Bombycilla cedrorum</i>	G5	S3B, SZN			
Chestnut-sided warbler	<i>Dendroica pennsylvanica</i>	G5	S2B, SZN			
Eastern yellow-billed cuckoo	<i>Coccyzus americanusamericanus</i>	G5TU	S3B			
Evening grosbeak	<i>Coccothraustes vespertinus</i>	G5	S2S3B, S5N			
Great blue heron	<i>Ardea herodias</i>	G5	S3B, SZN			
Least flycatcher	<i>Empidonax minimus</i>	G5	S1B, SZN			
Long-billed curlew	<i>Numenius americanus</i>	G5	S2B, SZN	3C	SC	FS
Ovenbird	<i>Seiurus aurocapillus</i>	G5	S2B			
Red-eyed vireo	<i>Vireo olivaceus</i>	G5	S3B, SZN			
Rose-breasted grosbeak	<i>Pheucticus ludovicianus</i>	G5	S1B			
Three toed woodpecker	<i>Picoides tridactylus</i>	G5	S3S4			FS
Turkey vulture	<i>Cathartes aura</i>	G5	S3B, SZN			
White-faced ibis	<i>Plegadis chihi</i>	G5	S2B, SZN	C2		FS
Wood Duck	<i>Aix sponsa</i>	G5	S2B, SZN			

FISH

Common Name	Scientific Name	Global Rank	State Rank	State status	Federal Status	Federal Sensitive
Common shiner	<i>Notropis cornutus</i>	G5	S2	SC		
Iowa darter	<i>Etheostoma exile</i>	G5	S2	SC		
Johnny darter	<i>Etheostoma nigrum</i>	G5	S3			
Northern red-bellied dace	<i>Phoxinos eos</i>	G5	S1	SC		
Plains topminnow	<i>Fundulus sciadicus</i>	G4	S2	SC	(C2)	

MAMMALS

Scientific Name	Common Name	Global Rank	State Rank	State status	Federal Status	Federal Sensitive
<i>Sorex meriami</i>	Meriam's shrew ³	G5	S3			
<i>Zapus hudsonius preblei</i>	Preble's meadow jumping mouse ³	G5T2	S2	(C2)	SC	FS
<i>Plecotus townsendii</i>	Townsend's big-eared bat ³	G4	S4	(C2)		

REPTILES

Scientific Name	Common Name	Global Rank	State Rank	State status	Federal Status	Federal Sensitive
<i>Tropidoclonium lineatum</i>	Lined snake	G5	S3			FS

Table 2. Rare and imperiled invertebrates potentially occurring on Denver Water property

BUTTERFLIES

Scientific Name	Common Name	Global Rank	State Rank	State status	Federal Status	Federal Sensitive
Argos skipper ³	<i>Atrytone argos</i>	G3G4	S2			
Colorado blue	<i>Euphilotes rita coloradensis</i>	G4T2T3	S2S3			
Cross-line skipper ³	<i>Polites origenes</i>	G5	S3S4			
Eastern tiger swallowtail	<i>Papilio glaucus</i>	G5	S3			
Hop-feeding azure ^{2,3}	<i>Celastrina sp 1</i>	G2	S2			
Hops vine blue	<i>Celastrina species</i>	G2	S1?			
Long dash	<i>Polites mystic</i>	G5	S3S4			
Moss's elfin ³	<i>Incisalia mossi</i>	G4T3	S2S3			
Mottled dusky wing ³	<i>Erynnis martialis</i>	G4	S2S3			
Nitra swallowtail	<i>nitra</i>	G5T5	S3S4			
Ottoo skipper	<i>Hesperia ottoe</i>	G3?	S2			
Pawnee montane skipper	<i>Hesperia leonardus montana</i>	G4T1	S1		LT	
Regal fritillary	<i>Speyeria idalia</i>	G3	S1		(C2)	FS
Rhesus skipper	<i>Polites rhesus</i>	G4	S2S3			
Sharp sprite ²	<i>Promenetus exacuus</i>	G?	S2			
Sister	<i>Adelpha bredowii</i>	G5	S3			
Snow's skipper ^{2,3}	<i>Paratrytone snowi</i>	G4	S3			
Snow's skipper	<i>Paratrytone snowi</i>	G4	S3			
Two-banded skipper ²	<i>Pyrgus ruralis</i>	G4	S3			

DRAGONFLIES AND DAMSELFLIES

Common Name	Scientific Name	Global Rank	State Rank	State status	Federal Status	Federal Sensitive
Sedge darner	<i>Aeshna juncea</i>	G5	S3			

TIGER BEETLES

Common Name	Scientific Name	Global Rank	State Rank	State status	Federal Status	Federal Sensitive
	<i>Cicindela nebraskana</i>	G5	S2			
	<i>Cicindela duodecimguttata</i>	G5	S3			

OTHER

Common Name	Scientific Name	Global Rank	State Rank	State status	Federal Status	Federal Sensitive
An Ant	<i>Stigmatomma pallipes</i>	G5	S1			
An Ant	<i>Sympheidole elecebra</i>	G1?	S1			

Table 4. Rare and imperiled plants potentially occurring on Denver Water property

Common Name	Scientific Name	Global Rank	State Rank	State status	Federal Status	Federal Sensitive
Lavender hyssop ¹	<i>Agastache foeniculum</i>	G4G5	S1			
Dwarf wild indigo ³	<i>Amorpha nana</i>	G5	S2S3			
Dwarf milkweed	<i>Asclepias uncialis</i>	G3	S2		(C2)	FS
Grass-fern	<i>Asplenium septentrionale</i>	G3G4	S3S4			
Green Spleenwort ¹	<i>Asplenium trichomanes-ramosum</i>	G4	S1S2			
A carex	<i>Carex oreocharis</i>	G3	S1			
Peck sedge ¹	<i>Carex peckii</i>	G4G5	S1?			
Yellow hawthorn	<i>Crataegus chrysocarpa</i>	G5	S1S2			
Yellow lady's slipper	<i>Cypripedium pubescens</i>	G5	S2			
Showy prairie gentian	<i>Eustoma russellianum</i>	G5	S3			
Colorado butterfly weed	<i>Gaura neomexicana ssp coloradensis</i>	G4T2	S1		C	FS

(Rare and imperiled plants continued)

Common Name	Scientific Name	Global Rank	State Rank	State status	Federal Status	Federal Sensitive
New mexico butterfly weed	<i>Gaura neomexicana sp neomexicana</i>					
Dwarf rattlesnake-plantain ¹	<i>Goodyeria rapens</i>	G5	S2			
Richardson alum-root	<i>Heuchera richardsonii</i>	G5	S1			
Gay-feather ²	<i>Liatris ligulistylis</i>	G5	S1S2			
Wood lily ²	<i>Lilium philadelphicum</i>	G5	S3			
White adder's mouth ¹	<i>Malaxis brachypoda</i>	G4	S1		(C2)	FS
Webber Monkey-flower ¹	<i>Mimulus gemmiparus</i>	G2	S2		(C2)	FS
Sensitive fern	<i>Onoclea sensibilis</i>	G5	SH			
Bell's twinpod	<i>Physaria bellii</i>	G2	S2		(C2)	
Pictureleaf wintergreen	<i>Pyrola picta</i>	G4G5	S2			
American currant	<i>Ribes americanum</i>	G5	S1			
Toothcup	<i>Rotala ramosior</i>	G5	S1?			
Pale blue-eyed grass	<i>Sisyrinchium pallidum richardsonii</i>	G2G3	S2		(C2)	
Carrion-flower	<i>Smilax lasioneura</i>	G5	S3S4			
Ute ladies' tresses	<i>Spiranthes diluvialis</i>	G2	S2		LT	
Prairie violet	<i>Viola pedatifida</i>	G5	S2			

Table 5. Rare and imperiled natural communities potentially occurring on Denver Water property

Scientific Name	Common Name	Global Rank	State Rank
<i>Andropogon gerardii- Schizachyrium scoparium</i>	Xeric tallgrass prairie	G2	S2
<i>Cercocarpus montanus/Stipa comata</i>	Foothills shrubland	G2	XX
<i>Danthonia parryi</i>	Montane grassland ³	G2	S2
<i>Muhlenbergia montana-Danthonia parryi</i>	Montane grassland	G3G4	S2?
<i>Picea pungens/ Alnus incana</i>	Montane riparian forests	G3	S3
<i>Pinus ponderosa / Leucopoa kingii</i>	Foothills ponderosa pine savannas	G2	S2
<i>Pinus ponderosa/Muhlenbergia montana</i>	Foothills Ponderosa pine_ savannas	G5	S2S3
<i>Pseudotsuga menziesii/ Jamsia americana</i>	Lower montane forests ¹	G3G4	S3
<i>Quercus gambelii Cercocarpus montanus/ Muhlenbergia montana</i>	Oak shrubland	GU	S?

3 Field survey phase.

Field surveys by CNHP scientists and technicians took place from August 1996 through November 1996. Substantial information was gained regarding the natural significance of the study area. Additional information was gathered from the field regarding natural condition of the habitats, land status, apparent threats, and recommended placement of conservation planning boundaries. Similar information was gathered at sites that did not reveal the presence of significant elements as well.

Survey sites were visited at the appropriate time as dictated by the phenology of the individual targeted elements. It is essential that surveys take place during a time when the targeted elements are detectable. For instance, breeding birds cannot be surveyed outside of the breeding season and plants are often not identifiable without flowers which are only present during certain seasons. Because field work did not begin until late in the season, it is possible that some rare or endangered plants or breeding birds potentially occurring in the study sites (but not included as high priority target elements) were not detectable. CNHP decided upon a strategy of targeting high priority elements with phenologies and life history traits that would predispose them to being identified using standard survey methodologies at the appropriate season.

Table 6. Elements targeted in CNHP ecological survey:

Scientific Name	Common Name	Global Rank	State Rank	State status	Federal Status	Federal Sensitive
<i>Zapus hudsonius preblei</i>	Preble's meadow jumping mouse ³	G5T2	S2		(C2)	
<i>Hesperia leonardus montana</i>	Pawnee montane skipper	G4T1	S1		LT	
<i>Pinus ponderosa/</i> <i>Muhlenbergia montana</i>	Foothills ponderosa pine Savannas	G5	S2S3			
<i>Gaura neomexicana coloradoensis</i>	Colorado butterfly plant	G4T4	S1	SC	(C2)	
<i>Sisyrinchium pallidum</i>	Pale blue-eyed grass	G2G3	S2			
<i>Spiranthes diluvialis</i>	Ute ladies' tresses	G2	S2		LT	

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

- Reptiles:** visual or with hook
- Mammals:** small mammals only, Sherman live traps or gopher traps
- Birds:** visual or by song/call, evidence of breeding sought
- Fish:** aquatic nets
- Insects:** aerial net
- Plants:** visual
- Natural communities :** visual, collect plot data including percent cover and composition

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

When a rare species or significant natural 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.

Table 7. Rare and imperiled elements known from Denver Water Board owned lands

Element	Common Name	Global Rank	State Rank	Federal Status	State Status	Federal Sens.	EO* Rank
<i>Hesperia leonardus montana</i>	Pawnee montane skipper	G4T1	S1	LT			A
<i>Pinus ponderosa/ Muhlenbergia montana</i>	Foothills ponderosa pine savannas	G5	S2S3				A B/C
<i>Pseudotsuga menziesii/ Carex rossii</i>	Lower montane woodlands	G5	S4				B/C
<i>Pseudotsuga menziesii / Jamesia americana</i>	Lower montane forests	G3G4	S3				B/C

*EO=Element Occurrence

4. Delineate preliminary conservation planning boundary.

Finally, since the objective for this inventory is to prioritize specific areas for conservation efforts, a preliminary conservation planning boundary was delineated. Such a boundary is an estimation of what area is to be considered in the persistence of the particular element occurrence. Primarily, in order to insure the preservation of an element occurrence, the ecological processes that support that occurrence must be preserved. The preliminary conservation planning boundary is meant to include features on the surrounding landscape that provide these functions. Data collected in the field are essential to delineating such a boundary, but other sources of information such as aerial photography are also used.

HIGH PRIORITY RARE AND IMPERILED ELEMENTS OF BIODIVERSITY TARGETED IN CNHP ECOLOGICAL INVENTORY AND FIELD SURVEYS.

Preble's meadow jumping mouse (*Zapus hudsonius preblei*)

Global rank: G5T2 **State rank:** S2 **Federal Status:** (C2) **State Status:** SC

Habitat: Riparian meadows with tall grass and shrubs component. Feeds on seeds and herbaceous material most of the year. May supplement diet with animal matter when emerging from hibernation. Distribution of the species is limited to a few island populations with characteristics of a wetland tall grass prairie. May be one of North America's rarest mammals (Fitzgerald, 1994). The species is known in Colorado on the basis of fewer than fifty specimens from Larimer, Weld, Boulder, Jefferson, Denver, Adams, and Arapahoe counties (Armstrong 1978)

OBJECTIVE

The objective of this study was to determine the presence or absence (more accurately a "no capture") of the Preble's meadow jumping mouse on preselected tracts of Denver Water Board Property.

METHODS

The surveys were conducted in accordance with the U.S. Fish and Wildlife Service's June 7, 1995 Interim Survey Guidelines for Preble's meadow jumping mouse. Each site was assessed as to the type of vegetation and condition or quality of the overall site as indicated by the habitat requirements of the Preble's meadow jumping mouse (as stated by the Interim Guidelines). Once the proper or adequate conditions were identified, a series of transects were plotted out and the traps were laid down.

Live trapping was conducted from July 23 - 27, 1996. Sherman live traps were used along the transects. Individual trap placement was spaced at regular intervals (approximately five meters apart), along the length of the seep or beneath the pipeline. Each transect consisted of two parallel traplines placed approximately 10 meters apart with 25 traps along each side of the transect. Each trap contained bedding material and a small amount of horse feed (Omalene) as bait. Each site was trapped with a minimum of two complete transects, 100 traps in total.

Due to the nocturnal behavior of the mouse, surveying efforts were restricted to the night. Traps were set in the early evening and checked at dawn. Traps remained closed during the day.

Traplines were run for four consecutive nights, or until a mouse was captured, whichever occurred first. The goal of the four night trapping effort was to either document a Preble's meadow jumping mouse or achieve a 50% unsuccessful trap level (Ryon 1995). This would document a "no capture" which may indicate their absence from that particular site. This meets the U.S. Fish and Wildlife Service Interim Survey Guidelines of 400 total trap nights, with 100 traps for four nights each.

In the event of a Preble's meadow jumping mouse capture, species, age class and trap location were recorded. After the data were recorded the animal was released. When a Preble's meadow jumping mouse was captured, measurements of the weight, total body length, tail length and hind foot length were taken, in addition to the previously listed criterion. Each Preble's was marked for recapture through the taking of an ear notch and a small tuft of hair from the dorsum. The tissue and hair samples were used for DNA research by the U.S. Fish and Wildlife Service. The sex and reproductive condition of the mouse were also noted.

Measurements and related information were collected only for the first capture of each individual (Corn et al. 1995). Several photos were taken of the mouse, its micro-habitat (where the actual trap was located) and the overall transect. The capture location was field marked with numbered flags in addition to flags on wires placed immediately surrounding the area. The terminal ends of the trapline were also kept intact to ensure the proper relocation of the original transects. The transect and exact capture location were then transferred to a USGS 7.5' topographic map.

RESULTS

After evaluating all of the sites selected by the Denver Water Board to be potential Preble's meadow jumping mouse habitat, only two of the sites qualified as having enough suitable habitat to be able to support a population. The sites were located at "Dowdy Draw" along either side of the pipeline, and at "Spring Brook" along a small seep (See Fig.??). One transect of fifty traps was set up at each of the locations. Transects were set for four consecutive nights totaling 400 trapnights for this site. Both transects produced a "no capture" for the Preble's meadow jumping mouse, indicating their absence from the area. A variety of other small mammal species were captured including: deer mice (*Peromyscus maniculatus*), prairie voles (*Microtus ochrogaster*), meadow voles (*Microtus pennsylvanicus*) and Mexican woodrats (*Neotoma mexicana*).

DISCUSSION

All of the sites were examined on foot as well as through the use of a video camera. The contents of the video tape were later reexamined by the director and chief scientist of the Colorado Natural Heritage Program, Chris Pague. After careful evaluation of all of the potential sites, only two of the

sites were surveyed for the Preble's meadow jumping mouse. This was due to several factors which eliminated the properties from being considered as suitable habitat. Some of these factors included; heavy recreational use, steepness of slopes, lack of riparian vegetation and/or water, and quality and size of the sites.

There could be many different factors contributing to the "no capture" results of the two sites surveyed. One possibility could be the lack of shrub and/or tree cover (especially the absence of willow) from either of the sites. Pertaining to the "Dowdy Draw" site, steepness of slopes and lack of a good riparian corridor were probably the biggest factors. The "Spring Brook" site, although very close in proximity to a recently known population of Preble's meadow jumping mice, most likely produced a "no capture" for a variety of reasons. In addition to the factors previously mentioned, lack of herbaceous diversity (most of the vegetation was comprised of *Carex. ssp.*), and the abundance of standing water throughout the site also contributed to the negative data.

Map 1. Preble's meadow jumping mouse transects on Denver Water's Lower Boulder County properties

Pawnee montane skipper (*Hesperia leonardus montana*)

Global rank: G4T1 **State rank:** S1 **Federal Status:** LT **State Status:**

Habitat: Restricted to the South Platte River Canyon drainage in Colorado. Roughly 23 mi. long and 5 mi. wide, the total habitat within its range is estimated to be 37.9 mi.² (ERT 1986). The butterfly's habitat is very open and dry ponderosa pine woodlands at 6,000 to 7,600 ft, with sparse vegetation and the presence of its exclusive larval food plant, *Boutaloua gracilis*, as well as the presence of a nectar source, preferably dotted gayfeather (*Liatris punctata*). Highest activity period is late August to early September.

The Pawnee montane skipper is very rare in pine woodlands with tall understory or where young dense conifers dominate the stand. Based on extensive occurrence data, the following are some general habitat characteristics: \cong 30% overstory tree crown canopy cover, with 25% ponderosa pine and 5% Douglas-fir. Tree density in the 0" to 5" DBH size class is less than 120 trees per acre, and overall tree density is less than 200 trees per acre. Shrub and grass cover is typically low and *Boutaloua gracilis* (Blue Grama) cover is 5% or less, but widely available. Slopes are gently undulating to steep and mostly sunny, with exposed granitic weathered soil.

Methods: It was the purpose of this survey to locate any population extension of the Pawnee montane skipper within Denver Water property surrounding Cheesman Lake. The preferred locales for this skipper are difficult to pinpoint using aerial photography or topographic maps due to the nature of woodland areas. A visual survey both with vehicle and on foot was conducted by a field zoologist during the flight time of this particular skipper (early-August through early-September).

Results: The Pawnee montane skipper was first observed on August 7, 1996. Subsequent observations took place on August 13, 21, 22, 26, 27, 30, and last observed on September 9. Peak flight time appeared to occur sometime around August 21, which coincided with the *liatris* bloom. All observations were in areas previously within the known occurrence range for this skipper. However, no range extension was located for this species at this time. The Pawnee montane skipper appeared to be extremely abundant during the 1996 field season (R.E. Stanford pers. obs.).

Utes lady tresses (*Spiranthes diluvialis*)

Global rank: G2S2 **State rank:** S2 **Federal Status:** LT **State Status:**

Habitat: Scattered populations are found in mesic meadows near riparian areas between 4,500 and 6,800 feet elevation. Does not do well in competition with dense vegetation. Threatened by modification of riparian habitat and grazing. The orchid may take many years to reach sexual maturity, and reproduction appears to be low. (US Forest Service Arapaho-Roosevelt Draft EIS 1996)

Methods: Visual survey of identified suitable habitat by a team of trained botanists. Surveys were conducted at Cherry Creek and Lower Boulder County sites.

Results: Both Cherry Creek and Lower Boulder County survey sites were found to be unsuitable habitat.

Front Range old-growth ponderosa pine natural communities (ex. *Pinus ponderosa*/*Muhlenbergia montana*) G3 S2S3

A comprehensive yet useful definition of old-growth ponderosa is the subject of lively academic debate, and currently there is no definition that satisfies everyone. This is largely because there is a whole suite of structural, compositional, and functional characteristics that come into play in considering the ecology of late successional forests (Kaufmann *et.al.* 1992). However, there are common themes that are generally agreed upon, which has resulted in several descriptions being developed, and refined (Mehl 1992, Lowry 1992).

One problem with using these descriptions to classify old-growth in the field is that they often rely on minimum criteria, such as a minimum size Diameter at Breast Height (DBH), or trees per acre. old-growth ponderosa pine can occur across a whole range of habitat types and physiogeographic conditions. Such minimum criteria would almost surely exclude an ecologically intact old-growth occurrence growing in an area with a poor site index (Robertson 1992, Robertson in press 1996). Data collected on age vs. DBH at the Cheesman site bares this point out dramatically. (fig.)

In order to accurately document the present condition of areas considered to be high quality old-growth at the Cheesman site, CNHP scientists developed a hybrid methodology borrowing extensively from the methodology used in the Arapaho-Roosevelt old-growth inventory, and that used by Dr. Phil Robertson in his state wide old-growth inventory (Lowry 1992, Robertson 1996 in press). The purpose of this effort was to be able to provide data that could be analyzed by scientists that might have differing approaches to the question of identifying old-growth, thereby removing any ambiguity in the classification.

In addition to standard Colorado Natural Heritage Program (CNHP) ecological inventory methodology, field work conducted by CNHP scientists at the Cheesman site involves quantitatively describing present conditions. 01 ha (17.84m.radius) plots were established within representative stands. Trees, saplings and regeneration were tallied by species and DBH size class, and overstory canopy closure was estimated. Increment cores were taken at DBH from three or four dominant trees in the plot, or just adjacent to the plot if unreadable cores were collected within the plot. Cores were analyzed to determine age and growth patterns. Understory composition and cover class were recorded in a 10.93m. radius nested plot. Environmental measurements such as slope, aspect, elevation, soil, and landform were noted. Photo

documentation of the site, form and architecture of dominant cored trees, and other features such as evidence of fire or disturbance was also made.

Data is summarized and presented in Appendix A. Further information is presented in the Cheesman Lake Conservation Site Summary

Map 6 Cheesman Lake old-growth ponderosa pine plot locations and Pawnee montane skipper concentrations.

REFERENCES

- Alexander, R.A. 1987. Classification of the forest vegetation of Colorado by habitat type and community type. USDA Forest Service Rocky Mountain Forest and Range Expt. Stat. Res. Note RM-478
- Armstrong, D.A. 1972. Distribution of Mammals in Colorado. Monograph of the Museum of Natural History, University of Kansas. No. 3. 415 pp.
- Biswell, H.H. et. al. 1973. Ponderosa pine management: a taskforce evaluation of controlled burning in ponderosa pine forests of central Arizona. Misc. Publ. No. 2. (Tall Timbers Research Station).
- Bratton, S.P. 1982. The effects of exotic plant and animal species on nature preserves. *Natural Areas Journal* 2:3-13.
- Chronic, H. 1980. *Roadside Geology of Colorado*. Mountain Press, Missoula, Montana.
- Colorado Natural Heritage Program (CNHP). 1996. Biological and Conservation Data (BCD) System. Data from field surveys. CNHP, Fort Collins Colorado.
- Compton, S.A., and R.R. Hugie. 1993. Status report on *Zapus hudsonius preblei*, a candidate endangered subspecies. Status report prepared by Pioneer Environmental Consulting Services Inc., Logan, UT. Under contract to the U. S. Fish and Wildlife Service. 31 pp.
- Cooper, C.F. 1960. Changes in vegetation, structure, and growth of southwest ponderosa pine forest since white settlement. *Ecological Monographs*. 30 (1): pp. 129-164
- Corn, J.G., C. Pague, A. Ellingson, M. Sherman, T. Zwiejacz, G. Kittel, and C. Fleming. 1995. Final report on the geographic extent of the Preble's meadow jumping mouse population on the United States Air Force Academy. 33 pp.
- Covington, W.W. and M.M. Moore. 1992. Postsettlement changes in natural fire regimes: implications for restoration of old-growth ponderosa pine forests. In Kaufmann et. al. 1992
- Covington, W. and Pamela Wagner eds. 1996. Conference on Adaptive Ecosystem Restoration and Management: Restoration of Cordilleran Conifer Landscapes in North America. Gen. Tech. Rep. RM-GTR-278. Fort Collins CO: USDA, Forest Service, RMFR exp. 91 p.
- DeLoach, C.J. 1991. Past successes and current prospects in biological control of weeds in the United States and Canada. *Natural Areas Journal* 11:129-142.

- ERT (Resource Engineering Company) 1986, 1988. Pawnee Montane Skipper results from 1986 and 1988 field study, prepared for Denver Water Dept. Denver CO.
- Fiedler, C.E. Stephens Arno, and Michael Harrington. 1995. Flexible Silvicultural and Prescribed Burning Approaches for Improving Health of Ponderosa Pine Forests. pp 69-74 In Covington and Wagner eds. 1995
- Fitzgerald, J.P., C.A. Meaney, and D.A. Armstrong. 1994. Mammals of Colorado. Colorado Associated University Press, Boulder, CO. 467 pp.
- Fleischner, Thomas L. 1994. Ecological costs of livestock grazing in western North America. *Conservation Biology* 8:629-644.
- Garber, C.S. 1995. A status survey for Preble's jumping mouse (*Zapus hudsonius preblei*), in southeastern Wyoming, including the F. E. Warren Air Force Base. 22 pp.
- Harrington, M.G and S.S. Sackett. 1992. Past and present fire influences on Southwestern Ponderosa Pine Old Growth. pp 44-50, *In*: Kaufmann, M.R., W.H. Moir and R.L. Bassett, (Tech. Coord.), old-growth forests in the Southwest and Rocky Mountain Regions, [Workshop Proceedings], USDA Forest Service Gen. Tech. Rpt. RM-13
- Harty, F.M. 1986. Exotics and their ecological ramifications. *Natural Areas Journal* 6:20-26.
- Hess, K., and R.A. Alexander. 1986. Forest vegetation of the Arapaho and Roosevelt National Forest in central Colorado: a habitat type classification. USDA Forest Service Rocky Mtn. Forest and Range Expt. Stat. Res. Pap. RM-266
- Hester, F.E. 1991. The U.S. National Park Service experience with exotic species. *Natural Areas Journal* 11: 127-128.
- Johnson, A.S. 1989. The thin green line: Riparian corridors and endangered species in Arizona and New Mexico. Pp. 35-46 in G. Mackintosh, ed. *In defense of wildlife: Preserving communities and corridors*. Defenders of Wildlife, Washington, D.C.
- Johnson, Barry C. 1987. Plant associations of Region Two. USDA Forest Service, Rocky Mountain Region. R2-ECOL-87-2.
- Kaufmann, M.R., W.H. Moir and R.L. Bassett, (Tech. Coord.), old-growth forests in the Southwest and Rocky Mountain Regions, [Workshop Proceedings], USDA Forest Service Gen. Tech. Rpt. RM-13
- Kaufmann, M.R., W.H. Moir, and W.W. Covington. 1992. old-growth forests: What do we know about their ecology and management in the Southwest and Rocky Mountain Regions? Pp. 1-11. *In*: Kaufmann, M.R., W.H. Moir and R.L. Bassett, (Tech. Coord.), old-growth forests in the Southwest and Rocky Mountain Regions, [Workshop Proceedings], USDA Forest Service Gen. Tech. Rpt. RM-13

- Knight, R.L., and K.G. Gutzwiller, eds. 1995. Wildlife and recreationists: coexistences through management and research. Island Press, Covelo, California.
- Lowry, D. 1992. An old-growth forest inventory procedure for the Arapaho and Roosevelt National Forests, Colorado. *In*: Kaufmann, M.R., W.H. Moir and R.L. Bassett, (Tech. Coord.), old-growth forests in the Southwest and Rocky Mountain Regions, [Workshop Proceedings], USDA Forest Service Gen. Tech. Rpt. RM-13
- Mehl, M.S. 1992. old-growth descriptions for the major forest cover types in the Rocky Mountain Region. Pp. 106-120, *In*: Kaufmann, M.R., W.H. Moir and R.L. Bassett, (Tech. Coord.), old-growth forests in the Southwest and Rocky Mountain Regions, [Workshop Proceedings], USDA Forest Service Gen. Tech. Rpt. RM-13
- Moir, W. 1992. Ecological concepts in old-growth forest definition. Pp. 18-23. *In*: Kaufmann, M.R., W.H. Moir and R.L. Bassett, (Tech. Coord.), old-growth forests in the Southwest and Rocky Mountain Regions, [Workshop Proceedings], USDA Forest Service Gen. Tech. Rpt. RM-13
- Moore, D.R.J. and P.A. Keddy. 1988. Conservation of infertile wetlands: priorities and management. Pp. 391-397 in M.J. Bardecki and N. Patterson, eds. Wetlands: inertia or momentum. Proceedings of conference, October 21-22, 1988, Ryerson Polytechnical Institute, Toronto, Canada.
- Mutel, C.F. and J.C. Emerick. 1992. Grassland to Glacier. Johnson printing, Boulder CO.
- Noss and Cooperrider 1994. Saving nature's legacy - Protecting and restoring biodiversity. Island Press, Washington D.C.
- Primack, R. B. 1993. Essentials of Conservation Biology. Sinauer Assoc., Inc. 564 pp.
- Quimby, D.C. 1951. The life history and ecology of the jumping mouse, *Zapus hudsonius*. Ecological Monographs 21:61-95.
- Robertson, P.A. old-growth *Pinus ponderosa* in Colorado: A revised definition. *Draft* Personal communication.
- Robertson, P.A. 1992. Characteristics of spruce-fir and lodgepole pine old-growth stands in the Arapaho-Roosevelt National Forest, Colorado. Pp 128-134. *In*: Kaufmann, M.R., W.H. Moir and R.L. Bassett, (Tech. Coord.), old-growth forests in the Southwest and Rocky Mountain Regions, [Workshop Proceedings], USDA Forest Service Gen. Tech. Rpt. RM-13
- Ryon, T.R. 1995. Evaluation of the Preble's meadow jumping mouse historical capture sites. A habitat comparison to the Rocky Flats Buffer zone. 7pp.

- Sackett, Stephen, S.M. Haase, and Michael G. Harrington. 1995. Lessons Learned from Fire Use For Restoring southwestern ponderosa pine ecosystems. Pp 54-61 in Covington and Wagner eds. 1995.
- Schonewald-Cox, C., and M. Beuchner. 1993. park protection and public roads. Pp. 373-395 in P.L. Fiedler and S.K.Jain, eds. Conservation biology. Chapman and Hall, New York.
- Schubert, G.H. 1974. Silviculture of southwestern ponderosa pine forests. The status of our knowledge. Res. Paper RM-123. Fort Collins CO. USDA, Forest Service, RMFRExp station. 71 p.
- Soule, M. 1990. The onslaught of alien species and other challenges in the coming decades. Conservation Biology 4(3):233-239.
- U.S. Fish and Wildlife Service. 1995. Interim survey guidelines for Preble's meadow jumping mouse. Ecological Services, Colorado Field Office, Golden, CO. 14pp.
- US Forest Service. 1996. Draft- Front Range Forest Health Assessment.
- USDA Soil Conservation Service. (1975). Soil survey of Boulder County area Colorado.
- USDA Forest Service and Soil Conservation Service. (1992). Soil survey of Pike National Forest, eastern part, Colorado.
- USDA Forest Service. 1996. Draft Environmental Impact Statement for the Arapaho and Roosevelt National Forest and Pawnee National Grassland land and resource management plan.
- Veblen, Thomas. 1991. The Colorado Front Range : a century of ecological change. Univ. of Utah press. 186 p.
- Weber, W.A. 1976. Rocky Mountain Flora. Colorado Associated University Press. Boulder, Colorado. 479 pp.
- White, D.J., E. Haber and C. Keddy. 1993. Invasive Plants of Natural Habitats in Canada. Canadian Wildlife Service, Environment Canada, Ottawa, Ontario.
- Wilcove, D.S., C.H. McLellan, and A.P. Dobson. 1986. Habitat fragmentation in the temperate zone. Pp. 273-256 in M.E. Soule, ed. Conservation biology. The science of scarcity and diversity. Sinauer Associates, Sunderland, Massachusetts.
- Wilson, E. O. 1988. Biodiversity. National Academy Press, Washington, D.C.

FIELD FORM EXAMPLES

APPENDIX 1. CONTACTS FOR MORE INFORMATION