Botanical Survey of Strawberry Lake, Arapaho National Forest, Grand County, Colorado

Colorado Natural Heritage Program
College of Natural Resources, 8002 Campus Delivery
Colorado State University
Fort Collins, Colorado 80523-8002

Natural Heritage Program COLORADO

Colorado State University
Knowledge to Go Places

Botanical Survey of Strawberry Lake, Arapaho National Forest, Grand County, Colorado

Prepared for:

U.S. Forest Service
Arapaho-Roosevelt National Forests and Pawnee National Grassland, Supervisor's Office
240 West Prospect
Fort Collins, CO 80526

Prepared by:
Joe Rocchio and Joe Stevens
January 21, 2004

Colorado Natural Heritage Program (CNHP)
College of Natural Resources
8002 Campus Delivery
Colorado State University
Fort Collins, Colorado 80523-8002

Cover photograph: Floating mat dominated by *Carex lasiocarpa* with an understory of *Sphagnum* spp., *Comarum palustris, Drosera rotundifolia*, *Carex interior*, *Carex buxbaumii*, and *Carex magellanica*.

Photo taken by: Joe Rocchio

Prepared under U.S. Forest Service check-writing authority (<$2500) FY03; job code TRTR11.

Table of Contents

List of Tables

List of Figures

Introduction

The Strawberry Lake analysis area is located in Grand County, approximately 10 miles east of the Town of Granby and within the Arapaho National Recreation Area (Figure 1). The site consists of a series of kettle ponds within an extensive wetland complex.

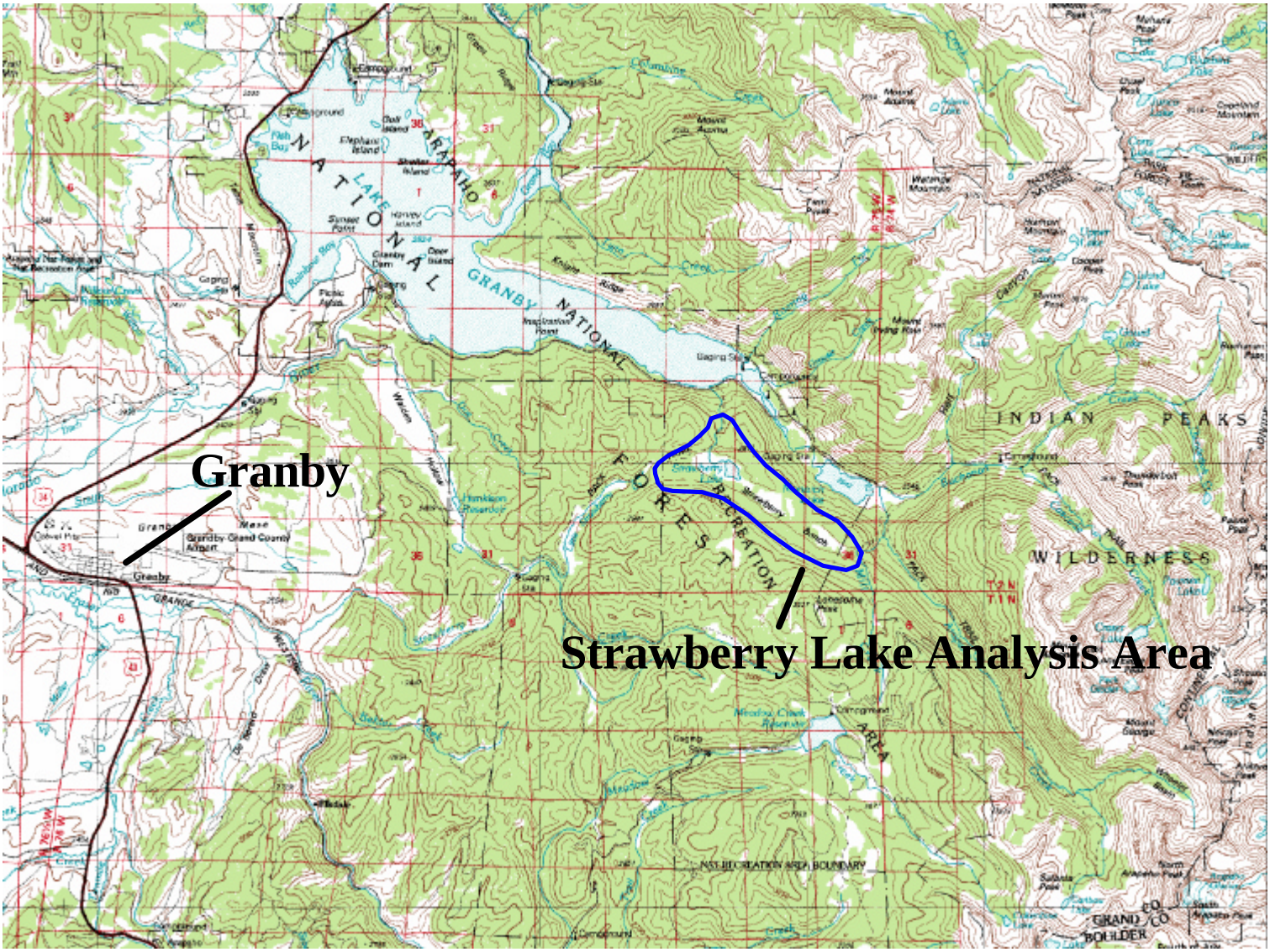
The Strawberry Lake fen system was first cursorily assessed by the Forest Service for rare plants and plant communities in July, 2002, by several Forest Service staff, including Steve Popovich, the Forest Botanist (Joe Stevens personal communication with Steve Popovich, August, 2002). They recorded the presence of the sundew, marsh cinquefoil, Buxbaum's sedge, and great bladderwort, the species at the time of visit they thought were most notable. They also noticed a variety of potentially uncommon sedge species, as well as the floating *Sphagnum* moss mats, and the presence of a fen system and related sedge areas and tufted hairgrass meadows. They recognized the need to more formally and thoroughly assess the area for botanical resources. They also noticed that the lake level was several feet below normal, and that the small pond near the southeast edge of the lake was rapidly drying. The areas supporting the sundew were wet and soggy, but dryer than normal. The visit marked the first documentation known to the Forest Service and CNHP of the area's noteworthy vegetation.

The U.S. Forest Service recently acquired the Strawberry Lake analysis area. In response to recently proposed activities in the analysis area, the Colorado Natural Heritage Program (CNHP) was contracted to conduct the following:

1. Conduct a botanical inventory of the Strawberry Lake analysis area;
2. Discuss importance of the fen;
3. Data interpretation and results overview; and
4. Management recommendations.

This report summarizes results (species lists and site characterization) from both 2002 and 2003 site visits. The survey focused on identifying and recording the plant species encountered and characterizing the site conditions and ecological processes. Another site visit will be made during late spring/early summer of 2004.

Figure 1. Strawberry Lake Analysis Area Location



Projection: UTM, Zone13, NAD27

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

map created 06 January 2004

Disclaimer

The data contained herein are provided on an as-is, as-available basis without warranties of any kind, expressed or implied, including (but not limited to) warranties of merchantability, fitness for a particular purpose, and non-infringement. CNHP, Colorado State University and the State of Colorado further expressly disclaim any warranty that the data are error-free or current as of the date supplied.

LEGEND

Strawberry Lake Analysis Area

USGS 7.5 Minute Series OR 30 x 60 Series Quadrangles*
Strawberry Lake, 4010517
Monarch Lake, 4010516

*Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

Natural Heritage Methodology

Just as ancient artifacts and historic buildings represent our cultural heritage, a diversity of plant and animal species and their habitats represent our "natural heritage." Colorado's natural heritage encompasses a wide variety of ecosystems from tallgrass prairie and shortgrass high plains to alpine cirques and rugged peaks, from canyon lands and sagebrush deserts to dense subalpine spruce-fir forests and wide-open tundra.

These widely diversified habitats are determined by water availability, temperature extremes, altitude, geologic history, and land use history. The species that inhabit each of these ecosystems have adapted to the specific set of conditions found there. Because human influence today touches every part of the Colorado environment, we are responsible for understanding our impacts and carefully planning our actions to ensure our natural heritage persists for future generations.

Some generalist species, like house finches, have flourished over the last century, having adapted to habitats altered by humans. However, many other species are specialized to survive in vulnerable Colorado habitats; among them are Bell's twinpod (a wildflower), the Arkansas darter (a fish), and the Pawnee montane skipper (a butterfly). These species have special requirements for survival that may be threatened by incompatible land management practices and competition from non-native species. Many of these species have become imperiled not only in Colorado, but also throughout their range of distribution. Some species exist in less than five populations in the entire world. The decline of these specialized species often indicates disruptions that could permanently alter entire ecosystems. Thus, recognition and protection of rare and imperiled species is crucial to preserving Colorado's diverse natural heritage.

Colorado is inhabited by some 800 vertebrate species and subspecies, and tens of thousands of invertebrate species. In addition, the state has approximately 4,300 species of plants and more than 450 recognized plant associations that represent upland and wetland ecosystems. It is this rich natural heritage that has provided the basis for Colorado's diverse economy. Some components of this heritage have always been rare, while others have become imperiled with human-induced changes in the landscape. This decline in biological diversity 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 biological diversity has been recognized for decades in the scientific community. However, many conservation efforts made in this country were not based upon preserving biological diversity; instead, they primarily focused on preserving game animals, striking scenery, and locally favorite open spaces. To address the absence of a methodical, scientifically based approach to preserving biological diversity Dr. Robert Jenkins of The Nature Conservancy pioneered the Natural Heritage Methodology in the early 1970s.

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

The Natural Heritage Methodology is used by Natural Heritage Programs throughout North, Central, and South America, forming an international database network. The 85 Natural Heritage Network data centers are located in each of the 50 U.S. states, five provinces of Canada, and 13 countries in South and Central America and the Caribbean. This network enables scientists to monitor the status of species from a state, national, and global perspective. Information collected by the Natural Heritage Programs can provide a means to protect species before the need for legal endangerment status arises. It can also enable conservationists and natural resource managers to make informed, objective decisions in prioritizing and focusing conservation efforts.

What is Biological Diversity

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

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

Genetic Diversity — the genetic variation within a population and among populations of a plant or animal species. The genetic makeup of a species varies between populations within its geographic range. Loss of a population results in a loss of genetic diversity for that species and a reduction of total biological diversity for the region. Once lost, this unique genetic information cannot be reclaimed.

Species Diversity — the total number and abundance of plant and animal species and subspecies in an area.

Community Diversity — the variety of plant associations or associations within an area that represent the range of species relationships and inter-dependence. These associations may be diagnostic or even restricted to an area. Although the terms plant association and community have been described by numerous ecologists, no general consensus of their meaning has developed. The terms are similar, somewhat overlapping, and are often used more or less interchangeably. The U.S. National Vegetation Classification (USNVC) (Anderson et al. 1998), the accepted national standard for vegetation, defines a community as an "assemblage of species that co-occur in defined areas at certain times and that have the potential to interact with one another" (The Nature Conservancy 1999), and a plant association as a type of plant community with "definite floristic composition, uniform habitat conditions, and uniform physiognomy" (Flahault and Schroter 1910). The term plant "association" is hereafter used in lieu of "community" except when referring to a broader definition of community (e.g. natural community). Identifying and protecting representative examples of plant associations ensures conservation of multiple number of species, biotic interactions, and ecological process. Using associations as a "coarse-filter" enables conservation efforts to work toward protecting a more complete spectrum of biological diversity.

Landscape Diversity — the type, condition, pattern, and connectedness of natural communities. A landscape consisting of a mosaic of natural communities may contain one multifaceted ecosystem, such as a wetland ecosystem. A landscape also may contain several distinct ecosystems, such as a riparian corridor meandering through shortgrass prairie. Fragmentation of landscapes, loss of connections and migratory corridors, and loss of natural communities all result in a loss of biological diversity for a region. Humans and the results of their activities are integral parts of most landscapes.

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

Colorado Natural Heritage Program (CNHP)

CNHP is the state's primary comprehensive biological diversity data center, gathering information and field observations to help develop statewide conservation priorities. After operating in the Colorado Division of Parks and Outdoor Recreation for 14 years, the Program was relocated to the University of Colorado Museum in 1992, and then to the College of Natural Resources at Colorado State University in 1994, where it has operated since.

The multi-disciplinary team of scientists, planners, and information managers at CNHP gathers comprehensive information on the rare, threatened, and endangered species and significant plant associations of Colorado. Life history, status, and locational data are

incorporated into a continually updated data system. Sources include published and unpublished literature, museum and herbaria labels, and field surveys conducted by knowledgeable naturalists, experts, agency personnel, and our own staff of botanists, ecologists, and zoologists.

The Biological and Conservation Data System (BCD) was the original database developed by The Nature Conservancy to be used by all Natural Heritage Programs to house data about imperiled species. The database includes taxonomic group, global and state rarity rank, federal and state legal status, observation source, observation date, county, township, range, watershed, and other relevant facts and observations. Recently, NatureServe, the parent organization to all Heritage programs, has updated BCD utilizing current technology and database capabilities. The new database, BIOTICS (Biodiversity Tracking and Conservation System), is currently being implemented throughout the Natural Heritage Network. The Colorado Natural Heritage Program began using BIOTICS for digitizing and mapping occurrences of rare plants, animals, and plant associations and tracking their distribution and life history information. These rare species and plant associations are referred to as "elements of natural diversity" or simply "elements."

Concentrating on site-specific data for each element enables CNHP to evaluate the significance of each location for the conservation of biological diversity in Colorado and in the nation. By using species imperilment ranks and quality ratings for each location, priorities can be established to guide conservation action. A continually updated locational database and priority-setting system such as that maintained by CNHP provides an effective, proactive land-planning tool.

To assist in biological diversity conservation efforts, CNHP scientists strive to answer questions like the following:

- What species and ecological associations exist in the area of interest?
- Which are at greatest risk of extinction or are otherwise significant from a conservation perspective?
- What are their biological and ecological characteristics, and where are these priority species or associations found?
- What is the species' condition at these locations, and what processes or activities are sustaining or threatening them?
- Where are the most important sites to protect?
- Who owns or manages those places deemed most important to protect, and what is threatening those places?

- What actions are needed for the protection of those sites and the significant elements of biological diversity they contain?

- How can we measure our progress toward conservation goals?

CNHP has effective working relationships with several state and federal agencies, including the Colorado Department of Natural Resources, the Colorado Division of Wildlife, the Bureau of Land Management, and the U.S. Forest Service. Numerous local governments and private entities, such as consulting firms, educators, landowners, county commissioners, and non-profit organizations, also work closely with CNHP. Use of the data by many different individuals and organizations encourages a cooperative and proactive approach to conservation, thereby reducing the potential for conflict.

The Natural Heritage Ranking System

Key to the functioning of Natural Heritage Programs is the concept of setting priorities for gathering information and conducting inventories. The number of possible facts and observations that can be gathered about the natural world is essentially limitless. The financial and human resources available to gather such information are not. Because biological inventories tend to be under-funded, there is a premium on devising systems that are both effective in providing information that meets users' needs and efficient in gathering that information. The cornerstone of Natural Heritage inventories is the use of a ranking system to achieve these twin objectives of effectiveness and efficiency.

Ranking species and ecological assocations according to their imperilment status provides guidance for where Natural Heritage Programs should focus their information-gathering activities. For species deemed secure, only general information needs to be maintained by Natural Heritage Programs. Fortunately, the more common and secure species constitute the majority of most groups of organisms. On the other hand, for those species that are by their nature rare, more detailed information is needed. Because of these species' rarity, gathering comprehensive and detailed population data can be less daunting than gathering similarly comprehensive information on more abundant species.

To determine the status of species within Colorado, CNHP gathers information on plants, animals, and plant associations. Each of these elements of natural diversity is assigned a rank that indicates its relative degree of imperilment on a five-point scale (for example, 1 = extremely rare/imperiled, 5 = abundant/secure). The primary criterion for ranking elements is the number of occurrences (in other words, the number of known distinct localities or populations). This factor is weighted more heavily than other factors because an element found in one place is more imperiled than something found in twenty-one places. Also of importance are the size of the geographic range, the number of individuals, the trends in both population and distribution, identifiable threats, and the number of protected occurrences.

Element imperilment ranks are assigned both in terms of the element's degree of imperilment within Colorado (its State-rank or S-rank) and the element's imperilment

over its entire range (its Global-rank or G-rank). Taken together, these two ranks indicate the degree of imperilment of an element. For example, the lynx, which is thought to be secure in northern North America but is known from less than five current locations in Colorado, is ranked G5 S1 (globally-secure, but critically imperiled in this state). The Rocky Mountain Columbine, which is known only in Colorado from about 30 locations, is ranked a G3 S3 (vulnerable both in the state and globally, since it only occurs in Colorado and then in small numbers). Further, a tiger beetle that is only known from one location in the world at the Great Sand Dunes National Monument is ranked G1 S1 (critically imperiled both in the state and globally, because it exists in a single location). CNHP actively collects, maps, and electronically processes specific occurrence information for animal and plant species considered extremely imperiled to vulnerable in the state (S1 - S3). Several factors, such as rarity, evolutionary distinctiveness, and endemism (specificity of habitat requirements), contribute to the conservation priority of each species. Certain species are "watchlisted," meaning that specific occurrence data are collected and periodically analyzed to determine whether more active tracking is warranted. A complete description of each of the Natural Heritage ranks is provided in Table 3.

This single rank system works readily for all species except those that are migratory. Those animals that migrate may spend only a portion of their life cycles within the state. In these cases, it is necessary to distinguish between breeding, non-breeding, and resident species. As noted in Table 3, ranks followed by a "B," for example S1B, indicate that the rank applies only to the status of breeding occurrences. Similarly, ranks followed by an "N," for example S4N, refer to non-breeding status, typically during migration and winter. Elements without this notation are believed to be year-round residents within the state.

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

Table 1. Definition of Natural Heritage Imperilment Ranks.

G/S1	Critically imperiled globally/state because of rarity (5 or fewer occurrences in the world/state; or 1,000 or fewer individuals), or because some factor of its biology makes it especially vulnerable to extinction.
G/S2	Imperiled globally/state because of rarity (6 to 20 occurrences, or 1,000 to 3,000 individuals), or because other factors demonstrably make it very vulnerable to extinction throughout its range.
G/S3	Vulnerable through its range or found locally in a restricted range (21 to 100 occurrences, or 3,000 to 10,000 individuals).
G/S4	Apparently secure globally/state, though it may be quite rare in parts of its range, especially at the periphery. Usually more than 100 occurrences and 10,000 individuals.
G/S5	Demonstrably secure globally/state, though it may be quite rare in parts of its range,

	especially at the periphery.
G/SX	Presumed extinct globally, or extirpated within the state.
G#?	Indicates uncertainty about an assigned global rank.
G/SU	Unable to assign rank due to lack of available information.
GQ	Indicates uncertainty about taxonomic status.
G/SH	Historically known, but usually not verified for an extended period of time.
G#T#	Trinomial rank (T) is used for subspecies or varieties. These taxa are ranked on the same criteria as G1-G5.
S#B	Refers to the breeding season imperilment of elements that are not residents.
S#N	Refers to the non-breeding season imperilment of elements that are not permanent residents. Where no consistent location can be discerned for migrants or non-breeding populations, a rank of SZN is used.
SZ	Migrant whose occurrences are too irregular, transitory, and/or dispersed to be reliably identified, mapped, and protected.
SA	Accidental in the state.
SR	Reported to occur in the state but unverified.
S?	Unranked. Some evidence that species may be imperiled, but awaiting formal rarity ranking.

Note: Where two numbers appear in a state or global rank (for example, S2S3), the actual rank of the element is uncertain, but falls within the stated range.

Legal Designations for Rare Species

Natural Heritage imperilment ranks should not be interpreted as legal designations. Although most species protected under state or federal endangered species laws are extremely rare, not all rare species receive legal protection. Legal status is designated by either the U.S. Fish and Wildlife Service under the Endangered Species Act or by the Colorado Division of Wildlife under Colorado Statutes 33-2-105 Article 2. In addition, the U.S. Forest Service recognizes some species as “Sensitive,” as does the Bureau of Land Management. Table 4 defines the special status assigned by these agencies and provides a key to abbreviations used by CNHP.

Candidate species for listing as endangered or threatened under the Endangered Species Act are indicated with a “C." While obsolete federal legal status (C1 and C2) are no longer used, CNHP continues to maintain them in its Biological and Conservation Data system for reference.

Table 2. Federal and State Agency Special Designations for Rare Species.

Federal Status:	
1. U.S. Fish and Wildlife Service (58 Federal Register 51147, 1993) and (61 Federal Register 7598, 1996)	
LE	Listed Endangered: defined as a species, subspecies, or variety in danger of extinction throughout all or a significant portion of its range.
E (S/A)	Endangered: treated as endangered due to similarity of appearance with listed species.
LT	Listed Threatened: defined as a species, subspecies, or variety likely to become endangered in the foreseeable future throughout all or a significant portion of its range.
P	Proposed: taxa formally proposed for listing as Endangered or Threatened (a proposal has been published in the Federal Register, but not a final rule).
C	Candidate: taxa for which substantial biological information exists on file to support proposals to list them as endangered or threatened, but no proposal has been published yet in the Federal Register.
2. U.S. Forest Service (Forest Service Manual 2670.5) (noted by the Forest Service as "S")	
FS	Sensitive: those plant and animal species identified by the Regional Forester for which population viability is a concern as evidenced by: Significant current or predicted downward trends in population numbers or density. Significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution.
3. Bureau of Land Management (BLM Manual 6840.06D) (noted by BLM as "S")	
BLM	Sensitive: those species found on public lands designated by a State Director that could easily become endangered or extinct in a state. The protection provided for sensitive species is the same as that provided for C (candidate) species.
4. State Status:	
The Colorado Division of Wildlife has developed categories of imperilment for non-game species (refer to the Colorado Division of Wildlife's Chapter 10 – Nongame Wildlife of the Wildlife Commission's regulations). The categories being used and the associated CNHP codes are provided below.	
E	Endangered: those species or subspecies of native wildlife whose prospects for survival or recruitment within this state are in jeopardy, as determined by the Commission.
T	Threatened: those species or subspecies of native wildlife which, as determined by the Commission, are not in immediate jeopardy of extinction but are vulnerable because they exist in such small numbers, are so extremely restricted in their range, or are experiencing such low recruitment or survival that they may become extinct.
SC	Special Concern: those species or subspecies of native wildlife that have been removed from the state threatened or endangered list within the last five years; are proposed for federal listing (or are a federal listing "candidate species") and are not already state listed; have experienced, based on the best available data, a downward trend in numbers or distribution lasting at least five years that may lead to an endangered or threatened status; or are otherwise determined to be vulnerable in Colorado.

Element Occurrences and their Ranking

Actual locations of elements, whether they are single organisms, populations, or plant associations, are referred to as element occurrences. The element occurrence is considered the most fundamental unit of conservation interest and is at the heart of the Natural Heritage Methodology. To prioritize element occurrences for a given species, an element occurrence rank (EO-Rank) is assigned according to the ecological quality of the

occurrences whenever sufficient information is available. This ranking system is designed to indicate which occurrences are the healthiest and ecologically the most viable, thus focusing conservation efforts where they will be most successful. The EO-Rank is based on three factors:

Size – a measure of the area or abundance of the element's occurrence, relative to other known, and/or presumed viable, examples. Takes into account factors such as area of occupancy, population abundance, population density, population fluctuation, and minimum dynamic area (which is the area needed to ensure survival or re-establishment of an element after natural disturbance).

Condition/Quality – an integrated measure of the composition, structure, and biotic interactions that characterize the occurrence. This includes factors such as reproduction, age structure, biological composition (such as the presence of non-native versus native species), structure (for example, canopy, understory, and ground cover in a forest community), and biotic interactions (such as levels of competition, predation, and disease).

Landscape Context – an integrated measure of two factors: the dominant environmental regimes and processes that establish and maintain the element, and connectivity. Dominant environmental regimes and processes include herbivory, hydrologic and water chemistry regimes (surface and groundwater), geomorphic processes, climatic regimes (temperature and precipitation), fire regimes, and many kinds of natural disturbances. Connectivity includes such factors as a species having access to habitats and resources needed for life cycle completion, fragmentation of ecological associations and systems, and the ability of the species to respond to environmental change through dispersal, migration, or re-colonization.

Each of these factors is rated on a scale of A through D, with A representing an excellent grade and D representing a poor grade. These grades are then averaged to determine an appropriate EO-Rank for the occurrence. If not enough information is available to rank an element occurrence, an EO-Rank of E is assigned. EO-Ranks and their definitions are summarized in Table 5.

Table 3. Element Occurrence Ranks and their Definitions.

A	Excellent viability.
B	Good viability
C	Fair viability.
D	Poor viability.
H	Historic: known from historical record, but not verified for an extended period of time.
X	Extirpated (extinct within the state).
E	Extant: the occurrence does exist but not enough information is available to rank.
F	Failed to find: the occurrence could not be relocated.

Potential Conservation Areas and Their Ranking

In order to successfully protect populations or occurrences, it is helpful to delineate Potential Conservation Areas (PCAs). These PCAs focus on capturing the ecological

processes that are necessary to support the continued existence of a particular element occurrence of natural heritage significance. Potential Conservation Areas may include a single occurrence of a rare element, or a suite of rare element occurrences or significant features.

The goal of the PCA process is to identify a land area that can provide the habitat and ecological processes upon which a particular element occurrence, or suite of element occurrences, depends for its continued existence. The best available knowledge about each species' life history is used in conjunction with information about topographic, geomorphic, hydrologic features, vegetative cover; and current and potential land uses. In developing the boundaries of a Potential Conservation Area, CNHP scientists consider a number of factors that include, but are not limited to:

- ecological processes necessary to maintain or improve existing conditions;
- species movement and migration corridors;
- maintenance of surface water quality within the PCA and the surrounding watershed;
- maintenance of the hydrologic integrity of the groundwater;
- land intended to buffer the PCA against future changes in the use of surrounding lands;
- exclusion or control of invasive non-native species;
- land necessary for management or monitoring activities.

The boundaries presented are meant to be used for conservation planning purposes and have no legal status. The proposed boundary does not automatically recommend exclusion of all activity. Rather, the boundaries designate ecologically significant areas in which land managers may wish to consider how specific activities or land use changes within or near the PCA affect the natural heritage resources and sensitive species on which the PCA is based. Please note that these boundaries are based on our best estimate of the primary area supporting the long-term survival of targeted species and plant associations. A thorough analysis of the human context and potential stresses has not been conducted. However, CNHP's conservation planning staff is available to assist with these types of analyses where conservation priority and local interest warrant additional research.

Off-Site Considerations

Frequently, all necessary ecological processes cannot be contained within a site of reasonable size. For example, taken to the extreme, the threat of ozone depletion could expand every site to include the entire planet. The boundaries described in this report indicate the immediate, and therefore most important, area to be considered for protection. Continued landscape level conservation efforts are necessary as well, which will involve regional efforts in addition to coordination and cooperation with private landowners, neighboring land planners, and state and federal agencies.

Ranking of Potential Conservation Areas

CNHP uses element and element occurrence ranks to assess the overall biological diversity significance of a PCA, which may include one or many element occurrences. Based on these ranks, each PCA is assigned a biological diversity rank (or B-rank). See Table 6 for a summary of these B-ranks.

Table 4. Natural Heritage Program Biological Diversity Ranks and their Definitions.

B1	Outstanding Significance (indispensable): Only known occurrence of an element A-ranked occurrence of a G1 element (or at least C-ranked if best available occurrence) Concentration of A- or B-ranked occurrences of G1 or G2 elements (four or more)
B2	Very High Significance: B- or C-ranked occurrence of a G1 element A- or B-ranked occurrence of a G2 element One of the most outstanding (for example, among the five best) occurrences rangewide (at least A- or B-ranked) of a G3 element. Concentration of A- or B-ranked G3 elements (four or more) Concentration of C-ranked G2 elements (four or more)
B3	High Significance: C-ranked occurrence of a G2 element A- or B-ranked occurrence of a G3 element D-ranked occurrence of a G1 element (if best available occurrence) Up to five of the best occurrences of a G4 or G5 community (at least A- or B-ranked) in an ecoregion (requires consultation with other experts)
B4	Moderate Significance: Other A- or B-ranked occurrences of a G4 or G5 community C-ranked occurrence of a G3 element A- or B-ranked occurrence of a G4 or G5 S1 species (or at least C-ranked if it is the only state, provincial, national, or ecoregional occurrence) Concentration of A- or B-ranked occurrences of G4 or G5 N1-N2, S1-S2 elements (four or more) D-ranked occurrence of a G2 element At least C-ranked occurrence of a disjunct G4 or G5 element Concentration of excellent or good occurrences (A- or B-ranked) of G4 S1 or G5 S1 elements (four or more)
B5	General or State-wide Biological Diversity Significance: good or marginal occurrence of common community types and globally secure S1 or S2 species.

Protection Urgency Ranks

Protection urgency ranks (P-ranks) refer to the timeframe in which it is recommended that conservation protection occur. In most cases, this rank refers to the need for a major change of protective status (for example agency special area designations or ownership). The urgency for protection rating reflects the need to take legal, political, or other

administrative measures to protect the area. Table 7 summarizes the P-ranks and their definitions.

Table 5. Natural Heritage Program Protection Urgency Ranks and their Definitions.

P1	Protection actions needed immediately. It is estimated that current stresses may reduce the viability of the elements in the PCA within 1 year.
P2	Protection actions may be needed within 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA within this approximate timeframe.
P3	Protection actions may be needed, but probably not within the next 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA if protection action is not taken.
P4	No protection actions are needed in the foreseeable future.
P5	Land protection is complete and no protection actions are needed.

A protection action involves increasing the current level of protection accorded one or more tracts within 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. Situations that may require a protection action are as follows:

- Forces that threaten the existence of one or more element occurrences at a PCA. For example, development that would destroy, degrade or seriously compromise the long-term viability of an element occurrence; or timber, range, recreational, or hydrologic management that is incompatible with an element occurrence's existence;

- The inability to undertake a management action in the absence of a protection action; for example, obtaining a management agreement;

- In extraordinary circumstances, a prospective change in ownership or management that will make future protection actions more difficult.

Management Urgency Ranks

Management urgency ranks (M-ranks) indicate the timeframe in which it is recommended that a change occur in management of the element or PCA. This rank refers to the need for management in contrast to protection (for example, increased fire frequency, decreased grazing, weed control, etc.). The urgency for management rating focuses on land use management or land stewardship action required to maintain element occurrences at the potential conservation area.

A management action may include biological management (prescribed burning, removal of non-natives, 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. Table 8 summarizes M-ranks and their definitions.

Table 6. Natural Heritage Program Management Urgency Ranks and their Definitions.

M1	Management actions may be required within one year or the element occurrences could be lost or irretrievably degraded.
M2	New management actions may be needed within 5 years to prevent the loss of the element occurrences within the PCA.
M3	New management actions may be needed within 5 years to maintain the current quality of the element occurrences in the PCA.
M4	Current management seems to favor the persistence of the elements in the PCA, but management actions may be needed in the future to maintain the current quality of the element occurrences.
M5	No management needs are known or anticipated in the PCA.

Wetland Functional Assessment

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

- Groundwater recharge--the replenishing of below ground aquifers.
- Groundwater discharge--the movement of ground water to the surface (e.g., springs).
- Floodflow alteration--the temporary storage of potential flood waters.
- Sediment stabilization--the protection of stream banks and lake shores from erosion.
- Sediment/toxicant retention--the removal of suspended soil particles from the water, along with toxic substances that may be adsorbed to these particles.
- Nutrient removal/transformation--the removal of excess nutrients from the water, in particular nitrogen and phosphorous. Phosphorous is often removed via sedimentation; transformation includes converting inorganic forms of nutrients to organic forms and/or the conversion of one inorganic form to another inorganic form (e.g., NO_3^- converted to N_2O or N_2 via denitrification).
- Production export--supply organic material (dead leaves, soluble organic carbon, etc.) to the base of the food chain.
- Aquatic diversity/abundance--wetlands support fisheries and aquatic invertebrates.
- Wildlife diversity/abundance--wetlands provide habitat for wildlife.

Wetland functions are evaluated or compared only with respect to other wetlands of the same type, because different types often perform very different functions. For example, a montane kettle pond may provide habitat for rare plant associations never found on a large river but provides little in the way of flood control, while wetlands along a major river perform important flood control functions but may not harbor rare plant species. Thus, the category, **Overall Functional Integrity**, was included in the functional assessment to provide the user of some indication of how a particular wetland is

functioning in comparison to its natural capacity, as opposed to comparing it to different wetland types.

Most functions are assigned a rating of “low," “moderate," or “high." Overall Functional Integrity is given as either "At Potential" or "Below Potential." Elemental Cycling is rated as either "Normal" or "Disrupted" depending on unnatural disturbances. The following functions were evaluated for riparian areas in the analysis area:

- Overall Functional Integrity
- Flood attenuation and storage
- Sediment/shoreline stabilization
- Groundwater discharge/recharge
- Dynamic surface water storage
- Elemental Cycling
- Removal of Imported Nutrients, Toxicants, and Sediments
- Habitat diversity
- General wildlife habitat
- General fish/aquatic habitat
- Production export/food chain support
- Uniqueness

Overall Functional Integrity

The overall functional integrity of each wetland is a rating indicating how a particular wetland is functioning in comparison to wetlands in its same hydrogeomorphic class and/or subclass. For example, mineral soil flats (salt meadows) do not typically function as high wildlife habitat but do have high capacity for storing surface/groundwater. Thus, a mineral soil flat that is given a low rating for General Wildlife Habitat, General Fish Habitat, and Production Export/Food Chain Support does not necessarily indicate that the wetland is not functioning to its capacity. These ratings may just reflect that mineral soil flats, because of their landscape position and soil chemistry, naturally perform fewer functions than a depressional wetland. However, this particular wetland may be functioning the ‘best’ that could be expected from a mineral soil flat. The Overall Functional Integrity rating would reflect this by giving this particular wetland a "At Potential" rating, based on the best professional judgment of CNHP ecologists. In summary, a mineral soil flat wetland having more low ratings than a depressional wetland does not necessarily mean that it is functioning improperly. However, if this particular mineral soil flat was given an Overall Functional Integrity rating of "Below Potential," then it could be assumed that the wetland is not functioning to the capacity that it should (relative to other mineral soil flat wetlands).

Flood Attenuation and Storage

Many wetlands have a high capacity to store or delay floodwaters that occur from peak flow, gradually recharging the adjacent groundwater table. Decreased flood attenuation and storage capacity can lead to increased flooding frequency, erosion, furthering lowering of water tables, etc. Indicators of flood storage include: debris along streambank and in vegetation, low gradient, formation of sand and gravel bars, high

density of small and large depressions, and dense vegetation. This field assesses the capability of the wetland to detain moving water from in-channel flow or overbank flow for a short duration when the flow is outside of its channel.

Sediment/Shoreline Stabilization
Shoreline anchoring is the stabilization of soil at the water's edge by roots and other plant parts. The vegetation dissipates the energy caused by fluctuations of water and prevents streambank erosion. The presence of woody vegetation and sedges in the understory are the best indicator of good sediment/shoreline anchoring.

Groundwater Discharge/Recharge
Groundwater recharge occurs when the water level in a wetland is higher than the surrounding water table resulting in the movement (usually downward) of surface water. Groundwater discharge results when the groundwater level of a wetland is lower than the surrounding water table, resulting in the movement (usually laterally or upward) of surface water (e.g., springs, seeps, etc.). Ground water movement can greatly influence some wetlands, whereas in others it may have minimal effect (Carter and Novitzki 1988).

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

Dynamic Surface Water Storage
Dynamic surface water storage refers to the potential of the wetland to capture water from precipitation and upland surface (sheetflow). Sheetflow is nonchannelized flow that usually occurs during and immediately following rainfall or a spring thaw. Wetlands can also receive surface inflow from seasonal or episodic pulses of floodwaters from adjacent streams and rivers that may otherwise not be hydrologically connected with a particular wetland (Mitsch and Gosselink 1993). Spring thaw and/or rainfall can also create a time-lagged increase in groundwater flow. Wetlands providing dynamic surface water storage are capable of releasing these episodic pulses of water at a slow, stable rate thus alleviating short term flooding from such events. This function is applicable to wetlands that are not subject to flooding from in-channel or overbank flow (see Flood Storage and Attenuation). Indicators of potential surface water storage include flooding frequency, density of woody vegetation (particular those species with many small stems), coarse woody debris, surface roughness, and size of the wetland.

Elemental Cycling
The cycling of nutrients, or the abiotic and biotic processes that convert elements from one form to another, is a fundamental ecosystem process, which maintains a balance between living biomass and detrital stocks (Brinson et al. 1985). Disrupting nutrient cycles could cause an imbalance between the two resulting in one factor liming the other. Thus, impacts to aboveground primary productivity or disturbances to the soil, which may cause a shift in nutrient cycling rates, could change soil fertility, alter plant species

composition, and affect potential habitat functions. Indicators of wetlands with intact nutrient cycling need to be considered relative to wetlands within the same hydrogeomorphic class/subclass. Such indicators include high aboveground primary productivity and high quantities of detritus, within the range expected for that particular hydrogeomorphic class of wetlands.

Removal of Imported Nutrients, Toxicants, and Sediments

Nutrient retention/removal is the storing and/or transformation of nutrients within the sediment or vegetation. Inorganic nutrients can be transformed into an organic form and/or converted to another inorganic form via microbial respiration and redox reactions. For example, denitrification, which is a process that is mediated by microbial respiration, results in the transformation of nitrate (NO_3^-) to nitrous oxide (N_20) and/or molecular nitrogen (N_2). Nutrient retention/removal may help protect water quality by retaining or transforming nutrients before they are carried downstream or are transported to underlying aquifers. Particular attention is focused on processes involving nitrogen and phosphorus, as these nutrients are usually of greatest importance to wetland systems (Kadlec and Kadlec 1979). Nutrient storage may be for long-term (greater than 5 years) as in peatlands or depressional marshes or short-term (30 days to 5 years) as in riverine wetlands. Some indicators of nutrient retention include: high sediment trapping, organic matter accumulation, presence of free-floating, emergent, and submerged vegetation, and permanently or semi-permanently flooded areas.

Sediment and toxicant trapping is the process by which suspended solids and chemical contaminants are retained and deposited within the wetland. Deposition of sediments can ultimately lead to removal of toxicants through burial, chemical break down, or temporary assimilation into plant tissues (Boto and Patrick 1979). Most vegetated wetlands are excellent sediment traps, at least in the short term. Wetland characteristics indicating this function include: dense vegetation, deposits of mud or organic matter, gentle sloping gradient, and location next to beaver dams or human-made detention ponds/lakes.

Habitat diversity

Habitat diversity refers to the number of physiognomic classes present. Thus, the presence of emergent, scrub/shrub, and forested physiognomic types would have high habitat diversity. The presence of open water in these areas also increases the habitat diversity.

General Wildlife and Fish Habitat

Habitat includes those physical and chemical factors which affect the metabolism, attachment, and predator avoidance of the adult or larval forms of fish, and the food and cover needs of wildlife. Wetland characteristics indicating good fish habitat include: deep, open, non-acidic water, no barriers to migration, well-mixed (high oxygen content) water, and highly vegetated. Wetland characteristics indicating good wildlife habitat are: good edge ratio, islands, high plant diversity, diversity of vegetation structure, and a sinuous and irregular basin.

Production Export/Food Chain Support

Production export refers to the flushing of organic material (both particulate and dissolved organic carbon and detritus) from the wetland to downstream ecosystems. Production export emphasizes the production of organic substances within the wetland and the utilization of these substances by fish, aquatic invertebrates, and microbes. Food chain support is the direct or indirect use of nutrients, carbon, and even plant species (which provide cover and food for many invertebrates) by organisms, which inhabit or periodically use wetland ecosystems. Indicators of wetlands that provide downstream food chain support are: an outlet, seasonally flooded hydrological regime, overhanging vegetation, and dense and diverse vegetation composition and structure.

Uniqueness

This value expresses the general uniqueness of the wetland in terms of relative abundance of similar sites occurring in the same watershed, size, geomorphic position, peat accumulation, mature forested areas, and the replacement potential.

Methods

Collect Available Information

CNHP's BIOTICS database was searched for records of biologically significant plant and animal species and plant communities within the analysis area. Geographic Information System (GIS) data layers were used to analyze spatial relationships between elements, land use, and other biotic and abiotic data.

Conduct Field Surveys

Site visits were made to the Strawberry Lake analysis area during 2002 on 8/22/02 and 9/12/02 by ecologists from the Colorado Natural Heritage Program. The 2002 site visit is summarized in Stevens (2002). Additional site visits were made on 8/11/03, 8/12/03, and 09/19/03. During the visits, CNHP biologists performed an assessment of the site using a rapid ecological assessment (see section on Natural Heritage methodology). Total survey effort included approximately 42 hours on site by two CNHP ecologists (Joe Rocchio and Joe Stevens).

The overall viability of each plant population and integrity of each plant community occurrence, relative to others of the same element, was estimated by rating the size, condition, and landscape context of the community. These factors are combined into an element occurrence rank, which is useful in refining conservation priorities. (*See the previous section on Natural Heritage Network for more about element occurrence ranking*). A qualitative assessment of species composition, structural diversity of vegetation, vegetation volume, soil and hydrological disturbance, and nearby and/or on-site land use was used to assess viability or integrity. Indicators of these variables were compared to ecological integrity specifications for Montane Fens (Rondeau 2001; Appendix A) to indicate the relative impairment of the fen communities to known reference conditions for these ecological systems. Viability specifications have not been completed for the three state imperiled plant species found at the site (discussed in Results section). Professional opinion, based on the authors' observations of each plant species throughout the state of Colorado and life history information contained within Biotic Tracker, was used to assess the overall size, condition, and landscape context for plant populations.

Field surveys also included a descriptive, overall, functional evaluation for the wetland areas. For this project, CNHP utilized a qualitative, descriptive functional assessment based on the best professional judgment of CNHP ecologists (Joe Rocchio and Joe Stevens).

Delineate Potential Conservation Area Boundaries

Available data on the elements present in the analysis area and information from the field survey was used to delineate a Potential Conservation Area. The Potential Conservation Area boundary is an estimation of the minimum area needed to assure persistence of the elements. Primarily, in order to insure the preservation of an element, the ecological

processes that support that occurrence must be preserved. The preliminary potential conservation area boundary is meant to include features on the surrounding landscape that provide these functions. Typically, a minimal buffer of at least 1,000 feet was incorporated into the boundaries. Data collected in the field are essential to delineating such a boundary, but other sources of information such as aerial photography are also used. These boundaries are considered preliminary and additional information about the PCA or the element may call for alterations of the boundaries.

Results

Three state rare plants and two state rare plant associations were documented at the Strawberry Lake analysis area (Table 7). Because of these occurrences, the Colorado Natural Heritage Program has identified Strawberry Lake as a B3 Potential Conservation Area (PCA). The definition and methods used to identify PCAs are in the Natural Heritage Methodology section. A full description of the Strawberry Lake PCA follows.

Approximately 100 plant species were observed during the site visits, including those in the fens, riparian areas, and kettle ponds. Notable on the list are slender sedge (*Carex lasiocarpa*), marsh cinquefoil (*Comarum palustre*), roundleaf sundew (*Drosera rotundifolia*), and notable diversity (13 species) of sedges (*Carex* sp.). Roundleaf sundew is currently a USFS Sensitive Species for Region 2 (revised sensitive-species list). Very few non-native, invasive species were observed at the site.

Element occurrence records (EORs) were documented for slender sedge, marsh cinquefoil, and roundleaf sundew populations. In addition, element occurrence records were documented for two state-rare plant communities, the slender sedge (*Carex lasiocarpa*) and blister sedge (*Carex vesicaria*) montane wetlands. GPS points were not logged for the element occurrences, however using U.S.G.S. 7.5 minute topographic maps, the occurrences were mapped and then digitized into Arc View GIS. The legal descriptions for the element occurrences can be found in the EORs in Appendix D.

Additional survey efforts in late spring/early summer 2004 may increase the totally number of species found. In addition, because of short-term climatic variations some species present at the site may not have been encountered during the field surveys due to unfavorable conditions for emergence. CNHP does not expect to encounter additional rare plants, rather the 2004 survey is intended to complete the total species list.

Collections were made for Carex lasiocarpa and sphagnum moss species (Table 7).

Table 7. Plant Specimens Collected

Collection #	Species	Herbarium
03FJR02	*Muhlenbergia sp.*?	University of Colorado
03FJR03	*Carex brunnescens*	University of Colorado
03FJR05	*Carex lasiocarpa*	University of Colorado
03FJR06	*Carex vesicaria*	University of Colorado
03FJR07	*Carex sartwellii?*	University of Colorado
03FJR08	*Carex buxbaumii*	University of Colorado
03FJR09	*Sphagnum* species	University of Colorado
03FJR10	*Sphagnum* species	University of Colorado
03FJR11	*Sphagnum* species	University of Colorado
03FJR12	*Sphagnum* species	University of Colorado
03FJR13	*Sphagnum* species	University of Colorado
03FJR14	*Sphagnum* species	University of Colorado
03FJR15	*Sphagnum* species	University of Colorado
03FJR16	*Sphagnum* species	University of Colorado

Strawberry Lake Potential Conservation Area

Biodiversity Rank: B3. High biodiversity significance. The PCA supports excellent examples of three state rare plants and two state rare plant associations.

Protection Urgency Rank: P2. Protection actions may be needed within 5 years. It is estimated that current stresses may reduce the viability of the elements in the PCA within this approximate timeframe. The U.S. Forest Service recently acquired the site from private owners. No special protection status has been designated to the site, although such a designation is warranted due to the occurrence of three state rare plants, one of which is a U.S. Forest Service Sensitive Species (roundleaf sundew) and the presence of an expansive fen.

Management Urgency Rank: M3. New management actions may be needed within five years to maintain the current quality of the element occurrences in the PCA. The apparent high quality of the Strawberry Lake site is partially due to its inaccessibility and lack of publicity. Management actions directed at increasing the types and quantity of use have the potential to severely degrade site conditions.

Location: The Strawberry Lake is located in Grand County, approximately 10 miles east of the Town of Granby and within the Arapaho National Recreation Area.

U.S.G.S. 7.5-min. quadrangles: Strawberry Lake

Legal Description: T02N R75W portions of Section 22, 23, 26, 27, 34, and 35. 6th Prime Meridian.

Elevation: 9,200-10,200 ft. **Size:** Approximately 1,292 acres

General Description: The Strawberry Lake site consists of a series of kettle pond wetlands located on the northwest-southeast oriented Strawberry Bench. Kettle ponds are formed from glacial movement of ice, which essentially carve out large "potholes". These potholes are left with glacial ice, melting to form a lake or pond, and are continually fed with water from streams and/or springs (Schnell 2002). There is not an obvious inlet to the Strawberry Lake complex, thus it is believed that springs discharge underneath the lake, supporting current lake levels. The entire complex consists of large herbaceous fens, a small lake (Strawberry Lake), and several ponds.

Scientists call both fens and bogs "peatlands." Peatlands are wetlands with organic soils that consist of at least 12-18% organic-carbon content (by weight) (USDA 1994). They form where the rate of plant growth exceeds the rate of decomposition of litter. Both saturated soils and cool climates contribute to the conditions necessary for peatland formation.

Peat accumulates slowly in all southern Rocky Mountain peatlands, anywhere from 4.3 to 16.2 inches per thousand years (Cooper 1990; Chimner and Cooper 2002). Thus, the depth of peat in extreme rich fens tends to be less than that in rich fens. The slow accumulation rates suggest that fens cannot be restored to historic conditions after massive disturbance in any time period relevant to humans.

Fens are peatlands that remain saturated primarily as a result of water percolating up from the ground with some contribution from surface water runoff. Peatlands are often classified along a chemical gradient (pH and concentration of cations such as Ca^{2+}, Na^{+}, K^{+}, and Mg^{2+}) (Cooper and Andrus 1994). The gradient is typically as follows: ombrotrophic bogs and poor fens are characterized by low pH and low cation concentration, whereas rich and extreme rich fens are characterized by high pH and high cation concentration. Most fens in Colorado would be considered "intermediate" or "rich" fens. The fens at Strawberry Lake fall within this category. These terms do not refer to the number of species in the wetland. They refer instead to the levels of nutrients (calcium, magnesium, etc.) in the water. Intermediate and rich fens are found in river basins, near seeps, and in small, water-filled depressions formed by glaciers, such as Strawberry Lake. Intermediate and rich fens typically are dominated by beaked sedge (*Carex utriculata*), water sedge (*Carex aquatilis*), and planeleaf willow (*Salix planifolia*). Their pH tends to be near neutral (7.0) or slightly acidic (less than 7.0). The peat soils in these fens range from shallow (less than 1 meter) to moderately deep (up to 4 meters).

The largest portion of the complex is located at the northwestern most end of the bench. A series of much smaller kettle pond wetlands also occur in the uplands near the large wetland complex. At the time of the 2002 site visit the water levels in the lake, ponds, and surrounding fen were low. The water level in the lake was approximately 0.5 meter below the normal bank level as expressed by exposed roots and above ground plant parts. Several small ponds populated with water sedge (*Carex aquatilis*) were completely dry. A hummocky area of beaked sedge (*Carex utriculata*) on the north side of the lake where it seemed standing water would typically be present was completely dry. At the time of the site visit, the fen appeared to be drier than would have been expected in a normal precipitation year. During 2003, water levels were higher as indicated by submergence of some roundleaf sundew (*Drosera rotundifolia*) along the pond margin.

Strawberry Lake is the largest of the kettle ponds. An extensive fen occurs to the west of the lake. A small outflow stream traverses the western side of the fen and exits the bench at the northwest corner. Patches of willow (*Salix planifolia, S. geyeriana, S. wolfii*) border the stream and are scattered sparsely throughout the fen and on the margin of the lake. The herbaceous area to the west of the lake is dominated by water sedge but grades into tufted hairgrass (*Deschampsia caespitosa*) toward the western and southern extent of the fen. Beaked sedge dominates wet swales throughout the site. Very few forbs are present in the graminoid-dominated areas, with the exception of marsh cinquefoil (*Comarum palustre*) and large-leaved avens (*Geum macrophyllum*) sparsely scattered between and under the water sedge.

Yellow pond lily (*Nuphar lutea* ssp. *polysepala*) dominates the shallow waters near the shoreline of Strawberry Lake. A stand of slender sedge (*Carex lasiocarpa*) dominates the lake edge on a floating mat of *Sphagnum* sp. and other moss species interspersed with marsh cinquefoil, bog bean (*Menyanthes trifoliata*), roundleaf sundew, and Buxbaum's sedge (*Carex buxbaumii*). Buxbaum's sedge is considered a U.S. Forest Service Sensitive Species in Region 1, but currently does not carry that status in Region 2. The mat is slowly moving inward on the lake. Further away from the lake edge, Buxbaum's sedge, water sedge, beaked sedge and a sparse cover of bog birch (*Betula nana*) and Wolf's willow (*Salix wolfii*) dominate.

To the east, an old beaver dam separates a small kettle pond from Strawberry Lake. Behind the dam, great bladderwort (*Utricularia macrorhiza*) was located in a small depression. Just a bit further east, yellow pond lily dominates the shallow waters of a small kettle pond. Slender sedge, sphagnum moss (*Sphagnum* sp.) marsh cinquefoil, bog bean, and roundleaf sundew are found along the pond's edge. Slender sedge dominates much of the surrounding area.

Scattered throughout the upland areas are small depressions, which are also thought to be of glacial origin (i.e. kettle ponds). These are dominated by beaked sedge and blister sedge (*Carex vesicaria*). Northern mannagrass (*Glyceria borealis*), tall mannagrass (*G. elata*), and bog bean are also common in these areas. One such depression was very unique from the others in that it is represents a lush riparian plant community as opposed to a wet meadow community, which dominates the other small kettle ponds. This particular kettle pond is entirely dominated by a thicket of Engelmann spruce, thin-leaf alder (*Alnus incana*), strapleaf willow (*Salix eriocephala*), and mountain willow (*S. monticola*) in the overstory while tall ragwort (*Senecio serra*), geranium (*Geranium richardsonii*), and fireweed (*Chamerion angustifolium*) are fairly common components of the understory. The vegetation volume and density made this particular depression impressive.

Upland vegetation consisted of Engelmann spruce, lodgepole pine (*Pinus contorta*), subalpine fir (*Abies lasiocarpa*), and common juniper (*Juniperus communis*). Rattlesnake plantain (*Goodyera oblongifolia*) was observed along the trail leading up to Strawberry Lake.

Water pH readings were taken with a Myron L EP11 pH/Conductivity Meter from various points around the lake's shoreline. The values ranged from 5.8 to 6.8. A reading was also taken of free water within the Sphagnum mat and was found to be 5.6. The outlet had a pH of 6.5.

Biodiversity Rank Justification: According to Natural Heritage methodology, this site would normally receive a B4 rank. However, due to the presence of a large fen and the site's integrity, a B3 rank is justified.

This site supports excellent examples of two state rare plant communities and three excellent examples of three state rare plant species (Table 8). The state critically imperiled (G5 S1) slender sedge (*Carex lasiocarpa*) reaches its southern distribution in Colorado and is more common in the northern Rocky Mountains (especially northwestern

Montana, northern Utah, and southeastern Idaho) where it is associated with peatlands in meadows, kettle ponds, and lakeshores (Hansen et al. 1995; Padgett et al. 1989). Slender sedge occurs in a dense stand (*Carex lasiocarpa* community G4 S1) around the peripheral of Strawberry Lake and the small kettle pond to the east along with two other state rare plants, marsh cinquefoil (*Comarum palustre*) and roundleaf sundew (*Drosera rotundifolia*). Marsh cinquefoil, a state imperiled (G5 S1S2) species, is associated with high elevation peatlands. A member of the rose family, it flowers in July and August. The species is circumboreal in distribution but is only known in Colorado from six counties: Delta, Grand, Gunnison, Jackson, Mesa, and Routt. The population at Strawberry Lake is one of the largest known in Colorado. This species is threatened by peat removal and other habitat alteration. Round-leaf sundew, a state imperiled (G5 S2) U.S. Forest Service Region 2 Sensitive Species is associated with floating peat mats and on the margins of acidic ponds and fens, often with sphagnum moss. A member of the sundew family, it blooms in July although flowers seldom open in Colorado. The species occurs in Eurasia, the northeast U.S. and Canada, south to Idaho, Montana, California, Nevada, Florida, and Colorado. Within Colorado it is only known from a few locations in Jackson County, one location in Grand County, and one location in Gunnison County. This species is threatened by peat removal and other habitat alteration. As with marsh cinquefoil, CNHP believes the population of roundleaf sundew at Strawberry Lake is one of the largest in Colorado. A good example of the state critically imperiled (G4Q S1) blister sedge (*Carex vesicaria*) plant association also occurs at this site. This association has a wide regional distribution, but has only been documented in very small patches on the landscape. The association is documented from only a few stands in Colorado, which may represent its southern distribution. The association forms open meadows similar to the beaked sedge plant association. As with beaked sedge, it occurs along the shores of lakes and ponds in shallow water, as well as in poorly drained basins and along rivers and streams. The water table typically remains above the ground surface throughout the year.

In addition, this site has an extensive cover of sphagnum moss species. CNHP currently tracks five species*: Sphagnum angustifolium, S. balticum, S. contortum, S. girgensohnii, and S. platyphyllum*. Specimens from this site are currently being identified and notification of any rare species will be made to the USFS as soon that information is available (expect by Spring 2004).

In addition, as a part of the on-going "Montane Mollusk & Crustacean Survey in Western Colorado" project conducted by CNHP and CU-Boulder, mollusks were collected from Strawberry Lake. Preliminary results suggest that *Gyraulus* sp. and *Pisidium* sp. were found. CNHP believes these specimens are not rare, however per further taxonomic evaluation, the USFS will be notified of the specific species located at Strawberry Lake.

Strawberry Lake is one of the largest, intact, kettle pond wetland complexes that CNHP is currently aware of in Colorado. Impacts from other human-induced impacts were only evident near the old cabin where a few non-native species were found.

Fens, which are formed by stable discharge of groundwater, are one of Colorado's rare wetland types. They require wet, anaerobic soils, carbon accumulation from vigorous

plant growth, low soil temperatures, and thousands of years to form their characteristic organic soils. Once formed, these organic soils are essentially irreplaceable in any management time frame. Due to their rarity and status as a non-renewable resource, the U.S. Fish and Wildlife Service has placed fens in Resource Category One, which requires "no loss of habitat value".

Table 8.Natural Heritage element occurrences of rare plants and plant communities at Strawberry Lake Fen PCA.

Scientific Name	Common Name	Global Rank	State Rank	Federal and State Status	EO* Rank	# of Sites in CO	Total # of Plants in CO*	# of Plants at Strawberry Lake*
Plants								
Carex lasiocarpa	Slender sedge	G5	S1		A	4	~1,000	300-500
Comarum palustre	Marsh cinquefoil	G5	S1S2		A	11	10,000 - 15,000	1,000 - 3000
Drosera rotundifolia	Roundleaf sundew	G5	S2	FS Sensitive	A	8	5,000 – 7,000	1,000 – 2,000
Plant Communities								
Carex lasiocarpa	Montane wetland	G4	S1		A	2	N/A	N/A
Carex vesicaria	Montane wetland	G4Q	S1		A	3	N/A	N/A

* Number of plants represents an estimation from element occurrence records. Rhizomatous species, such as sedges (*Carex*) and marsh cinquefoil (*Comarum*), are difficult to estimate accuarately.

Boundary Justification: Boundaries are drawn to include the potential groundwater recharge zones, which must be maintained to preserve the hydrological integrity (i.e. discharging springs) of the lake, ponds, and fens. It should be noted that the hydrological processes necessary to the elements might not be fully contained by the PCA boundaries. Thus, the boundaries are preliminary and additional research on the recharge zones is warranted. This boundary indicates the minimum area that should be considered for any conservation management plan.

Protection Comments: The U.S. Forest Service recently acquired the site from private owners. No special protection status has been designated to the site, although such a designation is warranted due to the occurrence of three state rare plants, one of which is a U.S. Forest Service Sensitive Species (roundleaf sundew), two rare plant communities, and the presence of an expansive fen. Due to the rarity and status of fens as a non-renewable resource, the U.S. Fish and Wildlife Service has placed fens in Resource Category One, which requires "no loss of habitat value".

Management Comments: The apparent high quality of the Strawberry Lake site is partially due to its inaccessibility and lack of publicity. Approximately four different groups of people (2 people per group; 8 total) were observed hiking in the area during site visits. Only one group traveled with a dog. Management actions directed at increasing the types and quantity of use have the potential to severely degrade site conditions. To preserve site conditions in their current state, activities with a potential to promote trampling, compaction, changes in hydrology or to serve as a source of weeds and erosion, especially associated with the floating peat mat surrounding the lake and ponds,

should be prohibited. These activities include livestock grazing and recreational activities such as fishing, camping, and hiking in sensitive areas.

The following discussion is from personal communication with Steve Popovich, USFS Botanist in Fort Collins, CO:

The Strawberry lake system was private land until recent acquisition by the Forest Service. Because of the area's relatively remote and little-known location, and because it was private property, The Forest Service believes that little recreation use historically occurred. Some amount of visitation for scenic values and fishing undoubtedly occurred, but probably at minimal levels. Hunting camps were historically and are presently located along the western periphery of the lake, just inside the forest edge, but no visible trailing or use from the hunting camps to the lakeshore has been observed. In the last two years, recreation use and fishing at Strawberry Lake has been observed by Forest Service staff to have increased significantly, and recent publicity of the area in local recreational brochures has highlighted the area's presence.

The history of grazing on the private property is unknown, and the previous landowners have not been contacted. However, historic use is believed to be low, and livestock class was probably cattle, perhaps horses, less likely sheep. It is possible that the area has never received high use levels commonly associated with riparian resources. The public land in the area historically was part of the Walden (Walden Hollow) allotment and received some cattle grazing pressure. In the 1930's to 1950's, the private property may have received incidental unauthorized use. Forest Service records indicate that fences were built around the private property in 1939, which may indicate that some incidental use onto the private property was occurring by that time. From 1956, when first under Forest Service term permit, to 1981, the stocking rate on public land in the area was 75 cow-calf pair for 31 days in July. Most use occurred at lower elevations in the valleys, and actual use on Strawberry Bench was low. The term permit was cancelled in 1981, but the area received some summer grazing under a temporary permit in 1982. No grazing has occurred since 1982, and permits were not issued after the 1982 grazing season. The area was closed to livestock grazing in 1997 under a Forest Plan revision.

The purpose of the existing historic cabin is unknown, but it was probably not a line-camp for livestock. There was a rough road to the cabin decades ago that offered direct access to the property. There is a faintly visible ground disturbance shallow line a few feet wide, and about 100 feet long, emanating from the northern edge of the lake just west of the cabin continuing northerly to about 50 feet north past the cabin. The purpose of this line is unknown, but it could be a former attempt to drain the lake or to provide water from the lake to the adjacent hairgrass meadow. There is otherwise no indication of past agricultural activities or meadow disturbances.

Soils Description: Soil pits were dug in the large fen west of Strawberry Lake. The soil profile, excavated to a depth of 3 ft., was entirely organic. Histosols, also known as organic soils (peatlands), are defined as having a layer of organic soil 40 cm or more thick in the upper 40 cm of the soil pit. Thus, the soil type in the fen is a Histosol, and consisted of the following soil horizons:

Oi (fibric) from 0-6 inches in depth;
Oe (hemic) from 6-? inches in depth.

The soil pits were at least 3 ft. deep and the bottom of the peat layer was never reached.

Wetland Functional Assessment: Headwater streams (zero, first, and second order streams) typically comprise well over half the total length of channels in a watershed and thus are the locations where the greatest exchange between terrestrial and aquatic ecosystems occurs (Meyer et al. 2003). Thus, they are very important links between terrestrial and aquatic ecosystems and are critical to the health and integrity of downstream rivers, lakes, and wetlands. Properly functioning headwaters streams and wetlands result from their hydrological, biological, and geomorphic processes remaining intact (Meyer et al. 2003). Because they comprise the largest proportion of total stream length within a watershed, headwater streams and wetlands are most important for flood control, surface water storage, sediment retention, groundwater discharge/recharge, nutrient cycling, and production export and food chain support.

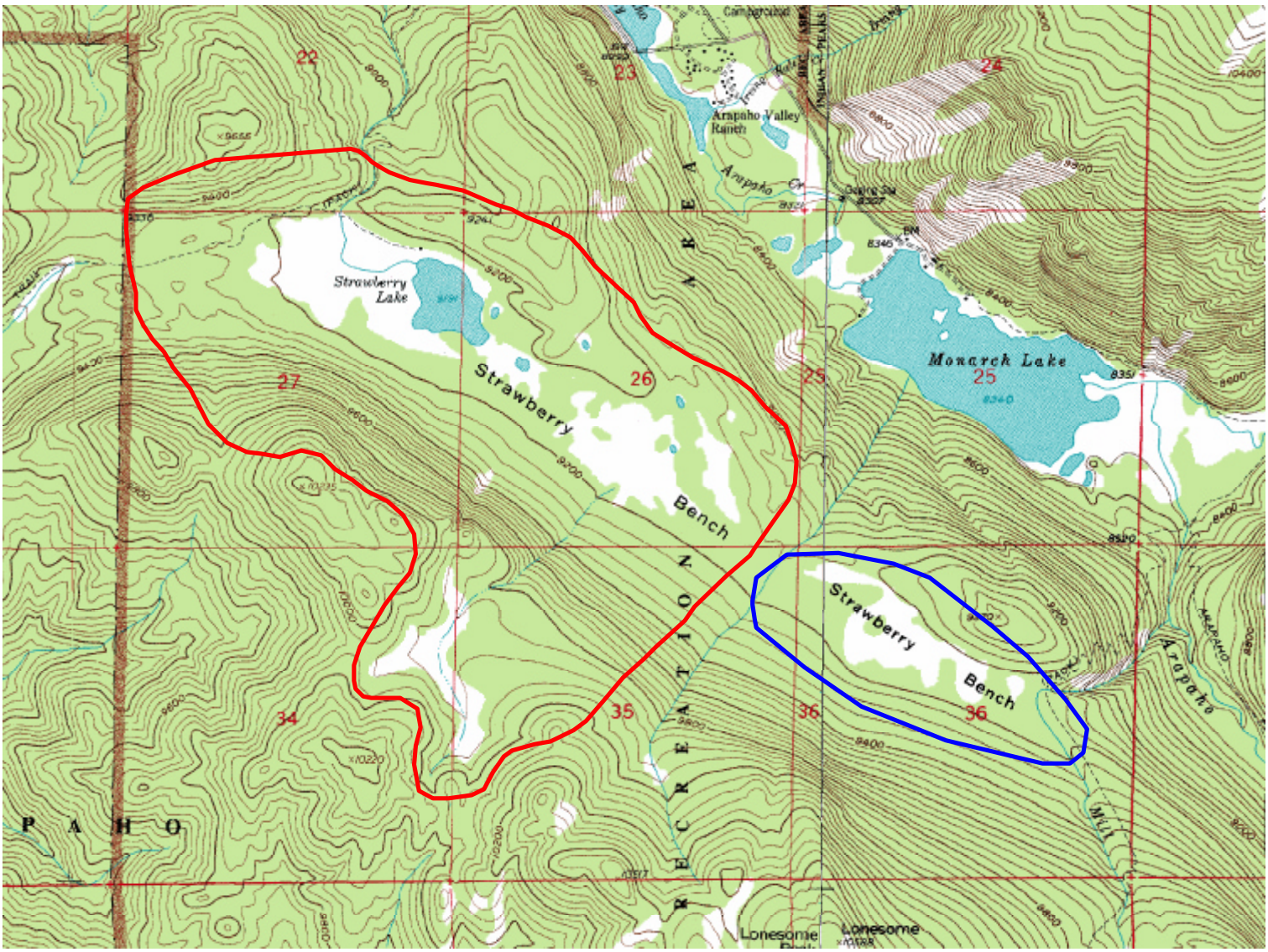
The headwater streams and wetlands in the Strawberry Lake area are remarkably intact, and apparently have not experienced significant levels of human-induced disturbance. As such, the area provides high functional value for surface water storage, sediment retention, groundwater discharge/recharge, nutrient cycling, and production export and food chain support (Table 9). The site also provides unique values in the form of research opportunities for the roundleaf sundew, a U.S. Forest Service Sensitive Species, and as a reference for kettle pond wetlands, especially fens.

Table 9. Wetland functional assessment for the Strawberry Lake Potential Conservation Area.

Function	Rating	Comments
Overall Functional Integrity	At Potential	The fen appears to be functioning at potential.
Hydrological Functions		
Flood Attenuation and Storage	N/A	This wetland receives groundwater inputs and thus does not experience large, short-term fluctuations in lake levels.
Sediment/Shoreline Stabilization	High	There is dense vegetative cover on the lake and pond margins which buffers wind-generated wave action and anchors the shoreline. Dense stands of herbaceous and woody species protects streambanks of the outlet creek from erosion and have allowed a sinuous, slow channel to form.
Groundwater Discharge/ Recharge	Yes	Groundwater discharge maintains water levels in the ponds, lake, and the fen.
Dynamic Surface Water Storage	High	The lake, ponds, and extensive organic soils hold large quantities of surface water ensuring a continuous and persistent stream flow from the site.
Biogeochemical Functions		
Elemental Cycling	Normal	A diverse canopy of herbaceous species plus large quantities of leaf litter and accumulating peat suggest intact and functioning nutrient cycles.
Removal of Imported Nutrients, Toxicants, and	Moderate	Intact nutrient cycles and a dense and diverse cover of vegetation remove excess nutrients, toxicants, and

Function	Rating	Comments
Sediments.		sediment. Lake and ponds add to sediment removal potential. However, inputs are low.
Biological Functions		
Habitat Diversity	High	Scrub-shrub, emergent, open water wetlands and nearby upland forests create high habitat diversity.
General Wildlife Habitat	High	Extensive wetland complex with a high diversity of wetland types provide much cover, browse, and nesting habitat for a variety of herbivores and birds. The shrub and herbaceous canopies and open water provide a diversity of vegetation structure, which along with high vegetation volume, provide excellent habitat for birds, mammals, and insects.
General Fish/Aquatic Habitat	High	Habitat structure appears to be high as there are a diversity of pools, riffles, overhanging vegetation, litter inputs, etc. along the streams and dense shoreline vegetation in the lake and ponds. The site is also important amphibian habitat, as hundreds of juvenile chorus frogs were observed and fish were observed in small channels and near lakeshores. CNHP does not have information regarding specific fish occurrences.
Production Export/Food Chain Support	High	Permanent water sources and large quantities of allochthonous organic substrates provide various sources of carbon (both dissolved and particulate) and nutrients for local and downstream ecosystems. The presence of open water areas and density of herbaceous and woody vegetation suggest that the area supports healthy invertebrate populations. Numerous dragonflies, damselflies, butterflies, spiders, and other insects were observed.
Uniqueness	High	Pristine example of a lake-fill succession wetland complex. Large fen which supports numerous rare plants.

Figure 2. Strawberry Lake Fen Potential Conservation Area



Projection: UTM, Zone13, NAD27

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

map created 06 January 2004

Disclaimer

The data contained herein are provided on an as-is, as-available basis without warranties of any kind, expressed or implied, including (but not limited to) warranties of merchantability, fitness for a particular purpose, and non-infringement. CNHP, Colorado State University and the State of Colorado further expressly disclaim any warranty that the data are error-free or current as of the date supplied.

LEGEND

Area in Need of Additional Survey

Strawberry Lake Fen Potential Conservation Area

USGS 7.5 Minute Series OR 30 x 60 Series Quadrangles*
Strawberry Lake, 4010517
Monarch Lake, 4010516

*Digital Raster Graphics produced by the U.S. Geological Survey, 1996

Location in Study Area

Recommendations

CNHP recommends that the Strawberry Lake be considered for designation as a Research Natural Area or at the very least receive protection from future human-induced activities sufficient for the long-term retention and maintenance of its high-quality wetland areas and rare plant populations. The site supports one of largest populations of two state imperiled plants, roundleaf sundew (*Drosera rotundifolia*) and marsh cinquefoil (*Comarum palustre*). The site also supports a large, expansive peatland dominated by a unique plant community, the slender sedge herbaceous fen. Padget et al. (1989) note that the Sims Peak Potholes region on the south slope of the Uinta Mountains in Utah was being considered as a candidate for a Research Natural Area due to the unique nature of the slender sedge (*Carex lasiocarpa*) plant community as well as other community types which occur in the area.

The Strawberry Lake Potential Conservation Area also provides an invaluable resource as a *reference site* from which the quality and integrity of fens and kettle ponds from other portions of the Southern Rocky Mountain Ecoregion could be compared. Such areas are uncommon as few have been without human-induced disturbance for any extended amount of time. For example, nearly 70% of U.S. Forest Service lands in the Southern Rocky Mountain Ecoregion are under active grazing allotments (Southern Rockies Ecosystem Project 2000). These reference areas are invaluable as they provide land managers with baseline conditions which management can strive for, they provide numerous opportunities for researchers, and they likely harbor greater biological diversity than other areas, which have been impacted. For example, the Strawberry Lake Potential Conservation Area supports three state imperiled plant species.

High-quality wetlands also provide important wildlife and fish habitat, serve as important water quality filters, moderate flooding potential, and maintain year-round stream flow. The reintroduction of grazing, increased recreation, and logging activities could impair the quality and integrity of the fen and rare plant populations. Given that the majority of Colorado's riparian and wetland systems are already affected by such impacts, it is imperative to protect those areas which have been allowed to recover or have remained relatively free of human-induced disturbance to preserve biological diversity, water quality and quantity, prevent erosion, provide benchmarks for desired ecological conditions, and for research opportunities.

The entire Strawberry Bench has not been fully surveyed. The bench area continuing for about two linear miles southeasterly beyond the eastern edge of Strawberry Lake contains other potentially noteworthy meadows and a few small ponds (personal communication with Steve Popovich, December 2003). This area has not been assessed by the Forest Service or CNHP, and may harbor important additional botanical resources.

Literature Cited

Adamus, P. R., L.T. Stockwell, E.J. Jr. Clairain, M.E. Morrow, L.P. Pozas, and R.D. Smith. 1991. Wetland Evaluation Technique (WET) Vol. 1: Literature Review and Evaluation Rationale. U.S. Army Corps of Engineers, Springfield, VA.

Anderson, M., P. Bougeron, M.T. Bryer, R. Crawford, L. Engelking, D. Faber-Langendoen, M. Gallyoun, K. Goodin, D.H. Grossman, S. Landaal, K.D. Patterson, M. Pyne, M. Reid, L. Sneddon, and A.S. Weakley. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume II. The National Vegetation Classification System: list of types. The Nature Conservancy, Arlington, Virginia.

Boto, K. G. and W.H. Jr. Patrick. 1979. The role of wetlands in the removal of suspended sediments. *In*: Wetland Functions and Values: The State of Our Understanding. American Water Resources Association, Minneapolis, MN.

Brinson, M.M., F.R. Hauer, L.C. Lee, W.L. Nutter, R.D. Rheinhardt, R.D. Smith, and D. Whigham. 1985. Guidebook for Application of Hydrogeomorphic Assessments to Riverine Wetlands. Wetlands Research Program Technical Report WRP-DE-11, U.S. Army Corps of Engineers Waterways Experiment Station.

Carter, V. and R.P. Novitzki. 1988. The Ecology and Management of Wetlands Vol. 1. Timber Press, Portland, OR.

Chimner, R.A. and D.J. Cooper. 2002. Modeling carbon accumulation in Rocky Mountain fens. *Wetlands* 22: 100-110.

Cooper, D.J. 1990. An evaluation of the effects of peat mining on wetlands in Park County, Colorado. Unpublished report prepared for Park County, Colorado. 31 pp.

Cooper, D. J. and R. Andrus. 1994. Peatlands of the west-central Wind River Range, Wyoming: Vegetation, flora and water chemistry. *Canadian Journal of Botany* 72: 1586-1597.

Flahault, C. and C. Shroter. 1910. Rapport sur la nomenclature phytogeographique. Proceedings of the Third International Botanical Congress, Brussels 1: 131-164.

Hansen, P.L., R.D. Pfister, K. Boggs, B.J. Cook, J. Joy, and D.K. Hinckley. 1995. Classification and Management of Montana's Riparian and Wetland Sites. Montana Forest and Conservation Experiment Station, School of Forestry, The University of Montana, Missoula, MT. Miscellaneous Publication No. 54.

Kadlec, R. H. and J.A. Kadlec. 1979. The use of freshwater wetlands as a tertiary wastewater treatment alternative. *Crit. Rev. Environ. Control 9*, pp. 185-212.

Meyer, J.L., L.A. Kaplan, D. Newbold, D.L. Strayer, C.J. Woltemade, J.B. Zedler, R. Beilfuss, Q. Carpenter, R. Semlitsch, M.C. Watzin, and P.H. Zedler. 2003. Where Rivers Are Born: The Scientific Imperative for Defending Small Streams and Wetlands. Sponsored by American Rivers and Sierra Club. Available for download at: http://www.amrivers.org/amriverpublications/default.htm

Mitsch, W. J. and J.G. Gosselink. 1993. Wetlands. Second edition, Van Nostrand Reinhold, New York, NY.

Nature Conservancy, The. 1999. An Alliance Level Classification of Vegetation of the Conterminous Western United States. Submitted to the University of Idaho, Cooperative Fish and Wildlife Research Unit.

Padgett, W.G., A.P. Youngblood, and A. H. Winward. 1989. Riparian Community Type Classification of Utah and Southeastern Idaho. USDA Forest Service R4-ECOL-89-01. Intermountain Region, Ogden, UT.

Schnell. D.E. 2002. Carnivorous Plants of the United States and Canada. Second Edition. Timber Press. Portland, OR.

Southern Rockies Ecosystem Project. 2000. The State of the Southern Rockies Ecoregion. A Report by the Southern Rockies Ecosystem Project. Nederland, CO.

Stevens, J. 2002. Site Summary: Strawberry Lake Fen, Arapaho National Forest, Grand County, Colorado. Unpublished report prepared for the U.S. Forest Service, Arapaho-Roosevelt National Forest, Supervisor's Office, Fort Collins, CO. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.

United State Department of Agriculture. 1994. Keys to Soil Taxonomy. Soil Survey Staff, Soil Conservation Service, U.S. Department of Agriculture. Sixth Edition. Pocahontas Press, Inc. Blacksburg, Virginia.

Wilson, E. O. 1988. Bio Diversity, National Academy Press. Washington, D.C.

Appendix A: Strawberry Lake Species list from 2002 & 2003 Visits

Scientific Name	***Common Name***	***Family***
Abies lasiocarpa (Hook.) Nutt.	subalpine fir	Pinaceae
Achillea millefolium L.	common yarrow	Asteraceae
Agrostis scabra	rough bentgrass	Poaceae
Agrostis variabilis Rydb.	mountain bentgrass	Poaceae
Alnus incana (L.) Moench subsp. Tenuifolia (Nuttall)	thin-leaf alder	Betulaceae
Antennaria rosea Greene	rosy pussytoes	Asteraceae
Arctostaphylos uva-ursi (L.) Spreng.	kinnikinnick	Ericaceae
Arnica chamissonis Lessing subsp. Foliosa (Nuttall) Maguire	chamisso arnica	Asteraceae
Arnica cordifolia Hook.	heartleaf arnica	Asteraceae
Batrachium sp.	water crowfoot	Ranunculaceae
Betula nana L.	dwarf birch	Betulaceae
Calamagrostis canadensis (Michx.) Beauv.	bluejoint reedgrass	Poaceae
Callitriche sp. L.	water-starwort	Callitrichaceae
Caltha leptosepala DC.	white marsh marigold	Ranunculaceae
Carex aquatilis Wahlenb.	water sedge	Cyperaceae
Carex brunnescens (Persoon) Poiret	brownish sedge	Cyperaceae
Carex buxbaumii Wahlenberg	Buxbaum’s sedge	Cyperaceae
Carex canescens L.	Silvery sedge	Cyperaceae
Carex geyeri Boott	Geyer's sedge	Cyperaceae
Carex interior Bailey	inland sedge	Cyperaceae
Carex lasiocarpa [1]	slender sedge	Cyperaceae
Carex magellanica Lam.	boreal bog sedge	Cyperaceae
Carex microptera Mackenzie	smallwing sedge	Cyperaceae
Carex rossii Boott	Ross' sedge	Cyperaceae
Carex utriculata Boott	Northwest Territory sedge	Cyperaceae

Scientific Name	***Common Name***	***Family***
Carex vesicaria L.	blister sedge	Cyperaceae
Carex L.	sedge	Cyperaceae
Chamerion angustifolium (L.) Holub	fireweed	Onagraceae
Comarum palustre L. [1]	marsh cinquefoil	Rosaceae
Conioselinum scopulorum (Gray) Coult. & Rose	Rocky Mountain hemlockparsley	Apiaceae
Crunocallis chamissoi (Ledebour) Rydberg	water spring beauty	Portulacaceae
Danthonia intermedia Vasey	timber oatgrass	Poaceae
Dasiphora floribunda (Pursh) Kartesz, comb. nov. ined.	shrubby cinquefoil	Rosaceae
Deschampsia caespitosa (L.) Beauv.	tufted hairgrass	Poaceae
Drosera rotundifolia L. [1, 2, 3]	roundleaf sundew	Droseraceae
Eleocharis quinqueflora (Hartman) Schwartz.	fewflower spikeruch	Cyperaceae
Eleocharis macrostachya Britton	common spikerush	Cyperaceae
Elymus repens L. Gould	quackgrass	Poaceae
Epilobium leptocarpum Haussknecht	slenderfruit willowherb	Onagraceae
Equisetum arvense L.	field horsetail	Equisetaceae
Erigeron peregrinus (Banks ex Pursh) Greene ssp. callianthemus (Greene) Cronq.	subalpine fleabane	Asteraceae
Eriophorum angustifolium Honckeny	tall cottongrass	Cyperaceae
Fragaria virginiana Duchesne ssp. glauca (S. Wats.) Staudt	Virginia strawberry	Rosaceae
Galium trifidum L. ssp. subbiflorum (Wieg.) Piper	threepetal bedstraw	Rubiaceae
Gaultheria humifusa (Graham) Rydb.	alpine spicy wintergreen	Ericaceae
Geranium richardsonii Fischer & Trautvetter	Richardson’s geranium	Geraniaceae
Geum macrophyllum Willd.	largeleaf avens	Rosaceae
Glyceria borealis (Nash) Batchelder	northern mannagrass	Poaceae
Glyceria elata (Nash) Jones	tall mannagrass	Poaceae
Glyceria striata (Lamarck) Hitchcock	fowl mannagrass	Poaceae

Scientific Name	***Common Name***	***Family***
Hordeum jubatum L.	foxtail barley	Poaceae
Juncus compressus Jacq.	roundfruit rush	Juncaceae
Juncus vaseyi Engelmann	Vasey's rush	Juncaceae
Ligusticum tenuifolium S. Wats.	Idaho licorice-root	Apiaceae
Linnaea borealis L.	twinflower	Caprifoliaceae
Luzula multiflora (Ehrh.) Lej.	common woodrush	Juncaceae
Luzula parviflora (Ehrh.) Desv.	smallflowered woodrush	Juncaceae
Maianthemum stellatum (L.) Link	starry false lily of the valley	Liliaceae
Mentha arvense L.	field mint	Lamiaceae
Menyanthes trifoliata L.	buckbean	Menyanthaceae
Mertensia cilata (James ext Torr.) G. Don	tall fringed bluebells	Boraginaceae
Nuphar lutea (L.) Sm. ssp. polysepala (Engelm.) E.O. Beal	Rocky Mountain pond-lily	Nymphaeaceae
Pedicularis groenlandica Retz.	elephant-head lousewort	Scrophulariaceae
Pedicularis racemosa Dougl. ex Benth. ssp. alba Pennell	sickletop lousewort	Scrophulariaceae
Penstemon procerus Dougl. ex Graham var. procerus	pincushion beardtongue	Scrophulariaceae
Phleum alpinum L.	alpine timothy	Poaceae
Phleum pratense L.	timothy	Poaceae
Picea engelmannii Engelmann	Engelmann spruce	Pinaceae
Picea pungens Engelmann	Colorado blue spruce	Pinaceae
Pinus contorta Dougl. ex Loud.	lodgepole pine	Pinaceae
Platanthera dilatata (Pursh) Lindl. ex Beck var. albiflora (Cham.) Ledeb.	Scentbottle	Orchidaceae
Poa pratensis L.	Kentucky bluegrass	Poaceae
Polemonium caeruleum L.subsp. amygdalinum (Wherry)	western polemonium	Polemoniaceae
Polygonum bistortoides Pursh	American bistort	Polygonaceae
Potamogeton sp.	pondweed	Potamogetonaceae
Pyrola asarifolia Michx.	liverleaf wintergreen	Pyrolaceae

Scientific Name	***Common Name***	***Family***
Rhodiola integrifolia Raf.	ledge stonecrop	Crassulaceae
Rhodiola rhodantha (Gray) Jacobsen	redpod stonecrop	Crassulaceae
Rosa woodsii Lindl.	Woods' rose	Rosaceae
Rumex obtusifolius L.	bitter dock	Polygonaceae
Salix drummondiana Barratt	Drummon's willow	Salicaceae
Salix geyeriana Andersson	Geyer's willow	Salicaceae
Salix monticola Bebb	Rocky mountain willow	Salicaceae
Salix planifolia Pursh	diamondleaf willow	Salicaceae
Salix wolfii Bebb	Wolf's willow	Salicaceae
Senecio serra Hooker var. admirabilis (Green) Nelson	tall ragwort	Asteraceae
Shepherdia canadensis (L.) Nutt.	russet buffaloberry	Elaeagnaceae
Solidago multiradiata Ait.	Rocky Mountain goldenrod	Asteraceae
Sphagnum sp.	Sphagnum	
Spiranthes romanzoffiana Chamisso & Schlechtendal	Lady's tress	Orchidaceae
Swertia perennis L.	felwort	Gentianaceae
Taraxacum officinale G.H. Weber ex Wiggers	common dandelion	Asteraceae
Trifolium repens L.	white clover	Fabaceae
Trisetum spicatum (L.) Richter	spike trisetum	Poaceae
Trisetum wolfii Vasey	Wolf's trisetum	Poaceae
Utricularia macrorhiza Leconte [3]	great bladderwort	Lentibulariaceae
Vaccinium caespitosum Michx.	dwarf bilberry	Ericaceae
Vaccinium scoparium Leib. ex Coville	grouse whortleberry	Ericaceae
Veronica wormskjoldii Roemer & J.A. Schultes	American alpine speedwell	Scrophulariaceae
Viola macloskeyi Lloyd	small white violet	Violaceae

[1] Species tracked by CNHP
[2] US Forest Service, Region 2 Sensitive Species as of 12/12/03
[3]Carnivorous plant

Appendix B: Ecological Specifications for Montane Fens

SOUTHERN ROCKY MOUNTAINS ECOREGION
MONTANE FEN—SMALL PATCH

Characteristic plant associations:

Carex aquatilis Herbaceous Vegetation
Carex aquatilis - Carex utriculata Herbaceous Vegetation
Carex lasiocarpa Herbaceous Vegetation
Carex simulata Herbaceous Vegetation.
Deschampsia cespitosa Herbaceous Vegetation
Eleocharis quinqueflora Herbaceous Vegetation
Kobresia myosuroides - Thalictrum alpinum
Kobresia simpliciuscula - Scirpus pumilus
(Picea engelmannii)/Betula glandulosa/Carex aquatilis-Sphagnum angustifolium

SCALE AND RANGE: SMALL PATCH AND LIMITED

Montane fen ecological system is a small patch system confined to specific environments defined by ground water discharge, soil chemistry, and peat accumulation of at least 40 cm. This system includes extreme rich fens and iron fens, both rare within the Southern Rocky Mountains ecoregion. Fens form at low points in the landscape or near slopes where ground water intercepts the soil surface. Ground water inflows maintain a fairly constant water level year-round, with water at or near the surface most of the time. Constant high water levels lead to accumulation of organic material. In addition to peat accumulation and perennially saturated soils, the extreme rich and iron fens have distinct soil and water chemistry, with high levels of one or more minerals such as calcium, magnesium, or iron. They usually occur as a mosaic of several plant associations dominated by either *Carex aquatilis, C. utriculata, C. simulata, C. lasiocarpa, Betula glandulosa, Kobresia myosuroides, K. simpliciuscula* and *Scirpus pumilus*. Moss (*Sphagnum* spp.) is indicative of iron fens. The surrounding landscape may be ringed with other wetland systems, e.g., riparian shrublands, or a variety of upland systems from grasslands to forest. Within the Southern Rocky Mountains ecoregion, this system is limited to a few small areas, notably South Park, Mount Evans, Grand Mesa, and Iron Creek.

The montane fen ecological system is rare in the Southern Rocky Mountains ecoregion. Since this system is reliant on groundwater any disturbances that impact water quality or quantity are a threat. These treats include groundwater pumping, mining, and improper placement of septic systems.

MINIMUM SIZE: 0.5 acre

SEPARATION DISTANCES: 1) substantial barriers to natural processes or species movement, including cultural vegetation greater than ¼ mile wide, major highways,

urban development, or large bodies of water. 2) natural community from a different ecological system wider than ½ mile wide, 3) major break in topography, soils, geology, etc., especially one resulting in a hydrologic break.

Justification: Primary criteria to be considered are the hydrologic system and the surrounding landscape. The separation distance for intervening natural or semi-natural communities assumes a different hydrologic regime. They are often isolated hydrologically from other wetlands, and easily impacted by surrounding land use.

RANK PROCEDURE: 1) condition, 2) landscape context, 3) size. Condition and landscape context are the primary ranking factors, with size secondary.

CONDITION SPECIFICATIONS:
A –rated condition: Natural hydrologic regime intact. No or little evidence of wetland alteration due to increased or decreased drainage, clearing, livestock grazing, mining (esp. peat mining), etc. Native species that increase with hydrologic and surface disturbance e.g., *Deschampsia cespitosa* and *Carex aquatilis* are present in typical proportions in diverse communities, rather than in expansive, low diversity stands. Non-native species are generally not a problem in fens of the Southern Rockies, and A-ranked occurrences should exemplify this pattern by having no or very few exotic species present. Roads or other antrhopogenically induced fragmentation is limited to less than 1% of the occurrence.

B- rated condition: Natural hydrologic regime nearly intact. Alteration from local drainage, upstream water diversions, groundwater pumping, haying, or livestock grazing is easily restorable by ceasing such activities. Alterations that are generally recognized as unrestorable (e.g., peat mining) may be present, but on less than 10% of the occurrence. Native species that increase with hydrologic and physical disturbance are absent, low in abundance, or very restricted. Few exotic species are present, with little potential for expansion if restoration occurs. The occurrence is virtually intact with fragmentation from roads, etc. limited to less that 3% of the occurrence.

C-rated condition: Natural hydrologic regime altered by local drainage or groundwater pumping. Alteration may be from clearing, mining or livestock grazing and may be locally severe. Native species that increase with disturbance or changes in hydrology/nutrients may be prominent, but with restoration activities diversity in these communities can potentially be enhanced.

D –rated condition: Natural hydrologic regime or disturbance not restorable. Fundamental structure of the substrate has been destroyed to such an extent that the occurrence is effectively unrestorable. System remains fundamentally compromised despite restoration of some processes. Native species that increase with disturbance or changes in hydrology/nutrients are prominent to dominant. Exotic species may be present in significant numbers.

Justification for A-rated criteria: Montane fens in the Southern Rocky Mountains depend on perennial water regime, seasonally to permanently saturated soils, and occasional flooding disturbance. A-ranked occurrences have these processes intact, with no history of alteration to the hydrology or surface structure.

Justification for C/D threshold: C-ranked occurrences have potential for restoration over several decades with significant resources. In D-ranked occurrences, hydrologic alterations and surface structure have been altered so extensively that there is little or no potential for restoration of these fundamental aspects of fens.

SIZE SPECIFICATIONS:
A – rated size: Very large (> 2 acres)
B –rated size: Large (1 to 2 acres)
C –rated size: Moderate (.5 to 1 ac)
D –rated size: Small (< .5 ac)

Justification for A-rated criteria: Fens are usually composed of mosaics of different plant associations included within this system. Very large fen complexes contain the maximum diversity of species and plant associations. Occurrences of this size would likely contain sufficient internal variability to capture characteristic biophysical gradients, natural geomorphic features, and hydrologic variation. In A-ranked occurrences, the majority of the occurrence is buffered from edge effects (e.g., cattle grazing along the edges of the wetlands) and small hydrology alterations.

Justification for C/D threshold: C-ranked occurrences generally contain moderate species and plant association diversity, and are large enough to sustain some natural or human caused perturbations. D-ranked occurrences have noticeably reduced species and plant association diversity, and are to small to remain viable with changes to the hydrology. They are also extremely susceptible to invasions by native and non-native ruderal species making them subject to loss of typical fen plant associations and their associated plants and animals.

LANDSCAPE CONTEXT SPECIFICATIONS:
A-rated landscape context: Uplands or any other system within the ground watershed are largely unaltered by urban or agricultural uses (>90% natural), and include few to no recent clearcuts, peat or gravel mines, pastures that are excessively grazed, or roads. There are no barriers to movement of species, water, nutrients, or other natural forms of energy and material between the occurrence and the surrounding systems. There are also few barriers to movement between this occurrence and other occurrence of the same system that may be necessary to maintain population dynamics.

B-rated landscape context: Uplands surrounding occurrence and within ground watershed may have moderate urban or agricultural alteration (60 to 90% natural), or natural vegetation is heavily managed (e.g., grazing, haying). There are few unnatural barriers to the movement of species and materials, and the occurrence retains much

connectivity with adjacent systems and nearby occurrences of the same system. Some natural processes such as flooding and fire may be compromised.

C-rated landscape context: Uplands surrounding occurrence and within ground watershed are fragmented by urban or agricultural alteration (20 to 60% natural). However sufficient upland allows some degree of natural interactions between wetland and upland systems. Sufficient natural or semi-natural vegetation around the occurrence esists that the occurrence is not heavily influenced by human induced changes in hydrologic regimes, nutrient cycles, or in the uplands. Some barriers to movement of species and materials are present limited connectivity exists among upland fragments. Natural patterns of water flow, fire, or nutrient cycling have been heavily altered by human influences. Restoration of most of these natural processes to near their historic patterns is feasible.

D-rated landscape context: Uplands surrounding occurrence within ground watershed are mostly converted to agricultural or urban uses. Connectivity among natural vegetation patches and natural processes are almost nonexistent. Restoration is not feasible within reason.

Justification for A-rated criteria: These occurrences are within nearly intact watersheds and ecological processes, fully supporting the occurrences natural structure, composition, and function. Native systems surrounding the occurrence buffer the fens from any unnatural human influences resulting from changes in water flows, nutrient status, or other hydrologic alterations. Connectivity of habitats allows natural processes and species migration to occur.

Justification for C/D threshold: C-ranked occurrences receive at least some benefit from adjacent natural or semi-natural vegetation (e.g., there is movement across wetland and native upland boundaries), and there is limited buffering from upland influences. D-ranked occurrences receive very little benefit from natural surroundings, so they are subject to altered hydrology, nutrient influxes, invasive species, and population and diversity declines resulting from a cessation of organismal immigration

AUTHORSHIP: Renée Rondeau, John Sanderson, Denise Culver
Date: July 19, 2000 (edited February 27, 2001)

Appendix C: Photos (on enclosed CD-Rom)

Roll E	**Date: 08/12/03**
Frame #	**Comments**
P8110001	fen west of Strawberry Lake
P8110002	fen west of Strawberry Lake
P8110003	fen west of Strawberry Lake
P8110004	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8110005	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8110006	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8110007	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8110008	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8110009	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8110010	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8110011	Spiranthes romonzoffiana
P8110012	Carex interior
P8110013	Carex magellanica
P8110014	Carex magellanica
P8110015	Carex interior
P8110016	Menyanthes trifoliata
P8120017	Carex lasiocarpa community
P8120018	Carex lasiocarpa community
P8120019	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8120020	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8120021	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8120022	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8120023	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8120024	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8120025	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8120026	Carex lasiocarpa community
P8120027	Nuphar lutea ssp. polysepala on Strawberry Lake - looking east
P8120028	Nuphar lutea ssp. polysepala on Strawberry Lake - looking east
P8120029	juvenile chorus frog
P8120030	juvenile chorus frog
P8120031	juvenile chorus frog
P8120032	small kettle pond located east of Strawberry Lake
P8120033	small kettle pond located east of Strawberry Lake - Carex lasiocarpa stand
P8120034	small kettle pond located east of Strawberry Lake - Carex lasiocarpa stand
P8120035	Carex buxbaumii
P8120036	Carex buxbaumii
P8120037	small kettle pond located east of Strawberry Lake
P8120038	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8120039	Drosera rotundifolia w/Comarum palustre & Sphagnum
P8120040	Drosera rotundifolia w/Comarum palustre & Sphagnum

P8120041	Nuphar lutea ssp. polysepala
P8120042	Nuphar lutea ssp. polysepala
P8120043	small kettle pond (foreground) and Strawberry Lake (background) - looking west
P8120044	small kettle pond (foreground) and Strawberry Lake (background) - looking west
P8120045	small kettle pond (foreground) and Strawberry Lake (background) - looking west
P8120046	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120047	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120048	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120049	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120050	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120051	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120052	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120053	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120054	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120055	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120056	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120057	lush "riparian" community in kettle pond - butterfly, bees, etc.
P8120060	Calamagrostis canadensis stand - healthy, lush, tall!
P8120061	beaver dams, meadows located east of Strawberry Lake area
P8120062	beaver dams, meadows located east of Strawberry Lake area
P8120063	beaver dams, meadows located east of Strawberry Lake area
P8120064	beaver dams, meadows located east of Strawberry Lake area
P8120068	sedge meadows in eastern-most area
P8120069	sedge meadows in eastern-most area
P8120070	sedge meadows in eastern-most area
P8120071	sedge meadows in eastern-most area
P8120072	sedge meadows in eastern-most area
P8120073	sedge meadows in eastern-most area
P8120074	sedge meadows in eastern-most area
P8120075	sedge meadows in eastern-most area
P8120076	sedge meadows in eastern-most area
P8120077	kettle pond in uplands
P8120078	kettle pond in uplands - Carex utriculata (nearest water) and Carex vesicaria (to left of Carex utriculata)
P8120089	moose - cow and calf observed in fen

Roll F	**Date: 08/13/03**
Frame #	**Comments**
P8120010	Goodyera oblongifolia
P8120011	Goodyera oblongifolia
P8120012	Goodyera oblongifolia
P8120013	Goodyera oblongifolia
P8120014	Goodyera oblongifolia
P8120015	Goodyera oblongifolia
P8120016	Goodyera oblongifolia
P8120017	Goodyera oblongifolia
P8120018	Goodyera oblongifolia
P8120019	Goodyera oblongifolia
P8120020	Goodyera oblongifolia
P8120025	unknown mushroom (Galeriana atkinsoniana???)
P8120026	unknown mushroom (Galeriana atkinsoniana???)
P8120027	unknown mushroom (Galeriana atkinsoniana???)
P8120028	unknown mushroom (Galeriana atkinsoniana???)
P8120029	unknown mushroom (Galeriana atkinsoniana???)
P8120030	unknown mushroom (Galeriana atkinsoniana???)
P8120031	unknown mushroom (Galeriana atkinsoniana???)
P8120030	various damseflies and dragonflies
P8120031	various damseflies and dragonflies
P8120032	various damseflies and dragonflies
P8120033	various damseflies and dragonflies
P8120034	various damseflies and dragonflies
P8120035	various damseflies and dragonflies
P8120036	various damseflies and dragonflies
P8120037	various damseflies and dragonflies
P8130038	unknown mushroom
P8130039	unknown mushroom
P8130040	unknown mushroom
P8130041	unknown mushroom

Roll J	**Date: 09/19/03**
Frame #	**Comments**
P9190001	seep on western edge of fen (the one located to the west of Strawberry Lake)
P9190002	seep on western edge of fen (the one located to the west of Strawberry Lake)
P9190003	seep on western edge of fen (the one located to the west of Strawberry Lake)
P9190004	seep on western edge of fen (the one located to the west of Strawberry Lake)
P9190005	seep on western edge of fen (the one located to the west of Strawberry Lake)
P9190006	seep on western edge of fen (the one located to the west of Strawberry Lake)
P9190007	seep on western edge of fen (the one located to the west of Strawberry Lake)
P9190008	seep on western edge of fen (the one located to the west of Strawberry Lake)
P9190009	seep on western edge of fen (the one located to the west of Strawberry Lake)
P9190012	seep on western edge of fen (the one located to the west of Strawberry Lake)
P9190013	view of seep while standing in fen looking west
P9190014	view of seep while standing in fen looking west
P9190015	view of seep while standing in fen looking west
P9190016	Drosera rotundifolia senescencing
P9190017	Drosera rotundifolia senescencing
P9190018	Drosera rotundifolia senescencing
P9190019	Drosera rotundifolia senescencing
P9190020	view of seep while standing in fen looking west
P9190021	view of seep while standing in fen looking west
P9190022	view of seep while standing in fen looking west
P9190023	view of seep while standing in fen looking west
P9190024	view of seep while standing in fen looking west
P9190025	view of seep while standing in fen looking west

Appendix D: Element Occurrence Records

Addendum - Botanical Survey of Strawberry Lake, Arapaho National Forest, Grand County, Colorado

Colorado Natural Heritage Program
College of Natural Resources, 8002 Campus Delivery
Colorado State University
Fort Collins, Colorado 80523-8002

Natural Heritage Program COLORADO

Colorado State University
Knowledge to Go Places

Addendum - Botanical Survey of Strawberry Lake, Arapaho National Forest, Grand County, Colorado

Prepared for:

U.S. Forest Service
Arapaho-Roosevelt National Forests and Pawnee National Grassland, Supervisor's Office
240 West Prospect
Fort Collins, CO 80526

Prepared by:
Joe Rocchio
November 17, 2004

Colorado Natural Heritage Program (CNHP)
College of Natural Resources
8002 Campus Delivery
Colorado State University
Fort Collins, Colorado 80523-8002

Cover photograph: Floating mat dominated by *Carex lasiocarpa* with an understory of *Sphagnum* spp., *Comarum palustris*, *Drosera rotundifolia*, *Carex interior*, *Carex buxbaumii*, and *Carex magellanica*.

Photo taken by: Joe Rocchio

Prepared under U.S. Forest Service check-writing authority (<$2500) FY04; job code NFWF12. Contract was performed under Purchase Order Number 43-82FT-4-0793.

Table of Contents

List of Tables

Introduction

The Strawberry Lake analysis area is located in Grand County, approximately 10 miles east of the Town of Granby and within the Arapaho National Recreation Area. The site consists of a series of kettle ponds within an extensive wetland complex.

The Strawberry Lake fen system was first cursorily assessed by the Forest Service for rare plants and plant communities in July, 2002, by several Forest Service staff, including Steve Popovich, the Forest Botanist (Joe Stevens personal communication with Steve Popovich, August, 2002). Another floristic inventory and ecological and conservation assessment was conducted by the Colorado Natural Heritage Program (CNHP) during the summer of 2003 (Rocchio and Stevens 2003). To augment the results gained from the 2003 field visits, CNHP was contracted in 2004 to conduct the following:

(1) perform botany field surveys during summer 2004 at the Strawberry Lake Fen; and
(2) Deliver a report and inventory information.

CNHP ecologists, Joe Rocchio and Jack Siegrist, visited Strawberry Lake Fen on July 6, 2004 and spent 6 hours (12 person hours) searching the site for any species not observed during previous site visits. The wet meadows and fens located near Strawberry Lake, as well as the seep located to the West of the lake, were thoroughly searched. Additionally, Steve Popovich performed a field visit in early summer, 2004, to collect early-blooming species which may have been overlooked in previous efforts.

This report summarizes results of the 2004 CNHP and Popovich efforts (e.g. species lists). The 2004 survey focused on identifying and recording any plant species encountered which were not documented in earlier visits. A full description of the project and methods can be found in the report *Botanical Survey of Strawberry Lake, Arapaho National Forest, Grand County, Colorado* (Rocchio and Stevens 2003).

Results

Approximately 100 plant species were observed during previous site visits (Rocchio and Stevens 2003). Another 12 new species were identified during the 2004 field visit by CNHP and U.S. Forest Service botanist, Steve Popovich (Table 1). In addition, two sphagnum species collected in 2003 were identified by William Weber and are listed in Table 1. Table 2 shows the sphagnum species collected by CNHP in 2003 and collections by Steve Popovich in 2004. Popovich's collections resulted in two new species not encountered by CNHP, *Ranunculus alismifolius* var. *montanus* and *Veronica nutans*.

Table 1. New Species Documented by CNHP in 2004.

Scientific Name	***Common Name***	***Family***
Antennaria corymbosa Nelson	Flat-top pussytoes	Asteraceae
Cardamine cordifolia Gray	Heartleaf bittercress	Brassicaceae
Cardamine pensylvanica Muhlenberg	Pennsylvania bittercress	Brassicaceae
Carex angustior Mackenzie	Star sedge	Cyperaceae
Carex limosa L.*	Mud sedge	Cyperaceae
Carex limnophila Hermann	Smallwing sedge	Cyperaceae
Epilobium hornemannii Haussknecht	Hornemann's willowherb	Onagraceae
Juncus confusus Coville	Colorado rush	Juncaceae
Petasites sagittatus (Banks) Gray	Arrowleaf sweet coltsfoot	Asteraceae
Ranunculus alismifolius Geyer var. montanus Watson	Water plantain buttercup	Ranunculaceae
Salix brachycarpa Nuttall	Short-fruit willow	Salicaceae
Sphagnum warnstorfii Russ.	Warnstorf's sphagnum moss	Sphagnaceae
Sphagnum squarrosum Swartz ex Crome	Sphagnum moss	Sphagnaceae
Veronica nutans Bongard	Alpine speedwell	Scrophulariaceae

* Species tracked by CNHP

Table 2. Sphagnum Specimens Collected by CNHP in 2003 and all collections by S. Popovich in 2004.

Collection #	Species	Herbarium
S. Popovich, #8324, US Forest Service	Carex canescens L.	Colorado State University
S. Popovich, #8325, US Forest Service	Eriophorum angustifolium Honckeny	Colorado State University
S. Popovich, #8326, US Forest Service	Galium trifidum L. ssp. subbiflorum (Wieg.) Piper	Colorado State University
S. Popovich, #8327, US Forest Service	Ranunculus alismifolius Geyer var. montanus Watson	Colorado State University
William Weber, # B-114094	Sphagnum warnstorfii Russ.	University of Colorado
William Weber, # B-114095	Sphagnum squarrosum Swartz ex Crome	University of Colorado
William Weber, # B-114096	Sphagnum squarrosum Swartz ex Crome	University of Colorado
William Weber, # B-114097	Sphagnum squarrosum Swartz ex Crome	University of Colorado
William Weber, # B-114098	Sphagnum squarrosum Swartz ex Crome	University of Colorado
William Weber, # B-114099	Sphagnum squarrosum Swartz ex Crome	University of Colorado
William Weber, # B-114100	Sphagnum warnstorfii Russ.	University of Colorado
William Weber, # B-114101	Sphagnum squarrosum Swartz ex Crome	University of Colorado
S. Popovich, #8328,US Forest Service	Veronica nutans Bongard	Colorado State University

One important observation made by CNHP in 2004 was that during the site visit, very few individuals of roundleaf sundew (*Drosera rotundifolia*) were observed. Water levels in Strawberry Lake appeared to be higher than observed in 2003 and may have affected growth of the sundew. Annual monitoring of the sundew population, along with associated environmental variables, would provide critical information regarding the species life history and the trend of the local population.

A total of 111 species have been documented in the study area to date. We feel the area has been adequately surveyed for higher vascular plants by the completion of the 2004 survey efforts. However, bryophytes species deserve additional attention. Additional survey efforts of aquatic plants may also reveal additional species as only near-shoreline plants were documented. Some bryophytes and/or aquatic species may be rare.

Literature Cited

Rocchio, J. and J. Stevens. 2003. Botanical Survey of Strawberry Lake, Arapaho National Forest, Grand County, Colorado. Unpublished report prepared for the U.S. Forest Service, Arapaho-Roosevelt National Forest, Supervisor's Office, Fort Collins, CO. Colorado Natural Heritage Program, Colorado State University, Fort Collins, CO.