

A Preliminary Wetland Vegetation Classification
for a portion of
Colorado's West Slope

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the Colorado Department of Natural Resources
and the Environmental Protection Agency

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Cover photo: In this subalpine lake at 3,200 m (10,400 ft.), a Rocky Mountain pondlily (*Nuphar lutea* ssp. *polysepala*) community with its striking yellow flowers grows in shallow water. Deep peat along the lake's shore indicates that this site has remained relatively unchanged for thousands of years. A fewflower spikerush (*Eleocharis quinqueflora*) community occurs on the nutrient-poor waterlogged peat.

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SUMMARY

This report presents the results of a wetland vegetation survey for a portion of Colorado's West Slope in the Upper Colorado River watershed. It describes 35 plant associations into which 152 sample plots of natural vegetation (stands) were classified. The plant associations are placed in the context of The Nature Conservancy's Preliminary Vegetation Classification of the Western United States (Bourgeron and Engelking 1994), which is based on the UNESCO Physiognomic-Ecological Classification of Plant Formations of the Earth (1973) as revised by Driscoll *et al.* (1984).

For each plant association, this report describes its distribution in the state and region, vegetation composition, and environmental conditions where it is found (i.e., geomorphologic setting, hydrology, soils, etc.). Plant association descriptions also include notes on successional status and management as well as a list of other wetland plant associations with which it may be found. The relationship of each plant association to previously described associations is also discussed. A dichotomous key to the plant associations is provided.

This study marks the beginning of the Colorado Natural Heritage Program's (CNHP) effort to complete an accurate portrait of Colorado's wetland vegetation in a manner similar to the riparian classification work also being done by CNHP (Kittel and Lederer 1993, Kittel *et al.* 1994, 1995). It is part of an ongoing effort by CNHP to develop a standardized classification of all of Colorado's vegetation (wetland, riparian, and upland). Information from Colorado is in turn used to continually update a vegetation classification for the entire western United States that is maintained by the Western Regional Office of The Nature Conservancy. The end result of these efforts--a comprehensive and consistent vegetation classification--will aid policy makers, land use planners, and resource managers in making wise decisions governing the use and conservation of natural heritage resources.

The need for this classification became even more apparent during the course of this study. Of the thirty-five plant associations described in this study, eleven (nearly one third) are not listed by Bourgeron and Engelking (1994) as occurring in Colorado, mainly because descriptions of these plant associations never or only rarely appear in existing literature. Six of these eleven are not even listed for the region, illustrating the general inattention paid to Rocky Mountain wetlands. It is clear that despite recent efforts by many individuals and organizations, our knowledge of Colorado's wetlands remains inadequate.

This classification must be considered preliminary. A short field season did not allow complete treatment of all wetland types in the large study area, especially wetlands at relatively low elevation on private land. Also, the information included here is subject to peer review, field testing, and revision.

INTRODUCTION

Background

Most people easily perceive that marshes, fens, and willow carrs are all wetlands, but calling them “wetlands” begs the question, “what is a wetland?” Cowardin *et al.* (1979) point out that no single, correct, indisputable, ecologically sound definition for wetlands exists because many types of wetlands occur on the landscape and because no clear-cut line exists between wetland and non-wetland. In general terms, wetlands are areas where saturation with water is the dominant factor governing soil development and determining the nature of plants and animals that live in the soil and on its surface (Cowardin *et al.* 1979). Common wetland plants include willows (*Salix* spp.), sedges (*Carex* spp.), rushes (*Juncus* spp.), certain grasses (e.g., *Calamagrostis canadensis* and *Glyceria* spp.), and spikerushes (*Eleocharis* spp.). Wetlands also include areas perennially flooded, but covered with less than 2 m (6.6. ft.) of water. These areas typically support emergent and submerged vegetation such as water milfoil (*Myriophyllum sibiricum*), bur-reeds (*Sparganium* spp.), and pondweeds (*Potamogeton* spp.).

Hydrology makes a wetland. When the hydrology of a wetland changes, the wetland changes. For example, if the average water level in a wetland increases or decreases, the vegetation and subsequently the fauna will change as well. Since water is a such an important, limited resource in Colorado, wetlands have been greatly influenced by humans since European settlement. Many wetlands were destroyed as water was diverted, dammed, and otherwise manipulated. In some areas irrigation has created wetlands, but in general the flora (and presumably the fauna) living in created wetlands does not resemble what historically inhabited Colorado’s wetlands.

Despite the importance of water to Coloradoans, the wetland ecosystems in this state are much more poorly understood than wetlands in other parts of North America (e.g., New England). Based on work outside the region and limited work in the Rocky Mountains, we do know that wetlands perform a number of important functions that make them valuable to not only the native flora and fauna but also the people of Colorado (Windell *et al.* 1986). Wetlands provide habitat for many animals, including waterfowl and other birds, fish, and certain mammals. They provide many hydrologic functions such as floodwater abatement and aquifer recharge. Wetlands also help maintain water quality by trapping sediments, excess nutrients, and heavy metals, including uranium (Owen and Breit 1995). In some areas wetland plant communities secure streambanks and lake shores, preventing erosion and sedimentation. Many wetlands in Colorado are also important for grazing, hay production, and recreation.

The Colorado Natural Heritage Program (CNHP) seeks to understand the variety of wetlands in Colorado, their distribution across the state and the region, and their relative natural heritage value. CNHP approaches this effort using the tool of a statewide and regional vegetation classification, using the classification to organize vegetation information and to analyze the communities in terms of location, abundance, condition, and habitat. The plant association (loosely called a “community”) forms the core of the Heritage Program classification. A plant association is a group of plants that commonly grow together under similar environmental conditions. Information about plant associations is located one centralized database for the entire state (the Biological and Conservation Data System), facilitating use by policy makers, land use

planners, and resource managers when making land use decisions, setting conservation priorities, and doing environmental impact reviews.

Classification of natural entities is the necessary first step towards understanding those entities. Unfortunately, unlike plants and animals, plant associations do not have centuries of classification history. Knowledge of plant associations allows appropriate resource management decisions because it tells us how the natural vegetation of a particular site should appear, and in many cases it suggests how a particular community will respond to a given management prescription. Knowledge of plant communities also allows an assessment of how rare or common, vulnerable or secure a certain type of wetland is, i.e., the natural heritage or conservation value of a wetland. For example, cattail (*Typha latifolia*) communities at low elevations are relatively common, often inadvertently appearing in human created wetlands; destruction of such wetlands is relatively easily mitigated. On the other hand, russet sedge (*Carex saxatilis*) communities are uncommon in Colorado. Because they generally occur on peat that formed over thousands of years, destruction of a russet sedge community cannot be mitigated.

Recent efforts notwithstanding, Colorado's wetland flora and the associated fauna is poorly understood. Occasional disparate wetland studies appeared from the early twentieth century to the mid-1980s, but not until 1986 did a publication pull together in a comprehensive manner existing information on Rocky Mountain wetlands, much of which applies to Colorado (Windell *et al.* 1986).

Most plant community classification studies in Colorado yield very little information on wetlands, including Baker's (1984) preliminary classification of the natural vegetation of Colorado, as well as the classifications for the White River National Forest (Hess and Wasser 1982), southern Colorado (DeVelice *et al.* 1985), Gunnison and Uncompahgre National Forests (Komárková 1986), and Region II of the U.S. Forest Service (Johnston 1987). Beginning in the late-1980s, a few studies have focused on riparian vegetation (e.g., Baker 1989, Kittel and Lederer 1993, Kittel *et al.* 1994, Kittel *et al.* 1995), but these have generally included wetlands only when they occurred in a riparian zone, excluding many other important types of wetland vegetation.

Previous to the mid-1980s, only occasional studies have documented information about non-riparian wetland communities (e.g., Ramaley and Robbins 1909, Johnson 1941, Bierly 1972). Cooper (from 1986 onward, see literature cited) has prodigiously produced information about wetland plant communities in Colorado. Bourgeron and Engelking (1994) compiled a list of communities that have been reported from Colorado with an indication of the relative rarity or commonness, but many communities present in the state are not listed. Despite these efforts, our knowledge of wetlands in many areas of Colorado remains poor, and we still lack a consistent, comprehensive, state-wide classification of plant communities.

In this report, we present a classification of wetland vegetation from a portion of the West Slope in the Upper Colorado River basin. The area includes the southern portion of the White River Plateau, the northern portion of the Gunnison River basin east of Paonia, and the area in between, west of the continental divide. The stands classified were all found in natural wetlands, most of which were relatively undisturbed by hydrologic modifications, heavy grazing, etc. The plant

associations described were placed in the context of The Nature Conservancy's Preliminary Vegetation Classification of the Western United States (Bourgeron and Engelking 1994), which is updated and maintained by Heritage Programs throughout the west (excluding California).

The classification presented here must be considered preliminary. It is subject to peer review, field testing, and revision. Also, the short field season available for this project resulted in an under-sampling of plant associations in the region. Some are known from the literature to occur in the region but were not sampled during this study (e.g., the frequently found *Polygonum amphibium* plant association and the rare *Carex limosa* plant association). Still other plant associations (especially in unique environmental settings) may remain undescribed in either this study or previous studies by other authors.

An important part of this type of classification work is the discovery by field workers of sites with high natural heritage value, i.e., locations with rare or imperiled plants or natural communities. Many of the sites visited in the course of field work for this study will be incorporated into CNHP's Biological and Conservation Data System for later inclusion in reports to National Forests or other management agencies as appropriate on the status of elements in their jurisdiction. This information will also be used to assess the relative status (e.g., distribution, imperilment, etc.) of the plant associations described here.

The Study Area

The study area is located in central Colorado and encompasses much of the Colorado River watershed above Glenwood Springs and part of the northern Gunnison River Basin east of Paonia. The area stretches almost to the Gunnison River in the south and it terminates in the north at the ridgeline that separates the White River and Colorado River watersheds. Toward the north, the Gore Range delimits the eastern edge of the study area; toward the south, the eastern edge is marked by the Continental Divide. Elevation ranges from around 1,740 m (5,700 ft) along the major rivers on the west end of the study area to over 4,270 m (14,000 ft.) in the high peaks on the eastern edge of the study area. In one short field season it was impossible to adequately cover this entire area of approximately 6,800 square miles, so separate ten-day outings targeted several subregions in the study area. These subregions centered roughly around the southern portion of the White River Plateau (the Flat Tops), the Elk Mountains, the West Elk Mountains, the Gore Range, and a large area around Taylor Park.

High elevation sites within the study areas receive around 1,150 mm (45") of precipitation annually, mostly as snow. Lower zones within the study area (e.g., near Paonia or Glenwood Springs) receive 300-400 mm (12-16") a year on average (Doesken *et al.* 1984). At high elevations, mid-day temperatures in July and August average around 65°F, but may drop below freezing any night of the summer. The growing season in these areas may be only several weeks long. Lower elevations experience a longer growing season, and mid-summer day time temperatures that average over 85°F. (Owenby and Ezell 1992).

The geology of this area is extremely complicated, as a glance at a geologic map quickly reveals (see Tweto *et al.* 1976 and 1978). No brief explanation here can capture this complexity, but a few sentences will illustrate it. The southern part of the White River plateau is a large mesa of Paleozoic sedimentary rock capped with thick layers of dark Tertiary basaltic flows. Many small,

shallow ponds and lakes dot this plateau. The peaks of the Elk Mountains consist of Middle Tertiary intrusive rocks; lower elevation sedimentary rocks around them are largely Permian and Pennsylvanian sandstones and mudstones as well as Cretaceous sandstones. Some carbonaceous rocks also are found around the Elk Mountains and in the Sawatch Range, especially toward Leadville. The peaks around Taylor Park are a complex mosaic of Precambrian granitic rocks with pockets of Paleozoic sedimentary rocks and occasional Tertiary igneous intrusions. Lower elevations nearby (e.g., in Taylor Park) consist of glacial deposits from these rocks. The West Elk Mountains consist largely of Oligocene lavas and breccias on top of Cretaceous shales exposed at lower elevations (Tweto *et al.* 1976 and 1978).

This complex geologic setting creates possibilities for unusual water and soil chemistry that in turn may lead to the presence of uncommon plant associations. This study captured most of the common plant associations of the area; more work should be done, however, to insure that the uncommon plant associations of high natural value are also characterized.

Typical Southern Rocky Mountain flora grows across the study area. Elevations up to about 2,300 m (ca. 7,500 ft.) consist mostly of a shrubland mosaic with Gambell's oak (*Quercus gambelii*), shadbush (*Amelanchier alnifolia*), sagebrush (*Artemisia* spp.), and snowberry (*Symphoricarpos* spp.). At these lower elevations wetlands occur most frequently in riparian areas on floodplains, as oxbow lakes, and in beaver complexes. Seeps and natural lakes and ponds are much less common.

Above 2,300 m the shrubland quickly diminishes, and quaking aspen (*Populus tremuloides*) becomes more prominent. In the zone from 2,500 m (ca. 8,000) to 2,900 m (ca. 9,500 ft.), Engelmann's spruce-subalpine fir (*Picea engelmannii*-*Abies lasiocarpa*) forests become at least as abundant as quaking aspen forests. Lodgepole pine (*Pinus contorta*) forests with sparse understories are also very common. In this montane zone, "potholes" (small ponds formed by glaciers) occur where glacial till covers relatively flat terrain, as in the area northeast of Taylor Reservoir.

From 2,900 m to around 3,300 m (ca. 11,000 ft.), the subalpine zone, Engelmann spruce-subalpine fir forests dominate. In this zone one finds moist, open mountain meadows dominated by tufted hairgrass (*Deschampsia cespitosa*), Thurber fescue (*Festuca thurberi*), and Canada bluejoint (*Calamagrostis canadensis*) as well as expansive willow carrs of planeleaf willow (*Salix planifolia*). Wolf's willow (*Salix wolfii*), and shortfruit willow (*Salix brachycarpa*) are also characteristic.

Trees give way to forb and graminoid meadows above 3,350 m (11,000 ft.). In the subalpine and extending above treeline, where evapotranspiration is low, peatlands (fens) dominated by sedges have formed in many wetland complexes.

Figure 1 The Study Area

METHODS

Site Selection

To sample as much of the diversity within the study area as possible in one short field season, we employed a stratified-random approach based on Austin and Heyligers's (1989) gradsect concept (this approach has been widely used by Heritage Program classification projects throughout the West). The study area was first subdivided into five regions, and each subregion into 460 m (1,500 ft.) elevation bands. Each wetland in a subregion that appears on a U.S. Geological Survey 7.5' topographic map was classified into an environmental cell type, a combination of the elevation band in which it occurs (a surrogate for climate) and its connectedness to perennial streams (separating isolated water bodies such as kettle ponds and lakes from wetland systems associated with streams such as beaver ponds).

The limited number of field days available restricted the number of cell types we could sample, hence the number of variables we could use to stratify. Time permitting, we would have incorporated size of the watershed above the wetland (a measure of energy in the system) and geology (to separate areas that may vary in soil and water chemistry). As a result of reducing the number of variables, we may have missed sites with unusual site features and uncommon plant associations.

Wetlands were classified in cells defined by all possible combinations of the stratification variables in a subregion. At least one site was then chosen from each cell type (i.e., from glacial lakes at 12,000 feet to beaver pond systems at 7,000 feet). With our focus on natural vegetation, we sampled primarily wetland communities that have not been drastically altered by human activity, with a few exceptions at low elevations. Degree of alteration or human disturbance was initially estimated from color infrared aerial photographs. Rejected sites included those converted to agriculture, those with heavy recreational use or heavy grazing, or those that were strongly influenced by hydrological modifications such as dams and ditches. At relatively low elevations we included some areas dominated by non-native plants (e.g., *Bidens cernua*) because few other sites were available for sampling. At many sites non-natives were present but not dominant.

As noted before, site selection at lower elevations was restricted due to the prevalence of private lands. Time did not permit a heavy investment in landowner contact, so low elevation wetlands were under-represented in the sampling plan.

Data Collection

At each site visited, we first determined if it met the criterion of minimal human disturbance. If the condition of the site was accepted as relatively natural, the wetland complex was mapped into homogenous stands of vegetation with no preconceived notion of existing vegetation classifications. For example, a pond system may have been mapped into units consisting of submerged vegetation (e.g., a pondweed (*Potamogeton* sp.) community), emergent shoreline vegetation (e.g., a beaked sedge (*Carex utriculata*) community), and a mesic graminoid band (e.g., bluejoint (*Calamagrostis canadensis*) community).

Selection of stands to be sampled was based on “subjective sampling without preconceived bias” as described by Mueller-Dombois and Ellenberg (1974). An attempt was made to avoid sampling in ecotones between communities, but some wetland communities (e.g., many wet forb meadows) are ecotonal in nature. In this type of community we still adhered as closely as possible to standards of homogeneity. At each wetland it was often impossible to sample all the communities present in one visit. Preference was given to stands not sampled earlier in the summer as well as large stands that best fit the standards of homogeneity.

Field data were collected so as to be compatible with other CNHP projects. Data forms used for classification at CNHP were derived from the U.S. Forest Service Ecodata format, allowing analysis of the data at local, regional, and national levels. At each site, data applicable to all stands present were recorded on a site form, including:

- a sketch of the site layout, with distribution of community types indicated. All stands in the complex mapped but not sampled were briefly described.
- a list of all plant associations in the wetland complex that could be easily classified based on stands sampled previously.
- elevation (from 7.5 min. USGS topographic maps).
- current and historic land use (e.g., grazing, logging, recreational use) when apparent.
- notes on geology and geomorphology.
- reference photos of the site.
- signs of disturbance such as logging, grazing, flooding, etc.

Environmental data were collected to represent each sampled stand, including:

- depth to water table (estimated when it could not be reach) as well as estimated maximum water table.
- slope and aspect.
- hydrologic information, including water source and hydroperiod (i.e., perennially flooded, seasonally saturated, etc.).
- pH and conductivity (when standing water was present).
- average height of overstory.
- a simplified soil description based on a shallow pit or an augered sample within each plot. Thickness, texture (via hand-texturing), color, mottling/gleying, structure, matrix color, coarse fragments, and parent material when possible were noted for each soil horizon.

Vegetation data were collected along transects subjectively located in a homogeneous portion of the community of interest. Transects were generally 30 m long, unless the size of the community prohibited this length. A few aquatic stands were estimated from the shoreline because deep water and peat precluded direct sampling. Percent cover of shrubs (if present) were sampled using a line-intercept procedure along the length of the transect. Forbs and graminoids were sampled in 0.25 m² microplots (50 x 50 cm) placed equidistantly along the transect. The minimum total area sampled with microplots was 1 m². More microplots were used in stands with high species richness. In each microplot, percent canopy cover by vascular plant species (ocular estimation to nearest cover class: <1%, 1-5%, 5-10%, in 10% increments up to 100%)

was recorded. Percent ground cover of bare soil, litter, wood, gravel, rock, and non-vascular plants was also recorded.

All plants not identified in the field, particularly of difficult genera such as *Salix*, *Carex*, and *Juncus*, were collected, pressed, and identified after the field season using state and regional floras and collections at the University of Colorado and Colorado State University herbaria. Voucher specimens are being deposited at the University of Colorado Herbarium. Nomenclature in this report follows Kartesz (1994). A list of wetland plants of the study area cross-referenced with Weber and Wittmann (1992) nomenclature is in Appendix 1.

Data Analysis and Classification of Stands

All stand data and site information was entered in a database for storage, manipulation, and future use. Agglomerative cluster analysis programs in PC-ORD (McCune 1991) were employed to determine relative similarities in vegetation composition. For the final cluster analysis, data were relativized by plot, interstand distance was determined using Sørensen's (1948) coefficient of community similarity, and plots were clustered using group averaging. To facilitate the cluster analysis, stands were separated into two clearly distinct groups: non-aquatic and aquatic. Several stands that were not easily placed in either one of these groups (e.g., emergent shoreline communities that contained some aquatics) were analyzed in both groups.

Time did not permit ordination, but environmental data have been retained for use in determining environmental relationships in the future. The emphasis was placed on cluster analysis because, although ordination procedures may assist in elucidating relationships among samples and the relations of stands to environmental gradients, they are of less value than clustering procedures in determining meaningful vegetation units (Baker 1989).

This classification is based on existing, relatively undisturbed, or naturally disturbed, native vegetation. A plant association (community), the most specific vegetation type in this hierarchical classification, is defined as natural vegetation with definite floristic composition, uniform physiognomy, and uniform habitat (Mueller-Dombois and Ellenberg 1974). Our definition differs slightly from the Daubenmire (1952) plant association concept in that we describe the existing communities, rather than perceived climax vegetation types. Our approach to plant associations is similar to the community type of Youngblood *et al.* (1985). Our alliance-level classification is similar to the dominance types of Hansen *et al.* (1988).

Stands and groups of stands derived from the cluster analyses were compared with plant association descriptions from published classification work, using stand data whenever possible. A stand or group of stands was considered synonymous with a previously described plant association when species composition, constancy, average cover, and environmental setting appeared very similar. In some cases, reference is made to plant associations that have similar canopy structure, physical setting, and species composition, but that differed enough not to be called synonymous. Several stands were considered unclassifiable because no similar plant associations were found in the literature and there were insufficient data from this study to describe a new type.

Existing association names were generally used when stands could be classified in a previously described plant association, with preference given to names in Bourgeron and Engelking (1994). Association names are based on plant species from each stratum that have high constancy (frequency of species occurrence) and/or high relative abundance (percent canopy cover) values. A slash separates canopy layers (e.g., tree/shrub/herb). A dash indicates co-dominance within a given canopy layer (e.g., *Carex aquatilis*–*Carex utriculata*).

Plant associations were placed in The Nature Conservancy's Preliminary Vegetation Classification of the Western United States (Bourgeron and Engelking 1994) which is based on the UNESCO Physiognomic-Ecological Classification of Plant Formations of the Earth (1973) as revised by Driscoll *et al.* (1984). This hierarchical system uses physiognomy and environment to distinguish vegetation units:

- I, II, etc. Class (Physiognomic type, e.g., forests, woodlands, shrublands, terrestrial herbaceous communities)
- A,B, etc. Subclass (evergreen, deciduous, mixed forest)
- 1,2, etc. Group (e.g., temperate, subtropical, tropical)
- a,b, etc. Formation (e.g., dense tall grassland, tall bunch grassland, semipermanently flooded medium tall grassland)
Alliance (dominant characteristic species, e.g., *Salix planifolia*)
Plant association (e.g., *Salix planifolia*/*Caltha leptosepala*)

The series and plant association levels have been added to the UNESCO system to more finely tune the classification to dominant species (alliance) and specific association levels, similar to U.S. Forest Service regional classifications, such as Johnston (1987).

The Colorado Natural Heritage Program and Determination of Natural Heritage Significance

Founded in 1981, the Colorado Natural Heritage Program (CNHP) was relocated from the Division of Parks and Outdoor Recreation into the University of Colorado Museum in the spring of 1992, and then to Colorado State University in the fall of 1994. With an increased staff, CNHP is revitalized and updating information on rare, threatened, and endangered species and natural communities in Colorado. The multi-disciplinary team of scientists and information managers gather information and incorporate it into the continually updated Biological and Conservation Data System (the BCD, developed by The Nature Conservancy). CNHP is part of an international network of over eighty conservation data centers that use the BCD and associated Heritage Program methodology. By concentrating on site-specific data for each element of natural diversity, the accurate status of each element is known. The mapped data illustrate sites that are important to the conservation of Colorado's natural biological diversity. By ranking elements and the quality of each occurrence, priorities can be established for protection of the most sensitive sites. This updated locational database and priority-setting system is CNHP's most effective, proactive land-planning tool.

Each of the species and natural communities (plant associations) tracked by CNHP is an element of natural diversity, or simply an element. Each element is assigned a rank that indicates its

relative rarity or degree of imperilment on a five-point scale (1 = extremely rare and/or imperiled; 5 = abundant and demonstrably secure; see Table 1 below).

The primary criterion for ranking elements is the number of occurrences, i.e. the number of known distinct localities. Also of great importance is the number of individuals at each locality or, for highly mobile organisms, the total number of individuals. Other considerations include condition of the occurrences, number of protected occurrences, threats, and historic distribution. However, the emphasis remains on the number of occurrences such that ranks are an index of known biological rarity. These ranks are assigned both in terms of the element's rarity within Colorado (its State or S-rank) and the element's rarity over its entire range (its Global or G-rank). Taken together, these two ranks give an instant picture of the rarity of the element. Although most species protected under state or federal endangered species laws are extremely rare, not all rare species are legally listed as endangered or threatened. Natural Heritage rarity ranks should not be interpreted as legal designations. Explanations of Heritage Program ranks are given below in Table 1.

Table 1. Definition of Natural Heritage rarity ranks used in this report.

Note: These ranks should not be interpreted as legal designations.

-
- S1(G1) Extremely rare: usually 5 or fewer occurrences in the state (world); or simply a few remaining individuals; often especially vulnerable to extirpation.
 - S2(G2) Very rare; usually between 5 and 20 occurrences in the state (world); or with many individuals in fewer occurrences; often susceptible to becoming endangered.
 - S3(G3) Rare to uncommon; usually between 20 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances.
 - S4(G4) Common; usually > 100 occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
 - S5(G5) Very common; demonstrably secure under present conditions.
 - S?(G?) Unranked; some evidence that element may be imperiled, but awaiting formal rarity ranking.
 - SU(GU) Status uncertain, often because of low search effort or cryptic nature of the element.

Notes: When a question mark follows a numerical rank (e.g., S2?), it indicates uncertainty about the accuracy of this rank. When two numbers appear in a state or global rank (e.g., S2S3), the actual rank of the elements falls between the two numbers. When a 'Q' follows a rank, it indicates uncertainty about the taxonomic status of the element.

In addition to ranking each element in terms of rarity, Natural Heritage staff scientists rank each element occurrence so that protection efforts can be aimed not only at the rarest elements, but at the best examples of each. The CNHP has mapped over 5,000 element occurrences in Colorado. Information on the location and quality of these element occurrences is all contained in the BCD. Element occurrences are ranked in terms of quality (size, vigor, etc.) of the population or community, condition or naturalness of the habitat, long-term viability of the population or community, and defensibility of (ease or difficulty of protecting) the occurrence. Given the intimate relationship between a natural community and its environment, community occurrences are largely ranked in terms of quality and size.

RESULTS AND DISCUSSION

Upland forests and grasslands, the mainstays of much agricultural and natural resource production in Colorado, are among the best studied ecosystems in the state. More recently with the work of Baker (1989), Kittel and Lederer (1993), Kittel *et al.* (1994), Kittel *et al.* (1995) and several other projects done under the auspices of the U.S. Forest Service (e.g., Kettler and McMullen 1995), the distribution and status of riparian vegetation is becoming understood. Knowledge of wetlands lags behind all other ecosystems in Colorado. Because forested riparian and wetland plant associations have been much better studied than non-forested systems, this study focused on shrublands, herbaceous communities, and especially shallow-water aquatic types.

A review of the literature revealed that knowledge of wetland flora in Colorado has advanced considerably in recent years, but many gaps still exist. One important step must be taken before we can systematically and accurately evaluate conservation priorities: wetland plant associations must be adequately incorporated into a consistent state and regional classification system. The need for this step is illustrated by the fact that only 29 of the 35 wetland plant associations described in this report appear in Bourgeron and Engelking (1994), while only 24 were previously even reported from Colorado, let alone well understood.

The literature also shows clearly that lower elevation wetlands are under represented in studies compared with those from the mid-montane and subalpine zones. This study similarly sampled few areas below 2,140 m (7,000 ft.). Two factors contribute to this effect. First, low-elevation areas are more heavily influenced by human activities that tend to degrade native vegetation, such as agriculture and manipulation of water resources. Since this study focused on natural vegetation, many low-elevation areas were excluded. Second, lower elevation riparian and wetland areas are largely under private ownership. Private ownership excludes them from most federal requirements for special management and also makes access much more time-consuming and difficult.

Despite the challenges presented by wetlands at lower elevations, it is imperative that scientists, resource managers, planners, and policy makers seek a better understanding of them. They are as critical an element of Colorado's natural heritage as higher elevation sites. Also, development pressure continues to be highest at lower elevations. Even given their generally degraded condition, further study may uncover sites of high natural heritage value at relatively low elevations. For example, the U.S. Army Corps of Engineers recently discovered a very unusual low-elevation peatland in northern Larimer County while reviewing a wetland permit (Carey, pers. comm., 1995).

During the course of this study 152 stands were sampled. These were classified into 35 wetland plant associations (see the Table of Contents for a complete list of alliances and plant associations described below). The classification was based mainly on the cluster analysis. The dendrograms that resulted from the cluster analysis (Figure 2 for non-aquatic stands; Figure 3 for aquatic stands) show the relative similarity of stands. The dendrograms cannot be taken *prima facie* as the classification. Some placements are an artifact of the clustering algorithms and do not necessarily represent community similarity. Groups of stands classified in a given plant

association are indicated in figures 2 and 3; stands removed from a cluster and classified elsewhere are also indicated, as are unclassified stands.

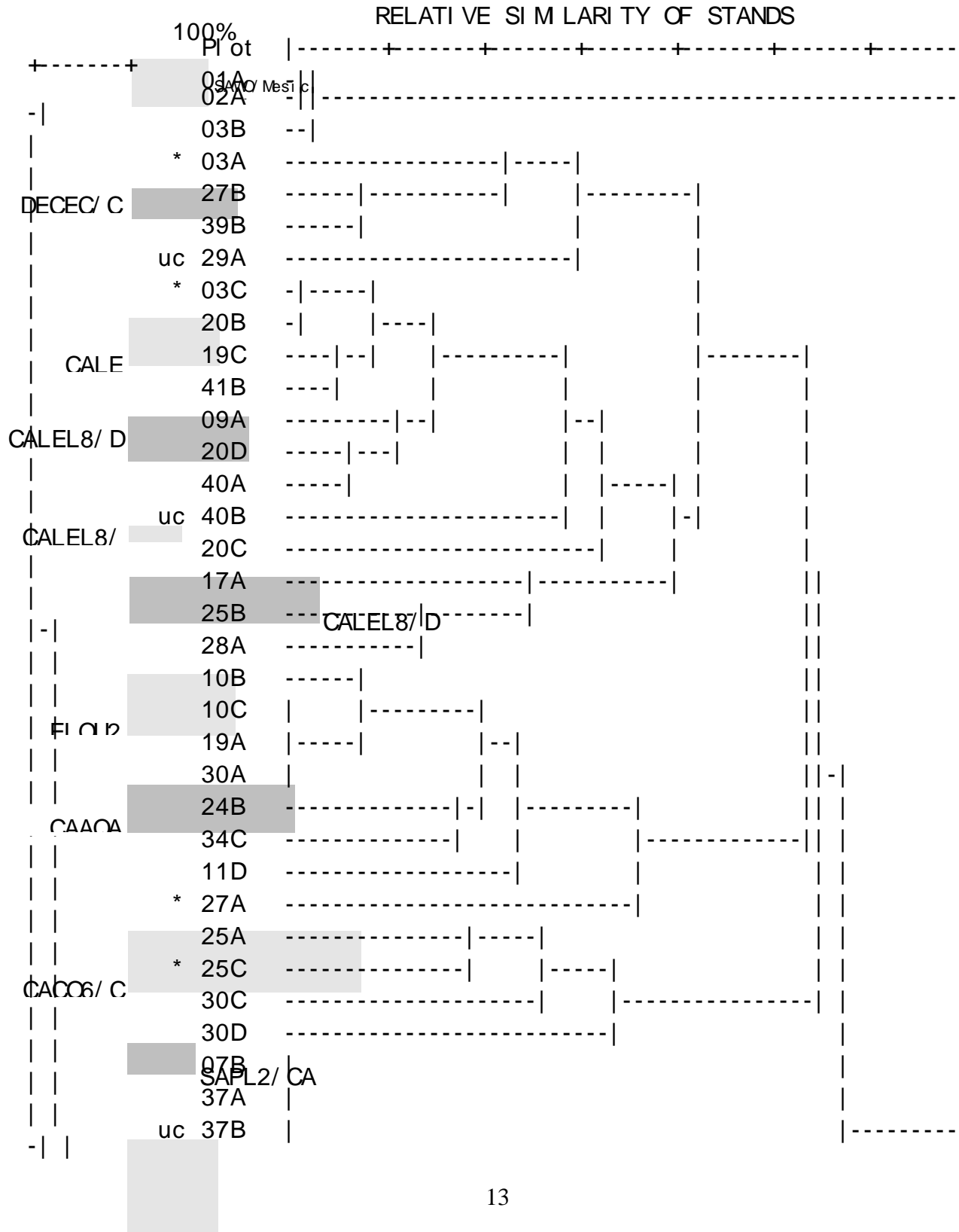
Whenever possible, stands were placed in a plant association listed by Bourgeron and Engelking (1994) to avoid further proliferation of plant association names. In some cases the name from Bourgeron and Engelking (1994) was modified (e.g., *Potamogeton richardsonii*-*Myriophyllum sibiricum* was changed to *Potamogeton richardsonii*) to make it more comprehensive or to make it fit a broader interpretation of the community. Plant association name modifications will be incorporated into The Nature Conservancy's Western Regional Classification. If, based on species cover and environmental setting, a stand did not merit placement in a plant association listed in the Western Regional Classification, it was grouped in a plant association that appears elsewhere in the literature wherever possible (these names, too, will be incorporated into TNC's Western Regional Classification). Again, some of these names were modified.

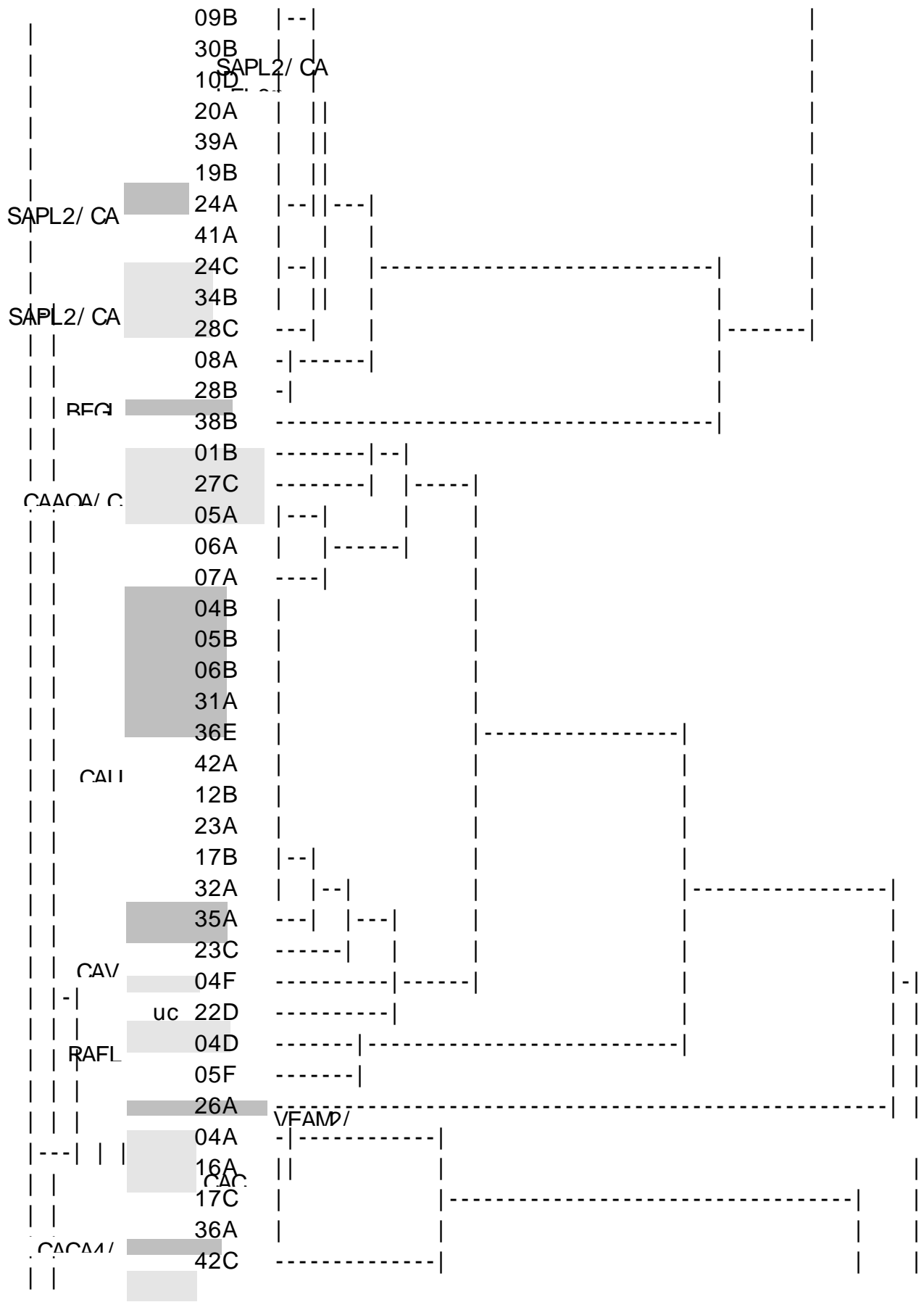
Two plant associations are tentatively described here for the first time: the *Betula glandulosa* plant association and the *Potamogeton foliosus*/*Potamogeton pusillus* plant association. These are considered tentative because, although these entities were sampled on the landscape, it is not clear under what environmental conditions and with what plant composition they repeat across the landscape. These name will likely be modified as we accumulate more data.

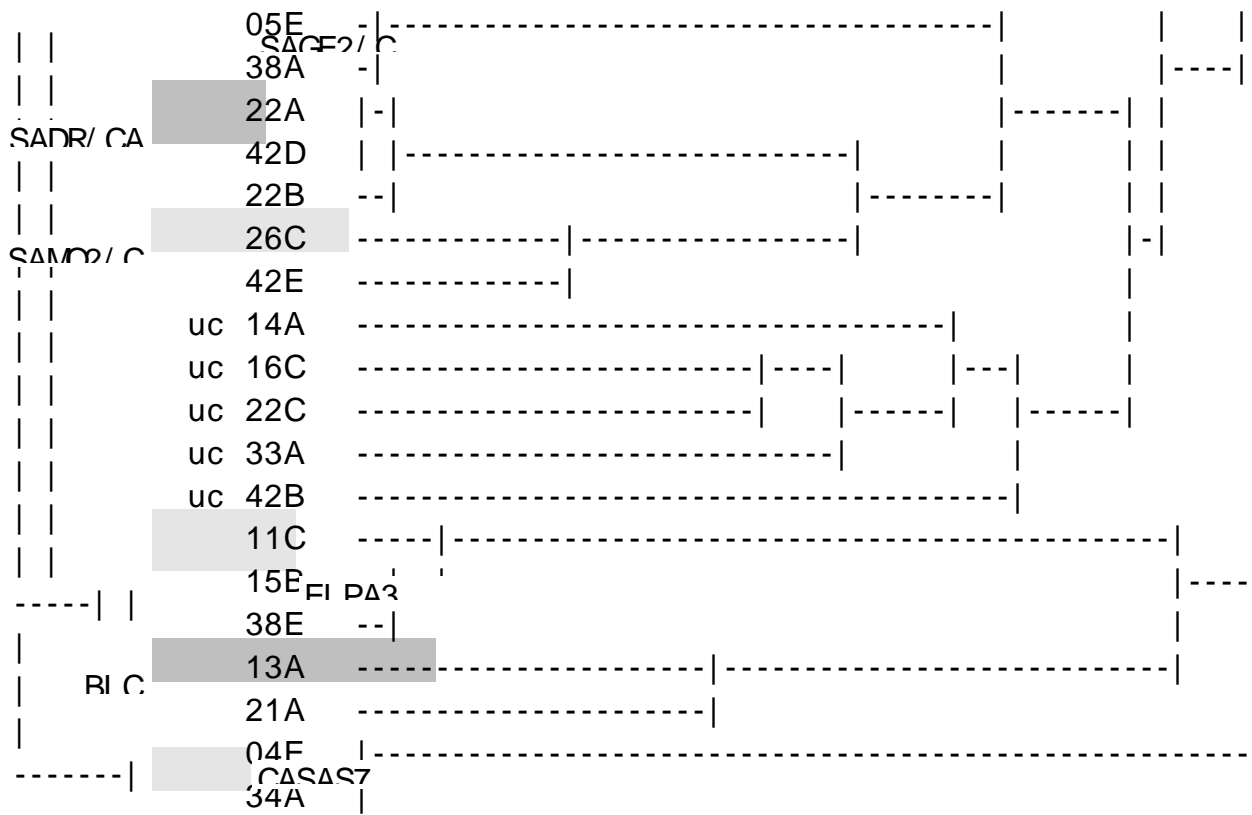
Three stands could not be classified at the plant association level (i.e., they were placed in an alliance but not in a plant association, and several stands remain unclassified below the formation level (i.e., not placed in either an alliance or plant association). Data were included for these stands so they can be considered for future classification efforts.

Figure 2. Dendrogram showing relative similarity of non-aquatic stands.

Similarity Coefficient: $2w/(a+b)$
 Cluster Analysis Method: Group Average
 Cover values relativized by stand







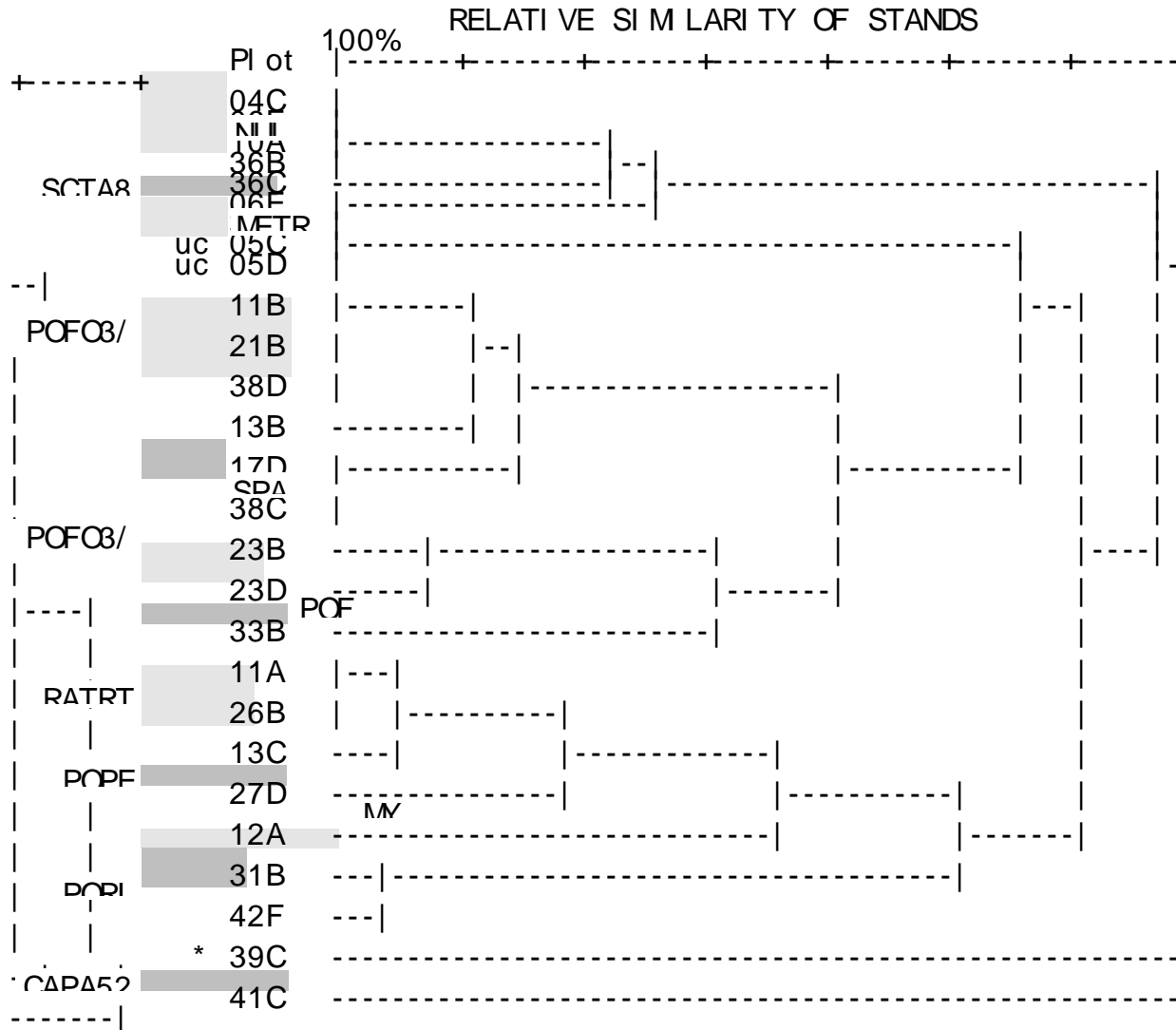
Note: Codes in capitol letters (e.g., DECEC/CALEL8) refer to plant associations. See Appendix 1 for the species that correspond to each code. Other symbols in this figure are explained on the following page.

Explanation of symbols used in Figure 2.

- * Stand placed in a non-adjacent group. Explanations for these placements appear in the text.
- uc Unclassified stands.
- # Indicates a group of CALEL8 stands. Two groups of CALEL8 stands that were clustered separately were classified together. The text contains a discussion of taxonomic problems with CALEL8 and related plant associations.
- ∞ Indicates SAPL2 plant associations clustered in two separate groups in this analysis that were classified together. The text contains a discussion of taxonomic problems among SAPL2 plant associations.

Figure 3. Dendrogram showing relative similarity of aquatic stands.

Similarity Coefficient: $2w/(a+b)$
 Cluster Analysis Method: Group Average
 Cover values relativized by stand



Note: Codes in capitol letters (e.g., DECEC/CALEL8) refer to plant associations. See Appendix 1 for the species that correspond to each code.

- * Stand placed in a group not adjacent to it in this dendrogram.
- uc Unclassified stands.
- # POFO3–POPU stands appear in two separate groups in this dendrogram, but they are tentatively classified together. See text for explanation.

In the following section we first provide a key to the plant association in this report, then descriptions of the plant associations sampled in the study area. Each description begins with the scientific name of the plant community, the vernacular name, and the Heritage Program global and state rarity rank (from Bourgeron and Engelking (1994) or from the CNHP Database. See Table 1 for an explanation of the ranking system. Note that these ranks are continuously under review; many will be modified as a result of this study). Codes for plant species in the scientific name come from the U.S. Natural Resource Conservation Service PLANTS Data Base. Each description also contains the following information:

General Description and Comments: A very brief summary of the most important characteristics of the plant association, including diagnostic characteristics. This section may also include comments on placement of stands within this particular type, comments about pertinent taxonomic issues, and other related concerns.

Geographic Extent: Comments on the range of this plant association Colorado and the region, including elevational distribution.

Site Features: Describes the environmental conditions under which the plant associations is found. This includes information derived from the literature and observations from this study.

Vegetation: A general description of vegetation composition focusing on dominants.

Succession/Management: Information on the successional status of the plant association and how management may affect it. Most of this information is derived from existing literature, but some field observations are also included.

Co-occurring Wetland Plant Associations: Lists plant associations occurring with the one described to give the reader a sense for the wetland complex(es) in which the plant association is found.

Related Types from Other Studies: Lists communities described from literature that are synonymous with or similar to this plant association.

Representative Stands: Shows the plant composition of sampled stands classified in this plant association by plot number. Only important species were included. *Important* is loosely defined as species with 3% or greater cover in any one plot, or very low cover but presence in most stands. More species of low cover were included for plant associations with few representative stands; also, more species with low cover were excluded for plant associations with high species richness.

Included here are some data from other reports in cases where the stands sampled insufficiently represent the class. In the row of plot numbers, JS94-XX refer to stands from this study (XX is the plot number). DC86, DC90a, and DC93 refer to stands from Cooper (1986, 1990a, 1993). VK86 refers to Komárková (1986). SK95 refers to Kettler and McMullen (1995) and GK95 refers to Kittel *et al.* (1995). It should be noted that stands other than JS94-XX were not included in the cluster analysis. These stands were included for comparative purposes only to give the reader a broader of impression of each plant association as interpreted by various researchers.

PRELIMINARY KEY TO THE WETLAND PLANT ASSOCIATIONS OF THE STUDY AREA

Note: All keys to plant associations should be viewed as general guidelines only. Within each plant association there is a certain amount of natural variability that may not be specifically represented in the key. Final determination of a community should be made only after carefully comparing plant composition and habitat with plant association descriptions, particularly stand tables.

Also, as noted in the introduction, this report does not include all wetland plant associations present in the study area. If a particular stand does not fit any of the plant association descriptions provided here, the user of this guide is encouraged to record species composition and contact the Colorado Natural Heritage Program regarding stand classification.

The key:

- 1a. Shrubs dominant, with >25% cover(2)
- 1b. Shrubs 25% cover or less; herbaceous plants dominant(8)

2a. *Betula glandulosa* the most abundant shrub, generally peat soil underneath. **Tentative**
***Betula glandulosa* p.a.**

- 2b. A species of *Salix* the most abundant shrub(3)

3a. *Salix planifolia* dominant in the overstory, often with nearly 100% cover. May be mixed with other *Salix* species or *Betula glandulosa* at low cover(4)

- 3b. A *Salix* species other than *Salix planifolia* the most dominant willow.....(5)

4a. *Carex aquatilis* dominant or co-dominant in understory. ***Salix planifolia/Carex aquatilis* p.a.**

4b. *Caltha leptosepala* dominant or co-dominant in understory. ***Salix planifolia/Caltha leptosepala* p.a.**

5a. A *Salix* species without white waxy (pruinose) twigs dominant the shrub layer(6)

- 5b. A *Salix* species with white waxy (pruinose) twigs dominating the shrub layer(7)

6a. *Salix monticola* dominating the shrub layer; *Calamagrostis canadensis* present in the understory. ***Salix monticola/Calamagrostis canadensis* p.a.**

6b. *Salix wolfii* dominating the shrub layer; a variety of mesic forbs in the understory. ***Salix wolfii/Mesic forb* p.a.**

- 7a. *Salix drummondiana* dominant in the shrub layer, usually with >50% cover; *Calamagrostis canadensis* usually present in the herbaceous layer. ***Salix drummondiana/Calamagrostis canadensis p.a.***
- 7b. *Salix geyeriana* dominant in the shrub layer; *Calamagrostis canadensis* present in the understory. ***Salix geyeriana/Calamagrostis canadensis p.a.***
- 8a. Grasses and/or grass-like species dominant, including the emergent genera *Scirpus* and *Eleocharis*(9)
- 8b. Terrestrial or aquatic forbs dominant, including both species with broad leaves and species with narrow leaves(19)
- 9a. A species of *Carex* dominant(10)
- 9b. A graminoid other than a *Carex* dominant(14)
- 10a. *Carex utriculata* clearly dominant or sharing dominance with *Carex aquatilis*(11)
- 10b. *Carex utriculata* absent or with cover 25% or less; at least one other *Carex* species with moderate to high cover(12)
- 11a. *Carex utriculata* and *Carex aquatilis* co-dominant, often in nearly equal proportions, commonly with both having greater than 25% cover. ***Carex aquatilis–Carex utriculata p.a.***
- 11b. *Carex utriculata* clearly dominant; cover of other species none or low. ***Carex utriculata p.a.***
- 12a. *Carex aquatilis* dominant; *Carex utriculata* cover low or none. ***Carex aquatilis p.a.*** Note: In stands of *Eleocharis quinqueflora*, *Carex aquatilis* may dominate. If *E. quinqueflora* is present on a peatland site, see the *E. quinqueflora* p.a. for comparison.
- 12b. A *Carex* other than *Carex aquatilis* dominant(13)
- 13a. *Carex vesicaria* the most abundant sedge; may be mixed with *Carex utriculata*; usually in shallow water. ***Carex vesicaria p.a.***
- 13b. *Carex saxatilis* dominant; usually on peat. ***Carex saxatilis p.a.***
- 14a. A species of grass dominant(15)
- 14b. A non-grass species dominant(17)
- 15a. *Deschampsia cespitosa* dominant, although sometime with low cover. *Caltha leptosepala* present in low amounts; a variety of other graminoids and forbs present. ***Deschampsia cespitosa–Caltha leptosepala p.a.***
- 15b. *Calamagrostis canadensis* dominant, often with very high cover(16)
- 16a. *Calamagrostis canadensis* forming a near monoculture, often with cover >80% and few other species present. ***Calamagrostis canadensis p.a.***
- 16b. *Calamagrostis canadensis* dominant, but mesic forbs, especially *Mertensia ciliata*, present with moderate cover. ***Calamagrostis canadensis/Mertensia ciliata p.a.***

- 17a. *Scirpus tabernaemontani* dominant. ***Scirpus tabernaemontani* p.a.**
 17b. A species of *Eleocharis* dominant(18)
- 18a. *Eleocharis palustris* dominant; usually in shallow water on the edge of a lake or pond.
***Eleocharis palustris* p.a.**
 18b. *Eleocharis quinqueflora* dominant; usually on peat; *Carex aquatilis* may co-dominate.
***Eleocharis quinqueflora* p.a.**
- 19a. Community clearly terrestrial, though surface may be inundated at times. Stand with *Veronica americana*, *Alopecurus aequalis*, and *Ranunculus flammula* key here, although they may be partially or completely submerged at times(20)
 19b. Stand aquatic; plants supported at least in part by water; plants submerged, partially emergent, or stranded on shore after water levels have dropped(26)
- 20a. *Caltha leptosepala* dominant(21)
 20b. Other forbs dominates(22)
- 21a. *Carex aquatilis* and/or *Pedicularis groenlandica* co-dominant or at least present with moderate cover; soil usually saturated much of the year, and may be peat. ***Caltha leptosepala* p.a.**
 21b. *Deschampsia cespitosa* nearly as abundant as *Caltha leptosepala*; soil drier. ***Caltha leptosepala*–*Deschampsia cespitosa* p.a.**
- 22a. *Cardamine cordifolia* or *Senecio triangularis* dominates; usually in or near flowing water(23)
 22a. Other species dominate; in mud or very shallow water on the edge of a lake or pond(24)
- 23a. *Cardamine cordifolia* clearly dominant; *Caltha leptosepala* usually present. ***Cardamine cordifolia*/*Caltha leptosepala* p.a.**
 23b. *Senecio triangularis* usually dominant, but other mesic forbs also present with moderate to high cover. ***Senecio triangularis* p.a.**
- 24a. *Bidens cernua* dominates. ***Bidens cernua* p.a.**
 24b. *Veronica americana*, *Alopecurus aequalis*, or *Ranunculus flammula* dominates(25)
- 25a. *Veronica americana* and/or *Alopecurus aequalis* dominate; usually on wet ground where water has receded. ***Veronica americana*–*Alopecurus aequalis* p.a.**
 25b. *Ranunculus flammula* dominates, often forming mats; habitats range from very shallow water to dried mud on the edges of lakes and ponds. ***Ranunculus flammula* p.a.**
- 26a. Aquatic stand dominated by a species of *Potamogeton*(27)
 26b. Other aquatic stands; plants may be stranded on muddy ground where water has receded(30)

- 27a. *Potamogeton richardsonii* with its broad submerged leaves dominates. ***Potamogeton richardsonii* p.a.**
- 27b. One or more species of *Potamogeton* species with narrow leaves dominant(28)
- 28a. *Potamogeton foliosus* and/or *Potamogeton pusillus* the most abundant species. **Tentative *Potamogeton foliosus/Potamogeton pusillus* p.a.**
- 28b. Other *Potamogeton* species with narrow leaves most abundant.....(29)
- 29a. *Potamogeton pectinatus* dominant; often in eutrophic and/or alkaline water. ***Potamogeton pectinatus* p.a.**
- 29b. *Potamogeton filiformis* dominates. ***Potamogeton filiformis* p.a.**
- 30a. Aquatic stand dominated by submerged plants with finely dissected leaves(31)
- 30b. Aquatic stand dominated by plants with large, floating or emergent leaves; if submerged, leaves small, entire, and opposite(32)
- 31a. *Myriophyllum sibiricum* most abundant; *Potamogeton* spp. and *Ranunculus trichophyllus* may also have moderate to high cover. ***Myriophyllum sibiricum* p.a.**
- 31b. Submerged stand dominated by *Ranunculus trichophyllus*; may intergrade with the *Myriophyllum sibiricum* p.a. ***Ranunculus trichophyllus* p.a.**
- 32a. Leaves of dominant plant long and linear, floating or emergent (*Sparganium* spp.). ***Sparganium angustifolium* p.a.**
- 32b. Leaves of dominant plant large or small, but not long and linear(33)
- 33a. Leaves of dominant plant very small, entire, opposite; most leaves submerged but upper rosette often floating; plants often found stranded on muddy banks where water has receded. ***Callitriche palustris* p.a.**
- 33b. Leaves of dominant plant large(34)
- 34a. Leaves of dominant plant simple, cordate, and floating (*Nuphar lutea* spp. *polysepala*). ***Nuphar lutea* spp. *polysepala* p.a.**
- 34b. Leaves of dominant plant trifoliolate (*Menyanthes trifoliata*). ***Menyanthes trifoliata* p.a.**

IV.B.2.d. DECIDUOUS SEASONALLY FLOODED/SATURATED SHRUBLAND

Betula glandulosa alliance

Tentative *Betula glandulosa* (BEGL) plant association

Tentative Bog birch p.a.

CNHP Rank: GUSU

Stands: 38B

General Description and Comments: This shrubland with its dominant cover of *Betula glandulosa* occurred with *Salix* species and an understory of *Carex* species. Descriptions of similar stands in other reports suggest stands of this plant association may contain as many forbs as graminoids. This plant association typically occurs on peat that is wet throughout the growing season.

An insufficient number of stands was sampled to classify definitively this stand. However, cluster analysis clearly separated this stand from all others sampled, and similar stands have been reported by Kettler and McMullen (1995) and Kittel *et al.* (1995). Since additional supporting information is lacking, this stand was placed in a tentative plant association.

Geographic extent: Komárková (1986) reported that *Betula glandulosa/Carex scopulorum* occurs in many Colorado mountains, but Bourgeron and Engelking do not even list a *Betula glandulosa* plant association. In this study, this plant association was sampled on the east slope of the Gore Range in central Colorado at 2,830 m (9,280 ft.). Kettler and McMullen (1995) reported that on the Routt National Forest this type occurs at elevations from 2,590 to 3,050 m (8,500 to 10,000 ft.).

Site Features: This stand was found in a fen on the upper (forested) edge of a very slightly inclined area above a beaver pond. The area receives water from several small seeps and springs in the stand and above it in the forest; several small, ephemeral channels run through the stand. Soils beneath this stand are peat to a depth of greater than 1 meter. The water table appears to be at or near the surface most of the growing season. Johnston (1987) noted that *Betula glandulosa/Carex scopulorum* (which appears very similar to this community) occurs in “bogs in valley bottoms.” Johnston (1987) also noted that the soils are Cryofibrists, similar to the soil found under the single stand sampled.

Vegetation: *Betula glandulosa* dominates with about 40-80% cover. It occurs in areas without hummocks and on small hummocks. All hummocks in this stand appear compositionally similar and all appear to be within the range of the capillary fringe the water table throughout most of the growing season. Several *Salix* species occur sporadically across the stand. *Carex aquatilis* dominates the understory. Komárková (1986) reports that associated forbs include *Caltha leptosepala* and *Sedum rhodanthum*. Kittel *et al.* 1995 sampled one stand (94JB23) similar to the one sampled during this study that contained several other shrubs (see stand data below).

Succession/Management: As hummocks develop further on this peatland they may become more heavily dominated by *Salix* species. This type may, therefore, be a mid-seral plant association on a long successional trajectory.

Co-occurring Wetland Plant Associations: The stand sampled (38D) was most closely associated with a large *Carex* meadow. *Salix geyeriana/Calamagrostis canadensis* and aquatic communities also occurred in the same wetland complex.

Related Plant Associations from Other Studies: Komárková (1986) described a *Betula glandulosa/Carex scopulorum* plant association, but it is unclear if this is the same type. The *Betula glandulosa* overstory and *Carex* sp. understory suggests these stands should be classified in the same plant association. Also, Cronquist *et al.* (1977) state that in some areas, “. . . *Carex aquatilis* and *Carex scopulorum* do not always appear to be sharply distinct . . .,” suggesting that even if not morphologically similar in Colorado, they may have similar habitat requirements.

An undocumented plant association related on the alliance level, *Betula glandulosa/Carex lasiocarpa*, has been reported from Idaho (Bourgeron and Engelking 1994), but no plot data was available to verify its composition. As noted above, Kettler and McMullen (1995) and Kittel *et al.* (1995) reported similar stands.

Representative stands:

Table 2. Tentative <i>Betula glandulosa</i> p.a. Percent Cover of Important Taxa					
Species	JS94-38	SK95-242	SK95-381	SK95-462	GK95-JB23
<i>Betula glandulosa</i>	39	80	40	30	60
<i>Calamagrostis canadensis</i>				30	3
<i>Caltha leptosepala</i>			10		
<i>Carex aquatilis</i>	8	3	10	10	
<i>Carex utriculata</i>				10	
<i>Deschampsia cespitosa</i>		1	3		
<i>Epilobium angustifolium</i>		10			10
<i>Fragaria virginiana</i>		3	1	1	
<i>Lonicera involucrata</i>					10
<i>Ligusticum tenuifolium</i>		3	10		
<i>Pentaphragmoides floribunda</i>		1	3	10	20
<i>Poa pratensis</i>		3	30		
<i>Polygonum</i> sp.			20		
<i>Salix boothii</i>	8				3
<i>Salix geyeriana</i>	7				
<i>Salix monticola</i>					20
<i>Salix planifolia</i>	5		10	20	
<i>Salix wolfii</i>	3	1		3	

Salix drummondiana alliance

Salix drummondiana/Calamagrostis canadensis (SADR/CACA4) plant association

Drummond's willow p.a.

CNHP Rank: G2?S2?

Stands: 22A, 22B, 42D

General Description and Comments: The *Salix drummondiana/Calamagrostis canadensis* plant association is characterized by dense cover of *Salix drummondiana*. Mesic graminoids, especially *Calamagrostis canadensis*, dominate the understory.

Both *Salix drummondiana* and *Salix drummondiana/Calamagrostis canadensis* plant associations have been reported from Colorado (see Bourgeron and Engelking 1994), with the latter reported more frequently. Although stand 22A contains no *Calamagrostis canadensis*, I have placed all three stands sampled in the *Salix drummondiana/Calamagrostis canadensis* plant association because they appear so similar (based on environmental setting, plant composition, and cluster analysis) and two of them clearly fit into *Salix drummondiana/Calamagrostis canadensis*. The overall similarity of these stands suggests that perhaps these two classes should be combined.

Salix drummondiana is one of two montane willows with white, waxy (pruinose) twigs. Without catkins it can be easily confused with the other montane "blue-stem" willow, *Salix geyeriana*, so care should be taken in applying this name.

Geographic extent: Bourgeron and Engelking (1994) indicate that *Salix drummondiana* is found in Montana (Heritage Program Rank: S3) and that *Salix drummondiana/Calamagrostis canadensis* has been reported from Idaho, but without stand data. This plant association likely also occurs in Wyoming. In central Colorado, it is found from 2,750-3,000 m (9,000-9,800 ft.).

Site Features: All three stand sampled in this study were closely associated with the front slopes of beaver dams where the soil is moist to saturated throughout the growing season. *Salix drummondiana/Calamagrostis canadensis* occurs along streams and floodplains on mild (3-12%) slopes and at a variety of aspects (Johnston 1987). Soils are Cryaquolls and Cryaquepts (Johnston 1987).

Vegetation: *Salix drummondiana* generally clearly dominates with up to 95% cover. Although no other shrubs grow in the stands sampled in 1994, other shrubs may occur with *Salix drummondiana*, especially *Salix monticola*. Komárková (1986) reports *Cornus sericea* and *Lonicera involucrata* associated with this type. *Calamagrostis canadensis* is the most common understory graminoid, but it is not 100% constant (see stand 22A) and may have low cover. Many species of mesic forb may occur in the understory at low cover, especially *Heracleum maximum*, *Cardamine cordifolia*, and *Senecio triangularis*. *Equisetum arvense* is often present at less than 10% cover.

Succession/Management: The association of *Salix drummondiana*/*Calamagrostis canadensis* stands with beaver dams suggests they may be a mid-successional type that will possibly yield in time to another *Salix* type. The abundance of this plant association may cycle along with beaver populations.

Co-occurring Wetland Plant Associations: *Salix drummondiana*/*Calamagrostis canadensis* stands can be expected to occur near *Carex* plant associations, especially *Carex utriculata*. It is also found with mesic graminoid and mesic forb associations, such as the *Calamagrostis canadensis*/*Mertensia ciliata* plant association. One stand of this type was found near, but not at all intermixed with, a *Salix monticola*/*Calamagrostis canadensis* stand.

Related Plant Associations from Other Studies: Johnston (1987) and Komárková (1986) reported *Salix drummondiana*/*Calamagrostis canadensis* plant associations that appear synonymous.

Representative Stands:

Table 3. <i>Salix drummondiana</i> / <i>Calamagrostis canadensis</i> p.a. Percent Cover of Important Taxa				
Species	JS94-22A	JS94-22B	JS94-42D	VK86-138
<i>Calamagrostis canadensis</i>		8	3	6
<i>Cardamine cordifolia</i>			3	3
<i>Conioselinum scopulorum</i>	+	2		
<i>Cornus sericea</i>				4
<i>Equisetum arvense</i>	5	7	7	
<i>Galium triflorum</i>		5	1	
<i>Glyceria elata</i>	5	11		
<i>Heracleum montanum</i>	+	25	2	5
<i>Lonicera involucrata</i>				2
<i>Mertensia ciliata</i>			3	
<i>Ribes inerme</i>				3
<i>Salix drummondiana</i>	95	88	65	100
<i>Senecio triangularis</i>		3	1	
<i>Veronica americana</i>		4		
<i>Viola macloskeyi</i>		8		

Salix geyeriana alliance

Salix geyeriana/Calamagrostis canadensis (SAGE2/CACA4) plant association

Geyer's willow/Bluejoint reedgrass

CNHP Rank: G5S2

Stands: 05E, 38A

General description and Comments: The *Salix geyeriana/Calamagrostis canadensis* plant association occurs across the montane to lower subalpine Rocky Mountains, but is among the less common willow associations in Colorado. *Salix geyeriana* is commonly over 2 m tall in this association, and *Calamagrostis canadensis* generally grows abundantly in the understory.

Salix geyeriana is one of two montane willows with white, waxy (pruinose) twigs. Without catkins it can be easily confused with the other montane “blue-stem” willow, *Salix drummondiana*, so care should be taken in applying this name.

Geographic extent: This plant association has been reported from the Bighorn National Forest of northern Wyoming (Olson and Gerhart 1982) south to the Gunnison National Forest in Colorado (see Johnston 1987). Bourgeron and Engelking (1994) indicate that this plant association also occurs in Montana, Idaho, and Utah. In Montana and Idaho it is quite common (Montana Natural Heritage Program Rank: S4), suggesting that Colorado is on the southern edge of its range. In Colorado this plant association is found at 2,300-3,050 m (7,500-10,000 ft.).

Site Features: The *Salix geyeriana/Calamagrostis canadensis* plant association is generally considered a riparian community, but in this study it was also found as a narrow border to kettle ponds. According to Johnston (1987), *Salix geyeriana/Calamagrostis canadensis* is found in nearly level, sometimes narrow, valley bottoms along rivers and streams (Johnston 1987). It is inundated by early flooding, but it is moderately well drained and groundwater levels drop throughout the growing season (Johnston 1987). Kittel *et al.* (1994) found this community in the Kawuneeche Valley where the Colorado River is sinuous and of low gradient (8%). Soils consist of fine silty clayey loams with moderate amounts of organic matter (Kittel *et al.* 1994).

Vegetation: At least one other species of willow almost always accompanies *Salix geyeriana*. Commonly the other most abundant willow is *Salix monticola*, but it may be others, including *Salix planifolia*, *Salix brachycarpa*, *Salix boothii*, and *Salix drummondiana*. Sedges (*Carex microptera*, *Carex aquatilis*, and *Carex utriculata*) may be present along with other graminoids at low cover. *Fragaria* sp., *Achillea millefolium*, and *Castilleja sulphurea* are among the most commonly associated forbs. Kittel *et al.* (1994) noted that the herbaceous layer is often quite diverse, with around 30 species.

Succession/Management: Kettler and McMullen (1995) report that immature *Pinus contorta* occurred in the one plot sampled on the Routt National Forest. Padgett *et al.* (1989) suggest that in Utah and southeast Idaho, this may indicate a conversion to their Conifer/*Calamagrostis canadensis* type over a long period of time.

Co-occurring Wetland Plant Associations: When occurring as a narrow band along ponds and lakes, the *Salix geyeriana/Calamagrostis canadensis* occurs adjacent to or near emergent wetland plant associations such as *Carex utriculata*, and slightly removed from submerged plant associations such as a *Potamogeton* sp. It also occurred on a slightly inclined, north-facing slope above a large *Carex* meadow and near a stand of the tentative *Betula glandulosa* plant association.

Related Plant Associations from Other Studies: Cooper and Cottrell (1990), Kettler and McMullen (1995), Kittel *et al.* (1994), Padgett *et al.* (1989), and Youngblood *et al.* (1985) all reported a *Salix geyeriana/Calamagrostis canadensis* type. Johnston (1987) described a *Salix geyeriana–Salix spp./Calamagrostis canadensis* plant association.

Representative stands (important taxa only):

Table 4. <i>Salix geyeriana/Calamagrostis canadensis</i> p.a. Percent Cover of Important Species		
Species	JS94-05E	JS94-38A
<i>Calamagrostis canadensis</i>	13	9
<i>Carex utriculata</i>	9	
<i>Galium trifidum</i>	2	+
<i>Geum macrophyllum</i>		2
<i>Polygonum amphibium</i>	2	
<i>Salix drummondiana</i>		31
<i>Salix geyeriana</i>	50	70
<i>Swertia perennis</i>		2
<i>Taraxacum officinale</i>		3

Salix monticola alliance

Salix monticola/Calamagrostis canadensis (SAMO2/CACA4) plant association

Park willow/Bluejoint p.a.

CNHP Rank: GUSU

Stands: 26C, 42E

General Description and Comments: This willow plant association is generally found along streams in the montane or upper montane zones. It can be recognized by *Salix monticola* of medium to tall height in a moderate to dense overstory with mesic graminoids and mesic forbs in the understory. *Calamagrostis canadensis* is almost always present in this plant association, but it may not have a high cover value.

Geographic Extent: This plant association has been reported from middle elevations in the Front Range of Colorado (Cooper and Cottrell 1990) and near Crested Butte, Colorado (Cooper 1993). It is not listed in Bourgeron and Engelking (1994) as reported from outside of Colorado. In this study it was sampled at 2,740 and 2,980 m (8,990 and 9,760 ft.).

Site Features: The *Salix monticola/Calamagrostis canadensis* plant association grows on floodplains that are typically wet in spring and early summer, but not saturated throughout the growing season, although Cooper and Cottrell (1990) report that on the Front Range of Colorado the water table is near the surface most of the growing season. Soils are silts and sands, often with a buried horizon of gravely alluvium (Cooper and Cottrell 1990).

Vegetation: *Salix monticola* usually has dense cover (from 50-99%), but may be more open. A variety of other *Salix* spp. may be present as well, especially *Salix drummondiana* and *Salix geyeriana*. *Calamagrostis canadensis* is generally the most important understory species. Many forb species may be present but with low cover.

Succession/Management: Cooper and Cottrell (1990) note that on the Front Range this plant association provides critical wildlife habitat, especially for migratory songbirds.

Co-occurring Wetland Plant Associations: *Salix monticola* stands were found in beaver complexes that contained *Carex utriculata* stands, *Deschampsia cespitosa* stands, and once near, but not intermixed with, a stand of *Salix drummondiana*. It can be expected to occur with other willow stands in riparian areas.

Related Plant Associations from Other Studies: The *Salix monticola/Calamagrostis canadensis* of Cooper and Cottrell (1990) and Cooper (1993) appear to be synonymous with this type.

Representative Stands:

Table 5. <i>Salix monticola</i> / <i>Calamagrostis canadensis</i> p.a. Percent Cover of Important Taxa			
Species	JS94-26C	JS94-42E	DC93-60
<i>Achillea millefolium</i>	+		5
<i>Aster foliaceus</i>	4		
<i>Calamagrostis canadensis</i>	3	1	30
<i>Carex utriculata</i>	6		
<i>Equisetum arvense</i>	2	2	
<i>Fragaria virginiana</i>	2		20
<i>Geum macrophyllum</i>	2		5
<i>Geranium richardsonii</i>	8	1	
<i>Heracleum maximum</i>	18	5	
<i>Mertensia ciliata</i>		3	
<i>Pentaphylloides floribunda</i>			3
<i>Pinus contorta</i>			5
<i>Salix drummondiana</i>	39		5
<i>Salix geyeriana</i>			10
<i>Salix monticola</i>	43	99	70
<i>Saxifraga odontoloma</i>		2	
<i>Senecio triangularis</i>	5	2	
<i>Taraxacum officinale</i>	4	+	7

Salix planifolia alliance

Salix planifolia/*Caltha leptosepala* (SAPL2/CALEL8) plant association

Diamondleaf willow/White marshmarigold

CNHP Rank: G4S4?

Stands: 08A, 09B, 10D, 19B, 20A, 24C, 28B, 28C, 30B, 34B

General Description and Comments: This common upper montane and subalpine willow association is recognized by generally low (up to 1.5 m) *Salix planifolia* and an understory of mixed forbs and graminoids, but dominated by *Caltha leptosepala*. It may contain small amounts of other willows.

Bourgeron and Engelking (1994) show that various authors have combined the name *Salix planifolia* with *Salix wolfii* and/or *Salix brachycarpa*, along with one of the herbaceous plants listed, to describe multifarious versions of this plant association. These include:

Salix planifolia
Salix planifolia–*Salix brachycarpa*/*Caltha leptosepala*
Salix planifolia–*Salix wolfii*/*Caltha leptosepala*
Salix planifolia/*Calamagrostis canadensis*
Salix planifolia/*Calamagrostis canadensis*–*Carex aquatilis*
Salix planifolia/*Carex aquatilis*
Salix planifolia/*Carex aquatilis*–*Carex rostrata* [utriculata]
Salix planifolia/*Carex scopulorum*
Salix planifolia/*Deschampsia cespitosa*.

Following Kittel *et al.* (1994), in this report we use the name *Salix planifolia*/*Caltha leptosepala*. The abundance of names for a set of plant associations that clearly overlap considerably makes it difficult to know which entity each author is referring to with each name.

To illustrate the confusion: Komárková (1986) reported that *Salix planifolia*/*Caltha leptosepala* occurs at lower elevations and has a considerably more species rich and taller herb layer than the *Salix planifolia*/*Carex aquatilis* plant association. Kittel *et al.* (1994) contradicted this by stating an elevational range for *Salix planifolia*/*Caltha leptosepala* of 3,100-3,340 m (10,160-10,950 ft.) and for *Salix planifolia*/*Carex aquatilis*, 2,800-3,160 m (9,200-10,360 ft.).

This study did little to elucidate this taxonomy. The *Salix planifolia* stands sampled were placed into two plant associations (*Salix planifolia*/*Carex aquatilis* and *Salix planifolia*/*Caltha leptosepala*), but there was overlap between the two and relative differences in community composition are small (see Figure 2). To satisfactorily get at this question, stand data from as many studies as possible should be compiled and analyzed as a regional data set.

Geographic Extent: This type is known from northwestern and northcentral Wyoming (Johnston 1987). It occurs throughout the subalpine of Colorado (Johnston 1987, Cooper and Cottrell 1990). According to Bourgeron and Engelking (1994), neither *Salix planifolia*–*Salix brachycarpa*/*Caltha leptosepala* nor *Salix planifolia*–*Salix wolfii*/*Caltha leptosepala* (two communities closely related to the one described here) has been reported outside Colorado, but they almost certainly occur beyond Colorado’s borders. The *Salix planifolia*/*Caltha leptosepala* plant association occurs at 2,930-3,600 m (9,600-11,800 ft.).

Site Features: The *Salix planifolia*/*Caltha leptosepala* plant association occurs mainly in wide, moist glaciated valleys adjacent to streams and in swales and depressions where snow melt runoff accumulates. It may also occur as an outer band of vegetation around high-elevation lakes. The water table on these sites tends to remain high throughout the summer. Kittel *et al.* (1994) reports that wetter sites have soil textures of silt loams, while slightly drier sites have loamy sands; these are classified as oxyaquic Cryumbrepts, typic Cryoborolls, Cryochrepts, typic Cryorthents, and typic Cryaquents. Komárková (1986) reports similar soils with the addition of histosols (Cryohemists and Cryosaprists). Cooper and Cottrell (1990) report that peats typically occur under this type in the Front Range, and that mineral soils are uncommon.

Vegetation: The shrub layer is dominated by dense, low stature *Salix planifolia*. Other willows often present in lesser amounts include *Salix brachycarpa*, *Salix wolfii*, and *Salix monticola*. The willow canopy is generally closed so that the herbaceous understory is not well developed except in openings between willow patches. Common graminoids include *Carex aquatilis* and *Calamagrostis canadensis*; common forbs include *Caltha leptosepala*, *Senecio triangularis* and *Mertensia ciliata*. Slightly drier sites have *Salix brachycarpa* co-dominant.

Stands 08A and 28B (with 14% and 26% *Salix monticola*, respectively) and stands 24C, 28C, and 34B (all three with *Salix wolfii*) were placed here because of the present uncertainty about classification within the *Salix planifolia* group. Some of these stands contained high cover of the associated shrubs (48% *Salix wolfii* in stand 34B), but were otherwise similar in composition to the other *Salix planifolia*/*Caltha leptosepala* stands.

Succession/Management: This plant association occurs in wet swales that are saturated through most or all of the growing season. Soils are susceptible to compaction by livestock. Heavy grazing will open the canopy and lower the water table through increased evapotranspiration, allowing *Salix brachycarpa* or *Salix wolfii* to become established (Kittel *et al.* 1994). Cooper and Cottrell (1990) state that it is possible but unlikely that this type is successional to another (presumably drier) *Salix planifolia* type.

Co-occurring Wetland Plant Associations: *Salix planifolia* plant associations commonly occurs near *Caltha leptosepala* and *Carex aquatilis* stands. Near one lake it was also found adjacent to an *Eleocharis quinqueflora* plant association. All of these are also found frequently in wetland complexes that have *Senecio triangularis* and other mesic forb plant associations near water sources (i.e., small streams and springs). Just as this plant association sometimes intergrades with *Salix brachycarpa* plant associations, it also occurs adjacent to well-developed *Salix brachycarpa* stands.

Related Plant Associations from Other Studies: Similar plant associations have been reported as *Salix planifolia*–*Salix wolfii*/*Caltha leptosepala*–*Carex aquatilis* (Baker 1989) and *Salix planifolia*/*Caltha leptosepala* (Cooper and Cottrell 1990, Hess and Wasser 1982, Komárková 1986, Wasser and Hess 1982). Bourgeron and Engelking (1994) appear to lump all of these communities into *Salix planifolia*–*Salix brachycarpa*/*Caltha leptosepala* and/or *Salix planifolia*–*Salix wolfii*/*Caltha leptosepala*.

Representative Stands:

Table 6. <i>Salix planifolia</i> / <i>Caltha leptosepala</i> p.a.										
Percent Cover of Important Taxa										
Species	JS94 -08A	JS94 -09B	JS94 -10D	JS94 -19B	JS94 -20A	JS94 -24C	JS94 -28B	JS94 -28C	JS94 -30B	JS94 -34B
<i>Aconitum columbianum</i>					6					2
<i>Antennaria corymbosa</i>	8									
<i>Calamagrostis canadensis</i>	3	6		8		1		+		
<i>Caltha leptosepala</i>	14	20	11	8	13		16	8	10	9
<i>Cardamine cordifolia</i>	3				3	2	5			2
<i>Carex aquatilis</i>		+	1	+	4			6	20	
<i>Carex disperma</i>						4				
<i>Carex saxatilis</i>								8		
<i>Carex utriculata</i>		2				3	1			
<i>Conioselinum scopulorum</i>			8			5		4	1	
<i>Epilobium anagallidifolium</i>				3						
<i>Epilobium angustifolium</i>	6									
<i>Fragaria virginiana</i>	6									
<i>Geum macrophyllum</i>						3				
<i>Luzula parviflora</i>	2									
<i>Mertensia ciliata</i>	17				7	12	5			+
<i>Oxypolis fendleri</i>	5		1		1		2			3
<i>Parnassia fimbriata</i>							5			
<i>Pedicularis groenlandica</i>			2				+	1		1
<i>Salix brachycarpa</i>	8									
<i>Salix monticola</i>	14						27			
<i>Salix planifolia</i>	60	93	98	93	100	78	62	23	76	74
<i>Salix wolfii</i>						26		5		48
<i>Saxifraga odontoloma</i>				7	3		7			
<i>Saxifraga oregana</i>					3					
<i>Sedum rhodanthum</i>	1	4	5		4					
<i>Senecio triangularis</i>	3			13	8	5	3		2	
<i>Swertia perennis</i>			8	7	+		6	+		
<i>Trollius laxus</i>							5			
<i>Veronica wormskjoldii</i>				6						
<i>Viola macloskeyi</i>	1		14	2		2				

***Salix planifolia*/*Carex aquatilis* (SAPL2/CAAQA) plant association**

Planeleaf willow/Water sedge p.a.

CNHP Rank: GUS?

Stands: 07B, 24A, 37A, 37B, 39A, 41A

General Description and Comments: This common upper montane and subalpine willow association is recognized by generally low (up to 1.5 m) *Salix planifolia* and an understory dominated by graminoids, especially *Carex aquatilis*. It may contain small amounts of other *Salix* species.

See comments under the *Salix planifolia*/*Caltha leptosepala* plant association for a discussion of the confusion in the taxonomy of *Salix planifolia* plant associations.

Geographic Extent: In addition to Colorado, this type is known from the Uinta mountains and central Utah (Padgett *et al.* 1989) and northwestern and northcentral Wyoming (Johnston 1987), Bourgeron and Engelking (1994) indicate that it also occurs in Montana. In Colorado the *Salix planifolia*/*Carex aquatilis* plant association occurs throughout the mountains above 2,590 m (8,500 ft) to about 3,500 m (11,500 ft.).

Site Features: The *Salix planifolia*/*Carex aquatilis* plant association is found in wide valleys and wet, open subalpine meadows, on broad, gently sloping swales fed by snow melt and in valley bottoms. The associated water table is high most or all of the growing season. Soils associated with this plant association are loams, often with a high organic component, or organic soils. Soils have been classified as Histosols, Cryaquolls, Hemists, and Borohemists (Kittel *et al.* 1994). Cooper (1990a) reports that in Big Meadows (Rocky Mountain National Park) the shrubs penetrate the thin organic surface horizon of the soils to root in mineral soil, and that the soils are high in Ca⁺⁺ and other metallic ions.

Vegetation: *Salix planifolia* dominates the low willow overstory. *Salix brachycarpa* and *Salix wolfii* are also often present with less than 25% cover, usually confined to steeper slopes and outer edges of wet swales. Cooper and Cottrell (1990) note that *Betula glandulosa* may have high cover, sometimes higher than *Salix planifolia*. The understory is characterized by a thick graminoid layer dominated by *Carex aquatilis*. Johnston (1987) notes that patches of *Carex utriculata* can occur within this plant association. *Calamagrostis canadensis* may also be present in small amounts. Forbs may include *Caltha leptosepala* (at low cover), *Pedicularis groenlandica*, and *Osmorhiza depauperata*.

Succession/Management: Soils with high organic content are susceptible to compaction by livestock. Heavy grazing will open the canopy and lower the water table through increased evapotranspiration, allowing *Salix brachycarpa* or *Salix wolfii* to become established (Kittel *et al.* 1994).

Cooper and Cottrell (1990) suggest that the *Salix planifolia*/*Carex aquatilis* could be successional to a *Carex aquatilis*–*Pedicularis groenlandica* plant association as peat soils thicken and the nutrient supply diminishes.

Co-occurring Wetland Plant Associations: On organic soils the *Salix planifolia*/*Carex aquatilis* plant association is frequently associated with the *Carex aquatilis*–*Pedicularis groenlandica* plant association. It also is found with *Carex aquatilis* plant associations. At the lower end of the elevation spectrum it may occur near *Carex aquatilis*–*Carex utriculata* plant associations. *Salix brachycarpa* plant associations may occur nearby.

Related Plant Associations from Other Studies: Plant associations with the name *Salix planifolia*/*Carex aquatilis* have been reported by Cooper and Cottrell (1990), Cooper (1990a), Padgett *et al.* (1989), Johnston (1987), Komárková (1986), and Hess (1981). Hess and Wasser (1982) included this as a phase of *Salix planifolia*/*Caltha leptosepala* (*Carex aquatilis* phase).

Representative Stands:

Table 7. <i>Salix planifolia</i> / <i>Carex aquatilis</i> p.a. Percent Cover of Important Taxa							
Species	JS94-07B	JS94-24A	JS94-37A	JS94-37B	JS94-39A	JS94-41A	DC90 (avg. of 6 stands)
<i>Abies lasiocarpa</i>					8		
<i>Aconitum columbianum</i>					6		
<i>Aster foliaceus</i>			3				
<i>Betula glandulosa</i>				20			
<i>Calamagrostis canadensis</i>	+	3	3	2		3	3
<i>Caltha leptosepala</i>							8
<i>Cardamine cordifolia</i>			2		6		
<i>Carex aquatilis</i>	10	13	2	2		6	28
<i>Carex festivella</i>							3
<i>Carex utriculata</i>							5
<i>Conioselinum scopulorum</i>		5					
<i>Epilobium anagallidifolium</i>						4	
<i>Geum macrophyllum</i>	2	2	2				
<i>Mertensia ciliata</i>					4		
<i>Picea engelmannii</i>		3					
<i>Salix monticola</i>		11					
<i>Salix planifolia</i>	77	69	84	96	100	20	57
<i>Salix wolfii</i>	5		14				
<i>Sedum rhodanthum</i>	1					+	1
<i>Senecio triangularis</i>					4		
<i>Swertia perennis</i>						4	
<i>Viola macloskeyi</i>		10	+			2	

Salix wolfii alliance

Salix wolfii/Mesic forb (SAWO/Mesic forb) plant association

Wolf's willow/Mesic forb p.a.

CNHP Rank: G3S?

Stands: 01A, 02A, 03B

General Description and Comments: The *Salix wolfii*/Mesic forb plant association occurs frequently in the mid to upper montane and lower subalpine, frequently covering wide, open, gently sloping areas near first and second order streams. It can be recognized by the generally dense layer of low, silvery *Salix wolfii* that dominates the overstory and the variety of mesic forbs (along with some graminoids) in the understory.

Geographic Extent: This association has been described from Utah and southeastern Idaho (Padgett *et al.* 1989) and from eastern Idaho and western Wyoming (Youngblood *et al.* 1985). In Colorado this association occurs at elevations from 2,500 m (8,200 ft.) to 3,210 m (10,520 ft.).

Site Features: This association often occurs on first or second order streams in meadows and on stream terraces in moderate to broad valleys. These areas commonly receive groundwater slowly seeping to the surface across a wide area. The *Salix wolfii*/Mesic forb plant association may be saturated by high water in a stream valley in late spring and early summer, but later water levels drop. No free water was found within 50 to 100 cm of the soil surface in the stands sampled. The slope of the stands sampled ranged from 0 to 11%.

Soils generally have high organic matter content in the upper profile, and are loamy to sandy textured. In the study area, the loamy horizons of the *Salix wolfii*/Mesic forb soil were underlain by a clay horizon between 24 and 60 cm below the soil surface. In many areas they have a gravel layer within 60 centimeters of the surface (Kettler and McMullen 1995).

Vegetation: *Salix wolfii* dominates the shrub layer (30-99% cover) in this plant association. *Salix planifolia* and *Salix boothii* occasionally co-dominate. *Salix monticola* may be present as a sub-dominant. Forbs dominate the understory in this association with combined cover of 30 to 50%. No one forb species is consistently dominant, but *Fragaria virginiana* is usually present with 3 to 10% cover. The graminoid layer may include *Calamagrostis canadensis*, *Deschampsia cespitosa*, and various *Carex* species at low cover.

Succession/Management: Stands of this type frequently receive moderate to heavy grazing pressure from domestic and wild ungulates (see Kettler and McMullen 1995). They may also receive heavy recreational use, especially along accessible streams.

Many of the species in the forb layer of this association are considered disturbance increasers or weedy species, including *Taraxacum officinale* and *Fragaria virginiana*. It is possible that this association may be a disturbance induced phase of the *Salix wolfii*/*Carex aquatilis* plant association, but further research is needed to determine this (Kettler and McMullen 1995).

Co-occurring Plant Associations: While the *Salix wolfii*/Mesic forb plant association may almost entirely cover large willow carrs, it may also be found with a variety of other wetland associations, including *Carex aquatilis*-*Carex utriculata*, *Carex utriculata*, *Deschampsia cespitosa*, *Betula glandulosa*, *Salix boothii*/*Carex utriculata*. A *Salix monticola* stand upslope from stand 01A appeared more closely tied to a stream channel, whereas the *Salix wolfii* occurred where the water flows across and below the surface more diffusely.

Other Studies: This association is very similar to the *Salix wolfii*/Mesic Forb association described by Padgett *et al.* (1989) and Youngblood *et al.* (1985), and to the *Salix wolfii*/*Fragaria virginiana* association reported by Johnston (1987).

Tuhy and Jensen (1982, in Bourgeron and Engelking 1994) report a *Salix wolfii*/*Swertia perennis*-*Pedicularis groenlandica* plant association from the Salmon River basin in Idaho that may be synonymous with this type. Stands 1A and 3B both contain these two understory forb species.

Representative Stands:

Table 8. <i>Salix wolfii</i> /Mesic forb p.a. Percent Cover of Important Taxa			
Species	JS94-01A	JS94-02A	JS94-03B
<i>Achillea millefolium</i>		2	6
<i>Aster foliaceus</i>			8
<i>Caltha leptosepala</i>			8
<i>Carex gynocrates</i>	3		
<i>Conioselinum scopulorum</i>	7		
<i>Deschampsia cespitosa</i>			3
<i>Fragaria virginiana</i>		8	
<i>Maianthemum stellatum</i>	4	16	
<i>Pedicularis groenlandica</i>	+		2
<i>Pentaphylloides floribunda</i>	5	3	
<i>Salix boothii</i>	10		
<i>Salix brachycarpa</i>	17		
<i>Salix monticola</i>	1	18	
<i>Salix wolfii</i>	79	83	98
<i>Senecio dimorphophyllus</i>			3
<i>Swertia perennis</i>	3		5
<i>Taraxacum officinale</i>	2	4	
<i>Thalictrum alpinum</i>		6	5
<i>Valeriana edulis</i>			4

VIII.A.2.e. SEMIPERMANENTLY FLOODED PERENNIAL TALL GRASS-LIKE (GRAMINOID) VEGETATION

Scirpus tabernaemontani alliance

Scirpus tabernaemontani (SCTA80) plant association

Softstem bulrush p.a.

CNHP Rank: GUSU

1994 Stands: 36C

General Description and Comments: The *Scirpus tabernaemontani* plant association occurs in marshes, along the margins of lakes and ponds, and in backwater areas of rivers with water up to one meter deep. In general it occupies sites similar to those of the *Typha latifolia* plant association (not included in this report), and some authors have on occasion lumped *Scirpus* and *Typha* associations together (e.g., Cooper 1988). These associations rarely intergrade significantly, however, and when they occur adjacent to each other the transition from one association to another is usually abrupt and distinct (Hansen *et al.* 1988).

According to Kartesz (1994), *Scirpus tabernaemontani* and *Scirpus acutus* are distinct species. According to Weber and Wittmann (1992), they are both subspecies of *Schoenoplectus lacustris*. In either case, more work is needed to fully understand the composition, distribution, and ecological conditions of the *Scirpus tabernaemontani* plant association and the related *Scirpus acutus* plant association to determine whether they merit separation in the classification.

Geographic Extent: The *Scirpus tabernaemontani* plant association is widespread throughout the Rocky Mountains and adjacent regions, mainly at low elevations. It was encountered only once during this study, probably because all sites were above 2,140 m (7,000 ft.).

Site Features: Sites are characterized by still or nearly still water up to one meter deep on the edges of lakes and ponds, as well as backwater reaches of large rivers. Water levels often remain high throughout the growing season, but may drop as far as one meter below the ground surface (Hansen *et al.* 1988). The *Scirpus tabernaemontani* plant association occur on most soil textures, from fine clays to sandy loams, often with relatively high amounts of organic matter (Jorgensen 1979). *Scirpus tabernaemontani* is tolerant of alkaline conditions (Hansen *et al.* 1988).

Vegetation: Dense cover of *Scirpus tabernaemontani* with few other species of significant cover generally characterize this plant association. Depending on growing conditions, stands may include limited amounts of emergent wetland species such as *Sagittaria* spp., *Carex* spp., etc. The *Scirpus tabernaemontani* stand sampled in this study was unusual because of the amount of unvegetated area. The cover of *Scirpus tabernaemontani* was sparser than usual, and *Nuphar lutea* ssp. *polysepala* occurred with low but significant cover in the stand.

Succession/Management: As with *Typha latifolia*, *Scirpus tabernaemontani* can quickly colonize bare, muddy ground (which it requires for germination). Once established, however, it can persist as a stable stand as long as the water regime remains constant (Hansen *et al.* 1988). It can also persist through several years of low-water conditions. This plant association can easily become established in unnatural wetlands (e.g., restored gravel mines).

The *Scirpus tabernaemontani* plant association is an important source of cover, nesting habitat, and food for wildlife, including waterfowl, other birds, muskrats, and deer.

Co-occurring Wetland Plant Associations: The one stand sampled occurred in a pond that had filled entirely with sediment. Along the edges of the pond were *Menyanthes trifoliata*, *Carex utriculata*, and *Calamagrostis canadensis* stands. Elsewhere this type can be expected to occur with a variety of emergent and submerged communities, especially *Typha latifolia*.

Related Plant Associations from Other Studies: Hansen *et al.* (1988) describe a *Scirpus tabernaemontani* dominance type as a minor dominance type at lower elevations throughout Montana. Johnson (1941) reported “dense growth of bulrush [*Scirpus validus*, a synonym for *S. tabernaemontani*] . . . on the south side of the lake [Lake John]” in northern Colorado.

Representative Stands:

Table 9. <i>Scirpus tabernaemontani</i> p.a. Percent Cover of Important Taxa	
Species	JS94-36C
<i>Scirpus tabernaemontani</i>	13
<i>Nuphar lutea</i> spp. <i>polysepala</i>	3

VIII.B.2.d. SEASONALLY/TEMPORARILY FLOODED MEDIUM TALL GRASSLANDS

Calamagrostis canadensis alliance

Calamagrostis canadensis (CACA4) plant association

Bluejoint reed grass p.a.

CNHP Rank: G4SU

Stands: 04A, 16A, 17C, 36A

General Description and Comments: The generally small stands of the *Calamagrostis canadensis* plant association are found in riparian zones, along lake and pond shores, and on the tops of beaver ponds. This lower alpine and upper subalpine graminoid meadow plant association occurs on sites that are drier than those of *Carex aquatilis* communities (with which it may intermix) but wetter than *Deschampsia cespitosa* communities. Generally dense cover of *Calamagrostis canadensis* serves as a diagnostic characteristic of this plant association.

Geographic Extent: This plant association is known from high elevations in Utah and central Colorado (Padgett *et al* 1989, Baker 1984). The *Calamagrostis canadensis* plant association has also been reported from Montana (where it is reported as common) and Wyoming (Bourgeron and Engelking 1994). *Calamagrostis canadensis* dominated communities are very common in the lowlands and forests of the boreal zone (Komárková 1986). Kittel *et al.* (1994) report this association from 2,930 m (9,600 ft.) in the Colorado River basin. In the study area the *Calamagrostis canadensis* plant association was found from 2,750 m to 3,360 m (9,020 ft. to 11,000 ft.).

Site Features: This meadow type occurs in broad glaciated valleys in the subalpine and on narrow floodplains of lower montane canyons (Kittel *et al.* 1994). It is frequently associated with beaver ponds and with the edges of lakes where coniferous trees approach the edge of the water body. This type may occur on mineral soil or may form shallow peat. Soils are Cryohemists, Cryaquolls, and Cryaquepts (Cooper 1990a, Kittel *et al.* 1994, Komárková 1986).

Vegetation: The vegetation consists of dense, near-monoculture *Calamagrostis canadensis* meadows. *Carex aquatilis* and/or *Deschampsia cespitosa* may be present in small amounts. Low cover of mesic forbs may also be present.

Succession/Management: According to Kittel *et al.* (1994), this plant association often occurs in association with *Pinus contorta*. They noted that due to pine bark beetle invasions, dead trees at the meadow/forest ecotone may allow for high water tables (less evapotranspiration), and thus allow for expansion of the *Calamagrostis canadensis* plant association.

Co-occurring Wetland Plant Associations: The *Calamagrostis canadensis* plant association often occurs adjacent to *Salix* spp. shrublands (Kittel *et al.* 1994) as well as *Carex aquatilis* and/or *Carex utriculata* associations. Stand 17C was found on hummocks (probably grazing induced) within a large *Carex utriculata* stand. When occurring on the edge of a pond in a forested matrix it may occur adjacent to *Pinus contorta* or *Picea engelmannii*–*Abies lasiocarpa* forests (on the upland edge) and near aquatic communities such as *Potamogeton* sp. or *Nuphar lutea* spp. *polysepala* plant associations.

Related Plant Associations from Other Studies from Other Studies: *Calamagrostis canadensis* communities were reported by Padgett *et al.* (1989) and Baker (1984). Cooper (1986) reports this type from the Cross Creek Valley, Colorado. Kittel *et al.* (1994) sampled one stand in the Colorado River Basin that they classified in the *Calamagrostis canadensis* plant association. Cooper (1990a) reports a *Calamagrostis canadensis* plant association from Rocky Mountain National Park. Several other studies also report this type.

Representative Stands:

Table 10. <i>Calamagrostis canadensis</i> p.a. Percent Cover of Important Taxa					
Species	JS94-04A	JS94-16A	JS94-17C	JS94-36A	DC90 (8 stands avg.)
<i>Betula glandulosa</i>					4
<i>Calamagrostis canadensis</i>	23	70	65	30	59
<i>Caltha leptosepala</i>					3
<i>Carex aquatilis</i>	1		18	4	18
<i>Deschampsia cespitosa</i>					3
<i>Glyceria borealis</i>		3			
<i>Glyceria elata</i>		7			
<i>Juncus tracyi</i>		3			
<i>Salix planifolia</i>					6
<i>Sidalcea candida</i>		8			
<i>Vaccinium cespitosum</i>	10				3

***Calamagrostis canadensis*–*Mertensia ciliata* (CACA4/MECI) plant association**

Bluejoint–Mountain bluebells p.a.

CNHP Rank: G?S?

Stands: 42C

General Description and Comments: This small graminaceous/herbaceous plant association occurs along streams and on beaver dams on a mineral soil that is moist to wet, but not perennially saturated. It can be recognized by the abundance of *Calamagrostis canadensis* and the presence of significant amounts of large herbaceous species, especially *Mertensia ciliata*.

Geographic Extent: This plant association has been reported from several areas in Colorado, including the Front Range (Komárková 1976) and the Sawatch Range (Cooper 1986). It is not clear if it occurs outside Colorado. This plant association and variants of it extend from the upper montane (the only stand sampled in 1994 was found at 2,975 m (9,760 ft.)) to approximately 3,600 m (11,800 ft.).

Site Features: This type occurs along streams and on beaver dams as well as in seeps where the soil is often moist, but not perennially saturated. Stand 42C, the only stand of this plant association sampled in this study, occurred in a moist seep above a beaver pond. Cooper (1986) found this type on soils that were “warm and well-drained” and comprised of silts below the A horizon. According to Komárková (1986) the soils are Cryaquepts.

Vegetation: This plant association is dominated by *Calamagrostis canadensis* along with several other tall, robust forbs. *Mertensia ciliata* is nearly always present, although it may be replaced by *Senecio triangularis* or another large mesic forb (as in DC86-40 shown below). In slightly drier areas, *Elymus trachycaulus* may be present (see Komárková 1976).

Succession/Management: Cooper (1986) reports that this plant association clearly has the highest above ground primary productivity per unit area of any plant association occurring in the Cross Creek wetlands.

Co-occurring Wetland Plant Associations: The *Calamagrostis canadensis* plant association often occurs associated with other *Salix* spp. plant associations as well as *Carex aquatilis* and/or *Carex utriculata* associations.

Related Plant Associations from Other Studies: Cooper (1986) and Komárková (1986) both reported this type from the Sawatch Range. Johnston (1987) includes this type in *Calamagrostis canadensis*–*Carex scopulorum*/*Mertensia ciliata* (Bourgeron and Engelking (1994) followed suit), while also noting that *Carex scopulorum* does not appear in stands of this type in the Gunnison National Forest (effectively putting these stands in the *Calamagrostis canadensis*/*Mertensia ciliata* plant association). It appears from the representative stands below that *Carex scopulorum* is often not contained in this plant association.

Johnston (1987) includes both *Elymus trachycaulus*–*Calamagrostis canadensis* (Komárková 1976) and *Carex scopulorum*–*Mertensia ciliata* in *Calamagrostis canadensis*. The former appears to be a drier variety of *Calamagrostis canadensis*–*Mertensia ciliata*, since *Calamagrostis canadensis* and *Mertensia ciliata* are constants, often of high cover, in this type. The latter is clearly dominated by *Carex scopulorum*, and while *Mertensia ciliata* is a constant, *Calamagrostis canadensis* is not, so it may warrant separation into another plant association.

Representative Stands:

Table 11. <i>Calamagrostis canadensis</i> – <i>Mertensia ciliata</i> p.a. Percent Cover of Important Taxa				
Species	JS94-42C	DC86-40	DC86-42	VK86-97
<i>Aconitum columbianum</i>	3		20	
<i>Aster foliaceus</i>	3			
<i>Calamagrostis canadensis</i>	28	60	10	90
<i>Cardamine cordifolia</i>	5			
<i>Carex aquatilis</i>			5	
<i>Carex pachystachya</i>	9			
<i>Equisetum arvense</i>	5			
<i>Galium trifidum</i>		3	+	
<i>Heracleum lanatum</i>		30	5	
<i>Mertensia ciliata</i>	13		15	3
<i>Salix drummondiana</i>		20		
<i>Senecio triangularis</i>	4			15

Deschampsia cespitosa alliance

***Deschampsia cespitosa*–*Caltha leptosepala* (DECEC–CALEL8) plant association**

Tufted hairgrass–Marsh marigold

CNHP Rank: G4S4

Stands: 27B, 39B

General Description and Comments: This dense graminoid meadow occurs in subalpine regions across Colorado in broad, nearly flat, valley bottoms in openings of willow carrs and coniferous forests. It can be recognized by the prominence of both *Deschampsia cespitosa* and *Caltha leptosepala*, with *Deschampsia cespitosa* more abundant.

This plant association is closely allied the *Caltha leptosepala*–*Deschampsia cespitosa* plant association and its relatives. The taxonomy of this group (i.e., relatives of the *Caltha leptosepala* plant association) is currently unclear. The literature presents several plant associations that belong to the *Caltha leptosepala* group (see Bourgeron and Engelking (1994) for a complete listing of these plant associations and additional literature that discusses them). As a whole, this group needs more work to better delimit plant associations; such an analysis will likely result in the combining of some of these classes.

Geographic Extent: Outside Colorado, this plant association is found in Montana and Idaho (Bourgeron and Engelking 1994), and it can be expected in Wyoming. It is found across Colorado at 2,900-3,400 m (9,500-11,100 ft.) (Johnston 1987).

Site Features: The *Deschampsia cespitosa*–*Caltha leptosepala* plant association occurs on nearly level terrain (0-5%) in valley bottoms in openings in willow carrs and forests (Johnston 1987). Areas where this type occurs generally have high winter snow accumulation and deep poorly-drained alluvial soils (Johnston 1987). These habitats have a somewhat prolonged duration of snow cover and relatively deep soils (Komárková 1986). The soil of the stand sampled by Komárková (1986) was a Cryumbrept.

Vegetation: A relatively large number of graminoids dominate this type, but wet meadow forbs may also be prominent, including *Caltha leptosepala*, *Polygonum bistortoides*, *Pedicularis groenlandica*, and *Sedum rhodanthum*. Komárková (1986) reports that important subordinate taxa include *Achillea millefolium*, *Stellaria umbellata*, and *Erigeron eximius*.

Succession/Management: This appears to be a stable wet meadow plant association.

Co-occurring Wetland Plant Associations: The *Deschampsia cespitosa*–*Caltha leptosepala* plant association was found near *Carex utriculata*–*Carex aquatilis* stands. It also was sampled as an open meadow near a small lake containing aquatic communities with adjacent forb stands.

Related Plant Associations from Other Studies: This plant association has been reported from the Gunnison National Forest (Komárková 1986), from montane forest openings at higher elevations in the Roosevelt and White River National Forests (Hess 1981, Hess and Wasser 1982, Wasser and Hess 1982), and from the Arapaho, San Isabel, and Rio Grande National Forests (U.S. Department of Agriculture, Forest Service 1984). Cooper (1993) reported a *Deschampsia cespitosa* community from the Crested Butte region, but its relationship to this plant association is unclear.

Representative Stands:

Table 12. <i>Deschampsia cespitosa</i> – <i>Caltha leptosepala</i> p.a. Percent Cover of Important Taxa			
Species	JS94-27B	JS94-39B	VK86-125
<i>Achillea millefolium</i>			3
<i>Aster foliaceus</i>	3		
<i>Calamagrostis canadensis</i>			2
<i>Caltha leptosepala</i>	5	8	3
<i>Carex aquatilis</i>	6	7	
<i>Carex ebenea</i>	2		
<i>Carex phaeocephala</i>			2
<i>Carex scopulorum</i>			2
<i>Deschampsia cespitosa</i>	19	43	93
<i>Epilobium saximontanum</i>	5		
<i>Erigeron eximius</i>			5
<i>Galium trifidum</i>			2
<i>Pedicularis groenlandica</i>	1	+	
<i>Phleum alpinum</i>		2	
<i>Plantago tweedyi</i>	2		
<i>Poa pratensis</i>	4		
<i>Rorippa alpina</i>	3		
<i>Sedum rhodanthum</i>	+	+	
<i>Senecio dimorphophyllus</i>	5	3	
<i>Stellaria umbellata</i>			2
<i>Taraxacum officinale</i>	2		
<i>Trisetum wolfii</i>	4		
<i>Veronica wormskjoldii</i>	2		

Unclassified *Deschampsia cespitosa* plant associations

Stand: 03A

Comments: The only stand classified from 1994 in this plant association, 03A, does not appear to strictly fit any currently existing plant associations. It was placed here (i.e., as an unclassified *Deschampsia cespitosa* plant association) because the cluster analysis indicated it was most compositionally similar to the *Deschampsia cespitosa*/*Caltha leptosepala* plant association. However, the plant composition, its location on a spring, and the abundant sign of cattle grazing on the adjacent uplands suggest that this may be a disturbance induced phase of *Carex aquatilis*–*Pedicularis groenlandica* plant association. It cannot currently be placed there because *Equisetum variegatum* has greater cover in this stand than *Carex aquatilis*, *Pedicularis groenlandica*, and *Caltha leptosepala*, and the soil has only an 11 cm histic epipedon. It is also clearly related to the complex that contains *Caltha leptosepala*–*Deschampsia cespitosa* plant association and the *Deschampsia cespitosa*–*Caltha leptosepala* plant association.

Table 13. Unclassified <i>Deschampsia cespitosa</i> p.a. Percent Cover of Important Taxa	
Species	JS94-03A
<i>Caltha leptosepala</i>	8
<i>Carex aquatilis</i>	12
<i>Carex gynocrates</i>	5
<i>Carex microglochin</i>	6
<i>Carex saxatilis</i>	13
<i>Deschampsia cespitosa</i>	11
<i>Equisetum variegatum</i>	18
<i>Pedicularis groenlandica</i>	2

VIII.B.2.e. SEMIPERMANENTLY FLOODED MEDIUM TALL GRASSLAND

Carex utriculata alliance

Carex utriculata (CAUT) plant association

Beaked sedge p.a.

CNHP Rank: G5S3

Stands: 04B, 05B, 06B, 12B, 17B, 23A, 23C, 31A, 32A, 35A, 36E, 42A

General Description and Comments: The *Carex utriculata* plant association is a common wetland plant association of the montane region of Colorado. It grows in shallow water, often on saturated peats, as patches in willow carrs in wet, flat valley bottoms or on the edges of shallow lakes. It is characterized by often robust growth of *Carex utriculata* that frequently occurs as a monoculture.

The stands placed in this unit may actually consist of two different plant associations: one that occurs on peat with a near monoculture of *Carex utriculata*, and the other that occurs on mineral soil with low cover of many (often weedy) forbs.

The sedge that dominates this type was formerly (and mistakenly) called *Carex rostrata* (a close relative of *Carex utriculata* that is papillate-glaucous on the upper surface of the leaves) in Colorado, and many botanists in the region continue to apply this name to it. Weber and Wittmann (1992) state that, contrary to earlier beliefs, *Carex rostrata* does not occur in Colorado, and all specimens by that name are actually *Carex utriculata*. Weber *et al.* (1979) state that all of the *Carex rostrata* in the western U.S. is actually *Carex utriculata*. Other authors (e.g., Gleason and Cronquist 1991) agree with this opinion.

Geographic Extent: This plant association is known throughout the Rocky Mountains; it occurs in eastern Idaho, western and central Montana, western and south-central Wyoming, northern Utah, and in all national forests in Colorado. Kittel *et al.* (1994) report that in the Colorado and White River basins, the *Carex utriculata* plant association is found at 1,730-3,030 m (5,680-9,950 ft.) in elevation. In the study area, the *Carex utriculata* plant association was found from 2,690 m (8,820 ft.) to 3,360 m (11,000 ft.)

Site Features: This plant association occurs on flat saturated floodplains, in backwater areas, in slow-moving reaches of rivers and streams and on the edges of lakes and ponds in water up to 45 cm (e.g., stand 05B), but usually 10-20 cm deep. In the best-developed, least weedy stands of *Carex utriculata*, this plant association occurred in standing water on a layer of loosely consolidated organic material up to 1.1 m thick. Kittel *et al.* (1994) report that in the Colorado and White River basins soils associated with the *Carex utriculata* plant association classified as very-fine clayey to loamy skeletal calcareous cumulic or typic Cryaquolls, Aquepts, fine-loamy and sandy-skeletal typic Cryaquepts, and histic Cryaquepts. Cooper (1990a) reports that in Big Meadow (in Rocky Mountain National Park), all stands of this plant association occur on deep peats that are classified as Cryohemists. This plant association frequently occurs in water with a

pH that is relatively low for the study area (around 6.0 to 6.5) and with low conductivity (often between 20 and 40 μs).

Vegetation: *Carex utriculata* clearly dominates this plant association, often occurring as a monoculture, especially in deeper water. This type often intergrades into a *Carex aquatilis* plant association on slightly better drained soils. *Carex* spp. such as *Carex microptera*, *Carex lanuginosa*, and *Carex canescens* are common associates. *Eleocharis palustris*, *Juncus balticus*, and *Deschampsia cespitosa* are occasionally present. On mineral soils, many forbs may be found at low cover in *Carex utriculata* stands, especially where grazing animals frequent.

Succession/Management: *Carex utriculata* has low palatability and occurs on saturated soils that are not generally heavily utilized by livestock (Padgett *et al.* 1989).

Cooper (1990a) reports that in Big Meadows, Rocky Mountain National Park, Colorado, *Carex utriculata* stands grow to 60 cm high and had the highest standing crop of any herbaceous or shrub wetland plant association. One stand had a standing crop of 470 g/m², and the average of four stands was 399 g/m².

Co-occurring Wetland Plant Associations: The *Carex utriculata* plant association frequently occurs adjacent to *Carex aquatilis*–*Carex utriculata* plant association (see the discussion under that plant association). When on the edge of a pond or lake, it usually occurs near an aquatic plant association such as *Nuphar lutea* spp. *polysepala* (as at site 04), *Sparganium angustifolium*, *Myriophyllum sibiricum*, or *Potamogeton* spp.. When associated with a riparian wetland complex, it frequently co-occurs with *Salix* spp. plant associations, especially *Salix planifolia* and *Salix wolfii* associations. Kittel *et al.* (1994) report that in the Colorado and Gunnison River basins at lower elevations the *Carex utriculata* plant association is found with *Populus angustifolia* woodlands or tall, deciduous shrublands.

Related Plant Associations from Other Studies: Komárková (1986) reports a *Carex utriculata*–*Carex aquatilis* association that can be included here since the one stand sampled contains a very minor component of *Carex aquatilis* (only 3%). The *Carex utriculata* plant association also would include some stands included in Johnston's (1987) *Carex aquatilis*–*Carex utriculata*, which has been described by many authors throughout the Rocky Mountain region (see Johnston 1987).

Komárková (1986) also reports a *Carex utriculata*–moss habitat type/association that is closely related to the *Carex utriculata* plant association

Representative stands:

Table 14. <i>Carex utriculata</i> p.a. Percent Cover of Important Taxa												
Species	JS94 -04B	JS94 -05B	JS94 -06B	JS94 -12B	JS94 -17B	JS94 -23A	JS94 -23C	JS94 -31A	JS94 -32A	JS94 -35A	JS94 -36E	JS94 -42A
<i>Calamagrostis canadensis</i>							5					
<i>Carex utriculata</i>	20	80	28	58	13	45	23	28	50	18	23	53
<i>Carex aquatilis</i>					3							
<i>Deschampsia cespitosa</i>										7		
<i>Galium trifidum</i>							2		+			
<i>Mentha arvensis</i>				3			13					
<i>Potamogeton pusillus</i>						3						
<i>Viola macloskeyi</i>									3			

Unclassified *Carex utriculata* stand

Stand: 22D

Comments: In this stand, which occurred on the shoreline of a well-established beaver pond, *Carex lenticularis* shared dominance with *Carex utriculata*. This stand could possibly be classified in the *Carex utriculata* plant association, but it appeared different enough to highlight as an unclassified stand.

Table 15. Unclassified <i>Carex utriculata</i> stand Percent Cover of Important Taxa	
Species	JS94-04F
<i>Carex lenticularis</i>	8
<i>Carex utriculata</i>	8
<i>Salix drummondiana</i>	2

Carex vesicaria alliance

Carex vesicaria (CAVE6) plant association

Blister sedge p.a.

CNHP Rank: GUSU

Stands: 04F

General Description and Comments: The *Carex vesicaria* plant association is a sedge type similar to the *Carex utriculata* plant association. As with *Carex utriculata*, it occurs in poorly drained basins and along pond and lake margins in shallow water. This association is rare in the study area, and was found only once during this study. Descriptions are based mainly on literature from Montana and Oregon.

The single stand of *Carex vesicaria* found in 1994 was co-dominated by *Carex utriculata*. It was, however, distinct from other *Carex utriculata* stands and dominated slightly by *Carex vesicaria*, so it was classified in the *Carex vesicaria* plant association.

Geographic Extent: The *Carex vesicaria* plant association is known to occur in Montana (Hansen *et al.* 1988), northern Wyoming (Chadde *et al.* 1988, Mattson 1984), and Oregon (Kovalchik 1986, Kovalchik 1987). In Montana it occurs at mid-elevations (Hansen *et al.* 1988). During this study it was found at 3,170 m (10,400 ft.).

Site Features: The *Carex vesicaria* plant association occurs most commonly along the shores of lakes and ponds in shallow water, as well as in poorly drained basins and along rivers and streams. Water typically remains above the surface throughout the year. Where water does drop below the ground surface, it remains in the root zone so that the soil is still saturated (Hansen *et al.* 1988). This association typically occurs on histosols, except in young streambank stands with soil composed of coarse- to fine-textured alluvium (Mattson 1984, Kovalchik 1986, Kovalchik 1987).

Vegetation: *Carex vesicaria* generally forms loose to dense, nearly monotypic communities, although *Carex utriculata* may co-dominate. Emergent wetland plants (e.g., *Sparganium* sp.) may be sparsely present. On the drier end of the spectrum for this association *Deschampsia cespitosa*, *Galium trifidum*, and a few other species may be present with low cover.

Succession/Management: A consistently high water table and thick organic horizon provide conditions favorable to the long-term dominance of *Carex vesicaria* plant association. As with other wetland communities, vegetation composition will likely change with alteration of hydrology. Kovalchik (1986, 1987) suggests that if water levels permanently remain below the soil surface, composition shifts to dominance by *Carex rostrata* [= *C. utriculata*] are likely.

Wet conditions generally discourage early season grazing by cattle or wildlife, but when inundated this association may provide important habitat for aquatic organisms (e.g., Odonates).

When the *Carex vesicaria* plant association is grazed, its dense sod of thick rhizomes make it resistant to grazing and trampling damage (Hansen *et al.* 1988).

Co-occurring Wetland Plant Associations: The *Carex vesicaria* plant association may occur adjacent to and intermix with *Carex utriculata* plant associations. When it occurs on the edges of ponds or lakes, aquatic communities such as *Sparganium angustifolium* or *Nuphar lutea* spp. *polysepala* can be expected adjacent to this type; on the shoreline side of this plant association, *Calamagrostis canadensis* occurs.

Related Plant Associations from Other Studies: Padgett *et al.* (1989) noted a few communities dominated by *Carex vesicaria* along the margins of reservoirs on the southeast and the north slope of the Uinta Mountains. Hansen *et al.* (1988) report a *Carex vesicaria* dominance type from throughout mid-elevations of Montana. Kovalchik (1986, 1987) reports a similar type from Oregon. Chadde *et al.* (1988) and Mattson (1984) reported *Carex vesicaria* communities in Yellowstone National Park. Cooper and Severn (1992) found pure stands of this type in the San Luis Valley in south-central Colorado.

Representative Stands:

Table 16. <i>Carex vesicaria</i> p.a. Percent Cover of Important Taxa	
Species	JS94-04F
<i>Carex utriculata</i>	13
<i>Carex vesicaria</i>	15

VIII.C.2.f. SEMIPERMANENTLY FLOODED SHORT GRASSLANDS

Carex aquatilis alliance

Carex aquatilis (CAAQA) plant association

Water sedge p.a.

CNHP Rank: G5S3S4

Stands: 11D, 24B, 34C

General Description and Comments: This *Carex aquatilis* plant association is one of the more common sedge types in the study area. It occurs in a wide variety of environmental settings in the montane and subalpine zones. A clear dominance by *Carex aquatilis* and low cover of *Carex utriculata* or *Pedicularis groenlandica* and related forbs sets this plant association apart from others.

No clear line exists between the *Carex aquatilis* plant association and the *Carex aquatilis*–*Carex utriculata* plant association, nor does a clear line exist between the *Carex aquatilis*–*Carex utriculata* and the *Carex utriculata* plant associations. The ends of this spectrum are, however, very clear. *Carex aquatilis* plant association tends to occur on mineral soil without standing water, while *Carex utriculata* plant association tends to occur on organic soil with standing water. In general, the Colorado Natural Heritage Program places any mixed stand with more than 25% cover of both species into *Carex aquatilis*–*Carex utriculata* to set it apart from the ends of the spectrum, although it also includes stands with lower cover co-dominated by both species. This complex of plant associations requires more study to determine more clearly how mixed stands should be classified.

Geographic Extent: The *Carex aquatilis*–*Carex utriculata* plant association and closely related plant associations occur throughout the Rocky Mountains. It is found in the upper montane and subalpine zones (approx. 2,600-3,400 m; 8,500-11,000 ft.).

Site Features: *Carex aquatilis* dominates areas that are inundated seasonally, i.e., they are flooded during the beginning of the growing season, but then water levels recede. Cooper (1986) found that in the Cross Creek Valley the depth to water table under this plant association in late July and early August averaged 31 cm, although water levels varied greatly between stands. Wilson (1969) reports that *Carex aquatilis* communities in Rocky Mountain National Park occurred where the water table ranged from 30 cm below the surface to 25 cm above the surface. This type tends to be associated with poorly drained alluvial soils.

Vegetation: Cover of *Carex aquatilis* in this plant association ranges from low (ca. 15%) to dense (ca. 95%). Cooper (1986) found that associates include *Geum macrophyllum*, *Cardamine cordifolia*, *Viola* sp., *Galium trifidum*, and *Rorippa teres*. *Carex utriculata* is often present in small amounts, and other hydrophilic graminoids may also be present. *Caltha leptosepala* and *Pedicularis groenlandica* may be associated with this plant association in small amounts.

Succession/Management: Wilson (1969) reports the *Carex aquatilis* communities trap sediment from overbank flows which forms a clay pan, eventually raising the water table. This process drives retrogressive succession and a plant association dominated by *Carex utriculata* takes over on these sites (Wilson 1969).

Co-occurring Wetland Plant Associations: In some places (e.g., site 11) the *Carex aquatilis* is found along the edge of a lake or pond where it is adjacent to emergent communities such as *Eleocharis palustris* and near submerged communities such as *Ranunculus trichophyllus* and *Potamogeton foliosus*–*Potamogeton pusillus*. *Carex aquatilis* stands may also be found in *Salix planifolia* and other willow complexes as well as near stands of *Carex utriculata*.

Related Plant Associations from Other Studies: Cooper (1986) reports a *Carex aquatilis* plant association from the Cross Creek Valley in the Sawatch Range of Colorado which is a more pure *Carex aquatilis* plant association than described here (see table below). Johnston (1987) includes the *Carex aquatilis* plant association type of Youngblood *et al.* (1985) in *Carex aquatilis*–*Carex utriculata*. Ramaley (1920) described *Carex aquatilis* communities from subalpine lake shores east of the Continental Divide south of Rocky Mountain National Park.

Representative Stands:

Table 17. <i>Carex aquatilis</i> p.a. Percent Cover of Important Taxa					
Species	JS94-11D	JS94-24B	JS94-34C	DC86-49	DC86-45
<i>Aulocomnium palustre</i>				5	
<i>Calamagrostis canadensis</i>					5
<i>Cardamine cordifolia</i>			13	15	
<i>Carex aquatilis</i>	29	15	30	95	95
<i>Carex microptera</i>			23		
<i>Deschampsia cespitosa</i>			15		
<i>Epilobium saximontanum</i>		3			
<i>Equisetum arvense</i>	14		4		
<i>Geum macrophyllum</i>		5		5	
<i>Juncus confusus</i>		3			
<i>Juncus ensifolius</i>	4	3			
<i>Juncus tracyi</i>		8			
<i>Poa palustris</i>	12				
<i>Prunella vulgaris</i>	22				
<i>Taraxacum officinale</i>	12	2	+		
<i>Viola cf. macloskeyi</i>	2			10	

***Carex aquatilis*–*Carex utriculata* (CAAQA–CAUT) plant association**

Water sedge-Beaked sedge

CNHP Rank: G4S4

Stands: 01B, 05A, 06A, 07A, 27A, 27C

General Description and Comments: This frequently found plant association generally occurs in small to moderate sized patches in nearly still to still, very shallow water or on saturated soil near low-order streams, lakes, and backwater areas of larger rivers. The *Carex aquatilis*–*Carex utriculata* plant association can be recognized by the presence of both *Carex aquatilis* and *Carex utriculata* in roughly equal proportions, or, when total cover is dense, by >25% cover of both species.

Padgett *et al.* (1989) discuss the taxonomic problem of the inter-gradation of *Carex aquatilis* and *Carex utriculata* community types. A difference may be noted in the soil on which these two types occur: *Carex aquatilis* appears to occur more often on mineral soils, often with a high organic component, while pure *Carex utriculata* stands typically occur on organic soils. There remains some question as to the whether this plant association is a distinct association or simply an intermixing of the *Carex aquatilis* plant association and the *Carex utriculata* plant association. These latter two are clearly distinct, occurring in quite different environmental settings.

This report lists the *Carex aquatilis*–*Carex utriculata* plant association separately because its composition and habitat does not allow it to be easily classified into either of the extremes. Plenty of data have been collected on this plant association; however, more work is needed to clearly sort out the various distinct classes of composition and environmental setting. Either *Carex utriculata* or *Carex aquatilis* can have the greater cover, and in many cases a plant association name with the species order reversed would seem appropriate (as Cooper (1986) reported). The name *Carex aquatilis*–*Carex utriculata* has been retained here to follow Bourgeron and Engelking (1994).

Geographic Extent: The *Carex aquatilis*–*Carex utriculata* plant association is known throughout the high montane and subalpine meadows of the Rocky Mountains, from 2,510 m to above 3,050 m (8,240-10,000 ft) (see Johnston 1987 and Kittel *et al.* 1994). It also occurs in Idaho, Montana, Utah, Wyoming and has been reported from Arizona and Nevada (Bourgeron and Engelking 1994). In the study areas this plant association was sampled between 2,900 m (9,520 ft.) and 3,200 m (10,480 ft.).

Site Features: This type occurs in a variety of situations where the soil is saturated most of the growing season. The area may be flooded, but the water usually is not deep and generally drops below the soil surface at some time in the growing season. According to Kittell *et al.* (1994) this plant association occurs on loamy, clayey or sandy typic and cumulic Cryaquolls, often with a high organic component. This plant association can also occur on a histosol, as did stand 01B which occurred on a 60 cm thick layer of sapric peat, underlain by a layer of clay.

Cooper (1986) measured an average water table of 20 cm in this plant association. The pH of the water in and near these stands was generally circumneutral (6.4-7.6), while the conductivity ranged from 40 to 460 μ s.

Vegetation: This type consists of dense sedge stands with intermixed *Carex aquatilis* and *Carex utriculata*. It can have very low species diversity with only a few characteristic high elevation wetland forbs such as *Caltha leptosepala* and *Pedicularis groenlandica* present.

Stand 07A was highly disturbed by elk grazing, hence the presence of *Alopecurus aequalis*, *Equisetum arvense*, and other early colonizers. Stand 27A contains high cover of *Rumex densiflorus*. The presence of this species probably indicates a high level of grazing disturbance rather than unique environmental conditions. Komárková (1986) reports a *Rumex densiflorus*–*Caltha leptosepala* plant association that is similarly disturbed.

Succession/Management: *Carex utriculata* appears to tolerate standing water and may be the more pioneering of the two species. *Carex aquatilis* is more palatable to livestock, and grazing in this plant association may favor *Carex utriculata* (Padgett *et al.* 1989).

Co-occurring Wetland Plant Associations: The *Carex aquatilis*–*Carex utriculata* plant association was found in wetland complexes with a *Salix wolfii*/Mesic forb plant association and various *Salix monticola* plant associations. At higher elevations it is found in wetland complexes with *Salix planifolia* plant associations as well as *Deschampsia cespitosa* and/or *Caltha leptosepala* plant associations. This association was also found on the edges of a series of glacially formed ponds which contain *Carex utriculata*, *Menyanthes trifoliata*, and *Nuphar lutea* spp. *polysepala* plant associations.

Related Plant Associations from Other Studies: The *Carex utriculata*-*Carex aquatilis* of Hess and Wasser (1982), Komárková (1986), and Cooper (1986) all appear synonymous with this plant association. Johnston (1987) reports this plant association as *Carex aquatilis*–*Carex utriculata* (Johnston 1987).

Representative Stands:

Table 18. <i>Carex aquatilis</i> – <i>Carex utriculata</i> p.a. Percent Cover of Important Taxa						
Species	JS94-01B	JS94-05A	JS94-06A	JS94-07A	JS94-27C	DC86-37
<i>Agrostis idahoensis</i>				4		
<i>Alopecurus aequalis</i>				4		
<i>Calamagrostis canadensis</i>		6	8			
<i>Cardamine cordifolia</i>					10	
<i>Carex aquatilis</i>	18	13	15	13	8	25
<i>Carex canescens</i>				2		10
<i>Carex utriculata</i>	31	13	18	9	25	65
<i>Epilobium saximontanum</i>				3		
<i>Equisetum arvense</i>				3		
<i>Galium trifidum</i>					2	

<i>Rorippa alpina</i>					13	
<i>Sphagnum platyphyllum</i>						10

Eleocharis palustris alliance

***Eleocharis palustris* (ELPA3) plant association**

Common spikerush p.a.

CNHP Rank: G5S3S4

Stands: 11C, 15A, 15B, 38E

General Description and Comments: The *Eleocharis palustris* plant association is a conspicuous, common emergent association that occurs in shallow, mostly still water. Most of the sites where it occurs experience water levels that fluctuate to some degree throughout the growing season. It is recognized by the clear dominance, although sometimes sparse with cover, of *Eleocharis palustris*.

Stand 15A contained large amounts of *Lemna* spp. (by far the dominant), making it unclear if it should be classified here or in a plant association of its own. Since there is little history of reporting of *Lemna* plant association in Colorado, and since the environmental conditions closely match the other stands, stand 15A was grouped in this well-documented plant association.

Geographic Extent: The *Eleocharis palustris* plant association has been reported throughout the southern Rocky Mountains at elevations from 1,700 to 3,050 m (5,575 to 10,000 ft). In this study it was sampled only in the montane zone, but it was seen at both higher and lower elevations.

Site Features: The *Eleocharis palustris* plant association grows on the edges of small to large ponds, lakes, and reservoirs, or in backwater reaches of large rivers. It occurs on a broad range of soils from fine-textured mineral soils to organic soils. Sites are commonly ponded throughout much of the growing season, and soils have developed, for the most part, from pond siltation. The water where this plant association occurs is generally less than 1 m deep (Cooper and Severn 1992). It often occurs where flooding is of short duration (see Cooper and Severn 1992 and Padgett *et al.* 1989). In the study area it is commonly found where the water table fluctuates greatly over the growing season.

Vegetation: *Eleocharis palustris* dominates this plant association with scattered to dense cover. Usually few other species are present. On the drier end of the spectrum of this type, *Alopecurus aequalis* and other wet colonizing species may occur with *Eleocharis palustris*. At the wetter end of the spectrum, *Hippuris vulgaris*, *Utricularia vulgaris*, *Potamogeton* spp., and *Sparganium angustifolium* may occur. *Carex utriculata* may also be found mixed in this community with low cover.

Co-occurring Wetland Plant Associations: Stands of *Eleocharis palustris* frequently line the shoreline in shallow water adjacent to submerged aquatic communities such as *Ranunculus*

trichophyllus, *Sparganium angustifolium*, and *Potamogeton foliosus*–*Potamogeton pusillus*. Sedge communities, especially *Carex aquatilis*, commonly occur on the wet ground adjacent to *Eleocharis palustris* stands. This association was also found adjacent to and intergrading with the *Carex utriculata* plant association; however, Cooper (1993) states that the *Eleocharis palustris* plant association in the Crested Butte region does not occur on the edge of permanent natural lakes where *Carex utriculata* occurs.

Succession/Management: The *Eleocharis palustris* plant association is an early successional association that may eventually be replaced by the *Carex utriculata* plant association as siltation continues (Padgett *et al.* 1989), but probably only if water level fluctuations diminish. However, this plant association does persist on the edges of ponds and lakes that are regularly disturbed.

Related Plant Associations from Other Studies: Kittel and Lederer (1993), Johnston (1987), Padgett *et al.* (1989), and Youngblood *et al.* (1985) describe an *Eleocharis palustris* plant association. Hansen *et al.* (1988) report *Eleocharis palustris* as "a common dominance type of low to mid-elevations throughout Montana." Kovalchik (1987) described a similar *Eleocharis palustris* association for central Oregon. Cooper (1993) reported an *Eleocharis palustris* plant association from the Crested Butte region. Cooper and Severn (1992) reported an *Eleocharis palustris* plant association from the San Luis valley.

Representative Stands:

Table 19. <i>Eleocharis palustris</i> p.a. Percent Cover of Important Taxa						
Species	JS94-11C	JS94-15A	JS94-15B	JS94-38E	DC93-31	DC93-40
<i>Carex canescens</i>				3		
<i>Carex utriculata</i>		2	2			
<i>Eleocharis palustris</i>	11	11	24	23	80	60
<i>Equisetum arvense</i>	2		1			
<i>Hippuris vulgaris</i>					15	
<i>Hordeum jubatum</i>			2			
<i>Lemna cf. minor</i>		30	5			
<i>Lemna trisulca</i>		32	3			
<i>Potamogeton</i> sp.					10	2
<i>Sparganium angustifolium</i>	5					

VIII.C.2.g. SATURATED SHORT GRASSLANDS

Carex saxatilis alliance

Carex saxatilis (CASAS7) plant association

Russet sedge p.a.

CNHP Rank: G3S?

Stands: 04E, 34A

General Description and Comments: The *Carex saxatilis* plant association occurs as a sedge meadow on organic soils along shorelines of ponds and small lakes, and possibly near streams. It looks like other sedge meadow communities, but the distinctive shiny reddish color of the inflorescence of this species allows it to be distinguished readily from similar communities.

Geographic Extent: The *Carex saxatilis* plant association is a major type in the Uinta Mountains in northeast Utah, ranging from 2,745 m to 3,205 m (9,000 to 10,500 m) (Padgett *et al.* 1989). Kettler and McMullen (1995) report one stand of this plant association from northern Colorado at 3050 m (10,000 ft.). Stand 04E and 37A were both found around 3,200 m (10,500 ft.).

Site Features: This plant association was found in shallow, partially peat-filled ponds, Padgett *et al.* (1989) note that it occurs in narrow to broad mountain meadows, typically on organic substrates, with smooth to concave surface topography. Soils are typically saturated to the surface, but they may have a tolerance for seasonal drying in the upper horizons (Padgett *et al.* 1989). Seasonal drying may explain why some of the soils beneath this association exhibit a higher degree of decomposition than histosols under some other *Carex* communities (e.g., *Carex limosa* and *Carex lasiocarpa* associations, see Padgett *et al.* 1989).

Vegetation: *Carex saxatilis* dominates typically dense graminoid stands. Padgett *et al.* (1989) report that *Carex aquatilis* is commonly present and often a codominant. Other graminoids and wet-meadow forbs may also be present, but generally with low cover. The two stands sampled in this study contained 25 and 32 percent cover of *Carex saxatilis* and only one other species which in both stands had very low cover (litter and peat covered much of the remaining area in the sample plots).

Succession/Management: Padgett *et al.* (1989) state that *Carex saxatilis* appears to be more palatable than *Carex utriculata* but less palatable than *Carex aquatilis*. In any case, the *Carex saxatilis* plant association appears to be uncommon; it should not be relied upon heavily for forage because heavy grazing may destroy it. Use of heavy machinery on this plant association should be avoided because of the organic, wet soils.

Co-occurring Wetland Plant Associations: The *Carex saxatilis* plants may occur with *Carex utriculata* stands on one side and aquatic communities on the other in the middle to low portion

of its elevational range, whereas it may be found with *Salix planifolia* and *Carex aquatilis* communities at the middle to high portion of its range.

Related Plant Associations from Other Studies: This association appears to be the same as that reported by Padgett *et al.* (1989) from the Uinta Mountains in Utah. A *Carex saxatilis*/*Eriophorum gracile* plant association has been reported in Idaho, but it remains undocumented with stand data (Bourgeron and Engelking 1994). Kettler and McMullen (1995) report a *Carex saxatilis* plant association from northern Colorado in the Routt National Forest.

Representative stands:

Table 20. <i>Carex saxatilis</i> p.a. Percent Cover of Important Taxa			
SPECIES	JS94-04E	JS94-34A	SK-284
<i>Caltha leptosepala</i>			10
<i>Carex aquatilis</i>			20
<i>Carex saxatilis</i>	32	25	40
<i>Deschampsia cespitosa</i>			10
<i>Eleocharis quinqueflora</i>			20
<i>Eriophorum angustifolium</i>	3		

Eleocharis quinqueflora alliance

Eleocharis quinqueflora (ELQU2) plant association

Fewflower spikerush p.a.

CNHP Rank: G4SU

Stands: 10B, 10C, 19A, 30A

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

One stand (10B) classified here was dominated by *Carex aquatilis*. By nature of its environmental setting and the presence of *Eleocharis quinqueflora*, however, this stand is clearly more closely allied with other *Eleocharis quinqueflora* stands than with the typical *Carex aquatilis* stand.

Geographic extent: The *Eleocharis quinqueflora* plant association has been reported from northern Colorado, south to the Gunnison National Forest. It has also been reported from northeastern Utah (Johnston 1987, Briggs and MacMahon 1983), as well as central Oregon, western and north central Montana, and Yellowstone National Park (Padgett *et al.* 1989). It is also found in Idaho (where it is rare, Heritage Program Rank: S1) (Bourgeron and Engelking 1994). This plant association occurs above 3,170 m (10,380 ft)

Site Features: The *Eleocharis quinqueflora* plant association is always found on peat (Cryohemists); in this study peat as deep as 2 meters was found (stand 10C). The soils remain saturated throughout the growing season. Cooper (1990a) found this type on shallow peat over sand and gravel.

In stands sampled in this study the pH of the surface water was always 7.0 or less, and the conductivity was only 20 or 30 μs in all cases but one (where it was 100 μs). Cooper (1990a) reports that the soils under this plant association are the most nutrient poor of all those found in Big Meadows (in Rocky Mountain National Park), Colorado.

Vegetation: The vegetation is characterized by widely spaced *Eleocharis quinqueflora* plants. *Carex aquatilis* (which sometimes co-dominates or dominates) and *Pedicularis groenlandica* are common associates. Cooper (1990a) lists *Carex lachenalii* [= *C. bipartita*] as a diagnostic species of this plant association. *Carex lachenalii*, *Eriophorum angustifolium*, and a few other species possibly escape competition by growing on sites too poor in nutrients to support the more robust *Carex* species of Colorado's montane wetlands.

Succession/Management: This plant association is sensitive to trampling and heavy equipment.

Co-occurring Wetland Plant Associations: The *Eleocharis quinqueflora* plant association often occurs near *Salix planifolia* peatland communities and stands of *Caltha leptosepala*. Such systems may be fed by springs that provide habitat for a *Cardamine cordifolia*–*Caltha leptosepala* plant association. In some instances (e.g., stands 10B and 10C) it occurs near true aquatic communities such as *Nuphar lutea* spp. *polysepala*.

Related Plant Associations from Other Studies: The *Eleocharis quinqueflora*–*Carex lachenalii* plant association of Cooper (1990a) appears to be the same as this *Eleocharis quinqueflora* plant association, despite the appearance of *Carex lachenalii* in the plant association name. Three stands in Big Meadows that are classified under this name contain on average 2% *Carex lachenalii* and 12% *Carex aquatilis*.

Kettler and McMullen (1995), Kittel *et al.* (1994), Komárková (1976), and Padgett *et al.* (1989) also report *Eleocharis quinqueflora* communities. Johnston (1987) includes the *Eleocharis pauciflora* [= *E. quinqueflora*] plant association as a phase of the *Carex aquatilis*–*Carex utriculata* plant association.

Representative Stands:

Table 21. <i>Eleocharis quinqueflora</i> p.a. Percent Cover of Important Taxa					
Species	JS94-10B	JS94-10C	JS94-19A	JS94-30A	DC90a (3 stand avg.)
<i>Caltha leptosepala</i>					2
<i>Carex aquatilis</i>	40	11	10	8	11
<i>Carex canescens</i>	14	1			
<i>Carex lachenalii</i>					2
<i>Eleocharis quinqueflora</i>	5	8	10	18	68
<i>Epilobium anagallidifolium</i>			+		
<i>Eriophorum angustifolium</i>					2

VIII.E.1.a. PERENNIAL LOW FORB VEGETATION

Caltha leptosepala alliance

Caltha leptosepala (CALEL8) plant association

White marshmarigold p.a.

CNHP Rank: G4S?

Stands: 09A, 19C, 20B, 20D, 40A, 41B

General Description: The frequently seen *Caltha leptosepala* plant association occurs in the subalpine and lower alpine on perennially saturated ground. This association is often associated with shallow sloping seeps. It can be recognized by the prominence of *Caltha leptosepala* with a near absence of shrubs and low cover of *Sedum rhodanthum*.

When stands similar to this plant association contain large amounts of *Sedum rhodanthum*, some authors (Johnston 1987, Komárková 1976, Komárková 1986) have placed them in a separate *Caltha leptosepala*–*Sedum rhodanthum* plant association. This study followed this example with stand 20C. The *Caltha leptosepala*–*Sedum rhodanthum* association may, however, be only a phase of *Caltha leptosepala*; further work is needed to resolve this question.

The taxonomy of the plant associations closely related to this one is currently unclear. The literature presents several plant associations closely allied to the *Caltha leptosepala* plant association (see Bourgeron and Engelking (1994) for a complete listing of these plant associations and additional literature that discusses them). As a whole, this group needs more work to better delimit plant associations; such an analysis will likely result in the combining of some of these classes.

Geographic extent: This plant association has also been reported from Colorado, Utah (Padgett *et al.* 1989), Idaho, and Montana (Bourgeron and Engelking 1994). It can be expected to occur in Wyoming. *Caltha leptosepala* was found in this study at 3,000-3,500 m (9,820-11,500 ft.). It can be expected at slightly lower elevations and higher elevations.

Site Features: The *Caltha leptosepala* plant association typically occupies seeps, streamsides, springs, and wet, subirrigated meadows. It may be associated with small or narrow forest openings, open hillsides, and broad valley bottoms. Slopes range from almost none to 30 percent. Komárková (1986) reported this plant association on Cryaquepts or aquic Cryorthents, but it also occurs on peat soils.

Vegetation: A dense, conspicuous layer of *Caltha leptosepala* dominates this plant association. Many graminoids and forbs that tolerate long-term soil saturation may also be present. *Carex aquatilis* is a very common, sometimes co-dominant, associate. *Deschampsia cespitosa* may be present, but generally in small amounts. Forbs may include *Pedicularis groenlandica*, *Stellaria umbellata*, *Swertia perennis*, low amounts of *Sedum rhodanthum*, and several others.

Succession/Management: *Caltha leptosepala* is considered a stable community type (Padgett *et al.* 1989). It receives little livestock use, probably because of its wet substrate and because livestock avoid it due to its bitter, acrid taste (Craighead *et al.* 1963). Use by deer and elk is likely when this plant association is associated with forest openings.

Co-occurring Wetland Plant Associations: In forest openings this plant association was found with *Salix planifolia*, *Carex utriculata*–*Carex aquatilis*, and *Senecio triangularis* plant associations. In a high elevation peatlands it co-occurs with stands of *Eleocharis quinqueflora* and *Salix planifolia/Caltha leptosepala*.

Related Plant Associations from Other Studies: Ellison (1954) noted occurrences of communities dominated by *Caltha leptosepala* on the Wasatch Plateau of central Utah. Padgett *et al.* (1989) report *Caltha leptosepala* as a “minor type in the Uinta Mountains and Utah Plateaus Floristic Section.” Hansen *et al.* (1988) described the *Caltha leptosepala* dominance type as a rare to minor type in western and central Montana. Komárková (1976) described a *Caltha leptosepala*–*Sedum rhodanthum* plant association for north-central Colorado. Cooper (1990a) describes a *Carex aquatilis*–*Caltha leptosepala* plant association in Big Meadows, Rocky Mountain National Park, that resembles this plant association, but with the dominance roles of *Caltha leptosepala* and *Carex aquatilis* reversed.

Representative Stands:

Table 22. <i>Caltha leptosepala</i> p.a. Percent Cover of Important Taxa							
Species	JS94-09A	JS94-19C	JS94-20B	JS94-20D	JS94-40A	JS94-41B	DC90a (19 stand avg.)
<i>Arabis drummondii</i>			4				
<i>Arnica mollis</i>				3			
<i>Calamagrostis canadensis</i>	7						3
<i>Caltha leptosepala</i>	16	25	50	15	7	23	12
<i>Carex aquatilis</i>	4	8	11	4	3	15	61
<i>Carex canescens</i>							2
<i>Carex illota</i>		10		7			
<i>Carex magellanica</i>					3		
<i>Carex utriculata</i>	8						2
<i>Deschampsia cespitosa</i>	2		3	10	5		5
<i>Eleocharis quinqueflora</i>					3		
<i>Pedicularis groenlandica</i>	9			6	1		
<i>Salix planifolia</i>		10					
<i>Saxifraga oregana</i>			2				
<i>Sedum rhodanthum</i>		2		5			
<i>Swertia perennis</i>						14	

***Caltha leptosepala*–*Deschampsia cespitosa* (CALEL8–DECEC) plant association**

White marshmarigold–Tufted hairgrass p.a.

CNHP Rank: G?S?

Stands: 17A, 25B, 28A

General Description and Comments: This wet meadow plant association appears as a mixture of forbs and graminoids. *Caltha leptosepala* and *Deschampsia cespitosa* are usually both present, although often at relatively low cover, with the cover of *Caltha leptosepala* noticeably higher than that of *Deschampsia cespitosa*.

The taxonomy of the plant associations closely related to this one is currently unclear. The literature presents several plant associations closely allied to the *Caltha leptosepala* plant association (see Bourgeron and Engelking (1994) for a complete listing of these plant associations and additional literature that discusses them). As a whole, this group needs more work to better delimit plant associations; such an analysis will likely result in the combining of some of these classes.

Placement of stands from this study was based on cluster analysis. Two stands related to this group (3A and 40B) were not classified. Others, especially 17A and 25B in which *Arnica mollis* was the most abundant species, may later be classified in a new plant association.

Geographic Extent: This plant association has been reported on several occasions from Wyoming, and it (or closely allied associations) probably occurs in western Montana (see Komárková 1986). In Colorado *Caltha leptosepala*–*Deschampsia cespitosa* is distributed throughout the subalpine zone in central and northern Colorado, from 2,900 to 3,400 m (9,500 to 11,100 ft.).

Site Features: The *Caltha leptosepala*–*Deschampsia cespitosa* plant association occurs in forest openings and broad valleys, including montane cirques. These habitats have excess moisture from groundwater seepage, slightly prolonged duration of snow cover, and relatively deep soils (see Komárková 1986). By mid- to late-summer the water table associated with this plant association no longer remains near the surface. This plant association often occurs in the wet meadows associated with lakes and streams. At one site (site 20) this plant association was clearly associated with the front slopes of a large complex of beaver ponds that had long ago filled in and re-vegetated.

Komárková (1986) reports that her *Deschampsia cespitosa*–*Caltha leptosepala* stand occurred on a Cryumbrept. The stands sampled in this study occurred mainly on loams, occasionally with a histic epipedon.

Vegetation: In all of the stands sampled, *Caltha leptosepala* and *Deschampsia cespitosa* shared dominance, with *Caltha leptosepala* always present at slightly higher cover. However, both occurred with cover less than 15%. The dominant species have low cover apparently because of the high number of species in these stands. Almost all of the species are low-growing, wet-meadow herbaceous species. In the three plots here, eight to ten species had 4% or greater cover,

but no species had greater than 13% cover, i.e., these stands occur with many species balanced at relatively low cover.

Other species commonly found in this plant association include *Carex aquatilis*, *Pedicularis groenlandica*, and *Sedum rhodanthum*. In two of the stands classified here *Arnica mollis* was the species with the highest cover in the stand.

Succession/Management: *Caltha leptosepala–Deschampsia cespitosa* appears to be a stable, climax wet meadow plant association. The high diversity of graminoids and forbs may provide large amounts of forage. Some wildlife, especially elk, may make moderate to heavy use of *Caltha leptosepala*, but domestic livestock avoid it due to its bitter, acrid taste. (Craighead *et al.* 1963).

Co-occurring Wetland Plant Associations: Stands of *Caltha leptosepala–Deschampsia cespitosa* are found in a variety of situations. When occurring near a pond or lake, it may be associated with *Carex utriculata*, *Carex utriculata–Carex aquatilis*, and *Calamagrostis canadensis* plant associations; emergent communities such as *Sparganium angustifolium* may also occur in the same complex. Elsewhere it is associated with large willow carr/wet meadow complexes of *Salix planifolia* plant associations and/or other *Caltha leptosepala* plant associations.

Related Plant Associations from Other Studies: A plant association by this name appears three times in literature from Wyoming (Gregory 1983, Potkin and Munn no date, Starr 1974; all in Bourgeron and Engelking 1994), although data were not available to determine that in fact they are the same plant association. Johnston (1987) summarized six reports (Andersen *et al.* 1979, Hess 1981, Hess and Alexander 1986, Hess and Wasser 1982, Komárková 1986, Wasser and Hess 1982) that describe a *Deschampsia cespitosa–Caltha leptosepala* plant association across the subalpine zone in northern and central Colorado. Johnston does not list *Caltha leptosepala–Deschampsia cespitosa* as a plant association. The name *Caltha leptosepala–Deschampsia cespitosa* is retained here because in every stand sampled, *Caltha leptosepala* had a higher cover value than *Deschampsia cespitosa*. It appears likely that further investigation will reveal that these two plant associations are the same, or that one is a phase of the other.

Hansen *et al.* (1988) report that *Deschampsia cespitosa* is a common associate at the drier extreme of their *Caltha leptosepala* dominance type.

Representative Stands:

Table 23. <i>Caltha leptosepala</i> – <i>Deschampsia cespitosa</i> p.a. Percent Cover of Important Taxa			
Species	JS94-17A	JS94-25B	JS94-28A
<i>Aconitum columbianum</i>		5	
<i>Angelica grayi</i>		4	
<i>Angelica pinnata</i>			2
<i>Arnica mollis</i>	11	8	3
<i>Calamagrostis canadensis</i>	7		+
<i>Caltha leptosepala</i>	8	4	13
<i>Carex aquatilis</i>			2
<i>Carex illota</i>			
<i>Carex magellanica</i>			
<i>Carex microptera</i>	7		
<i>Carex nova</i>		4	5
<i>Carex utriculata</i>		2	
<i>Deschampsia cespitosa</i>	6	4	6
<i>Eleocharis pauciflora</i>			
<i>Epilobium halleanum</i>	7		
<i>Epilobium hornemannii</i>		2	4
<i>Erigeron peregrinus</i>	4	3	
<i>Gentianopsis thermalis</i>			3
<i>Juncus drummondii</i>	3	6	2
<i>Juncus tracyi</i>		3	
<i>Oxypolis fendleri</i>		3	4
<i>Pedicularis groenlandica</i>		4	2
<i>Ranunculus alismifolius</i>	7		
<i>Salix monticola</i>		3	
<i>Salix planifolia</i>		5	5
<i>Saxifraga odontoloma</i>			5
<i>Sedum rhodanthum</i>			
<i>Senecio triangularis</i>			3
<i>Trollius laxus</i>			7
<i>Taraxacum officinale</i>		5	

***Caltha leptosepala*–*Sedum rhodanthum* (CALEL8–SERH) plant association**

White marshmarigold–Rose crown p.a.

CNHP Rank: GUSU

Stands: 20C

General Descriptions and Comments: The *Caltha leptosepala*–*Sedum rhodanthum* plant association occurs commonly in the upper subalpine and lower alpine. It is characterized by prominent cover of wet meadow forbs, including *Caltha leptosepala*, *Sedum rhodanthum*, and *Pedicularis groenlandica*.

The taxonomy of the plant associations closely related to this one is currently unclear. The literature presents several plant associations closely allied to the *Caltha leptosepala* plant association (see Bourgeron and Engelking (1994) for a complete listing of these plant associations and additional literature that discusses them). As a whole, this group needs more work to better delimit plant associations; such an analysis will likely result in the combining of some of these classes.

Distribution: *Caltha leptosepala*–*Sedum rhodanthum* is found in mountainous regions throughout Colorado from 11,200 to 11,900 ft (Johnston 1987).

Site Features: *Caltha leptosepala*–*Sedum rhodanthum* occurs in marshy meadows, along streamsides, and near springs. It may occur in valley bottoms, in forest openings, and on open hillsides. Sites for this plant association are inundated for a large portion of the growing season.

Vegetation: *Caltha leptosepala*, *Sedum rhodanthum*, and *Pedicularis groenlandica* all figure prominently in this plant association, but they often occur with only around 10% cover. Graminoids that may occur with this plant association include *Carex pachystachya*, *Deschampsia cespitosa*, and *Trisetum wolfii*.

Succession/Management: This plant association appears to be a stable, climax plant association.

Co-occurring Wetland Plant Associations: Plant associations that occur most often with the *Caltha leptosepala*–*Sedum rhodanthum* plant association include other *Caltha leptosepala* associations and *Salix planifolia* plant associations.

Related Plant Associations from Other Studies: Komárková (1976, 1986) reports this plant association from the Indian Peaks region in Colorado and from the Gunnison National Forest.

Representative Stands:

Table 24. <i>Caltha leptosepala</i> – <i>Sedum rhodanthum</i> p.a. Percent Cover of Important Taxa	
Species	JS94-20C
<i>Agrostis idahoensis</i>	4
<i>Caltha leptosepala</i>	9
<i>Carex aquatilis</i>	4
<i>Deschampsia cespitosa</i>	4
<i>Epilobium saximontanum</i>	7
<i>Gentianopsis thermalis</i>	2
<i>Pedicularis groenlandica</i>	14
<i>Salix planifolia</i>	2
<i>Saxifraga oregana</i>	7
<i>Sedum rhodanthum</i>	8
<i>Trisetum wolfii</i>	8
<i>Veronica wormskjoldii</i>	6
<i>Viola</i> sp.	6

Unclassified *Caltha leptosepala* stand

Stand: 40B

Comments: This stand contained several of the plants characteristic of *Caltha leptosepala* plant associations, and the cluster analysis placed this stand among the *Caltha leptosepala* stands. The overall composition of this sparsely vegetated stand did not, however, fit clearly within any one of the existing classes. The species composition of this stand also looks similar to that of the *Carex nigricans*–*Juncus* spp. plant association in Johnston (1987). This stand was sampled at 3230 m (10,600 ft.). It was found in a large wet meadow with other *Caltha leptosepala* stands and with a poorly developed *Salix planifolia* stand.

Table 25. Unclassified <i>Caltha leptosepala</i> stand Percent Cover of Important Taxa	
Species	
<i>Agrostis thurberiana</i>	1
<i>Arnica mollis</i>	2
<i>Calamagrostis canadensis</i>	1
<i>Caltha leptosepala</i>	3
<i>Carex aquatilis</i>	5
<i>Carex nigricans</i>	6
<i>Epilobium</i> sp.	1
<i>Juncus drummondii</i>	2
<i>Pedicularis groenlandica</i>	1
<i>Vaccinium cespitosum</i>	4

Cardamine cordifolia alliance

Cardamine cordifolia–*Caltha leptosepala* (CACO6–CALEL8) plant association

Heartleaf bittercress–White marshmarigold p.a.

CNHP Rank: GUSU

Stands: 03C, 25A, 30C, 30D

General Description and Comments: The generally small stands of *Cardamine cordifolia*–*Caltha leptosepala* are found in and near running water of small streams, seeps, and springs. They can be recognized by the abundance of *Cardamine cordifolia* and *Caltha leptosepala*. Other associated species may vary widely.

The stands of this plant association did not fall out clearly in the cluster analysis performed on the stand data. Stand 03C was attached to *Caltha leptosepala* plant associations because of the dominance of *Caltha leptosepala*; the habitat and the abundance of *Cardamine cordifolia*, however, clearly place this stand here. Other stands were mixed with other mesic forb plant associations because of the abundance and variety of associated mesic forb species.

In some cases (e.g., stand 03C) stands of this plant association classify very easily and clearly. In other cases it intergrades with various other plant associations (e.g., *Senecio triangularis*) that occur in and along the edge of small, swiftly flowing streams.

Geographic Extent: This plant association is known to be distributed in the upper subalpine to lower alpine (3,210–3,510 m; 10,520–11,500 ft.) in central and southwestern Colorado. It has not been reported outside Colorado (Bourgeron and Engelking 1994).

Site Features: In the study area the *Cardamine cordifolia*–*Caltha leptosepala* plant association was found growing vigorously in a large, copiously flowing spring (03C) as well as in the shade of conifer trees (adjacent to a spruce forest) along the edge of small flowing streams. It occurs on slopes that range from nearly level to 25%. Johnston (1987) states that it occurs on northwest and southwest facing slopes. *Cardamine cordifolia*–*Caltha leptosepala* is found along streams, in seeps, as well as in and near springs. In many cases this habitat probably experiences a long period of snow cover (Johnston 1987). *Cardamine cordifolia*–*Caltha leptosepala* is found on a variety of mineral soil types. In these stands (in which standing water was often present) pH was found to be around neutral or slightly higher (6.9 to 7.5) and conductivity was between 100 and 330 μ s. These are typically values for many of the flowing waters in Colorado's mountains.

Vegetation: Associated taxa may vary greatly with this plant association, but the dominance of *Cardamine cordifolia* and the significant presence of *Caltha leptosepala* are always clear. Associated taxa may include several of the many common wet meadow species such as *Epilobium* spp., *Pedicularis groenlandica*, *Saxifraga odontoloma*, and *Carex* sp. In stands that occur in springs, mosses may grow abundantly.

Stand 30D consists of over 80% *Cardamine cordifolia* and no *Caltha leptosepala* on a slope of approximately 30% on top of a small stream with relatively fast flowing water. The steep slope

and subsequent fast flowing water may shift the balance of environmental conditions strongly in favor of *Cardamine cordifolia* and against *Caltha leptosepala*. Further investigation may verify that this is a phase of *Cardamine cordifolia*–*Caltha leptosepala*, or it may determine that a *Cardamine cordifolia* plant association requires a separate class.

Succession/Management: *Cardamine cordifolia*–*Caltha leptosepala* appears to be a stable plant association.

Co-occurring Wetland Plant Associations: *Cardamine cordifolia*–*Caltha leptosepala* occurring along streams is most closely associated with forests communities, sometimes upland (e.g., *Picea engelmannii*/*Abies lasiocarpa* forest) and sometimes forested wetland (e.g., *Abies lasiocarpa* and *Picea engelmannii* wetland communities). Spring associated stands may be found with many other wetland plant associations, e.g., *Salix wolfii* and *Carex aquatilis*. It was once found at the base of a steep slope (stand 30C), adjacent to a peatland with a *Salix planifolia* plant association and a large stand of *Eleocharis quinqueflora*; at the same site this plant association was especially well developed in a steep stream (stand 30D) leaving the peatland. Some stands, such as 03C, are connected to the remainder of the wetland complex only by a stream; these otherwise remain hydrologically distinct. This plant association may also occur in a complex of other forb associations such as *Caltha leptosepala* meadows and *Senecio triangularis* stands.

Related Plant Associations from Other Studies: Rottman and Hartman (1985) report this plant association from the San Juan mountains in southwestern Colorado. Johnston (1987) lists *Cardamine cordifolia*/*Caltha leptosepala* in his compilation of plant associations of USDA Forest Service Region 2. Komárková (1976) reports a *Epilobium angustifolium*–*Cardamine cordifolia* plant association from the Indian Peaks area of Colorado, which Johnston (1987) determined was synonymous with *Cardamine cordifolia*–*Caltha leptosepala*.

Representative stands:

Table 26. <i>Cardamine cordifolia</i> – <i>Caltha leptosepala</i> p.a. Percent Cover of Important Taxa				
Species	JS94-03C	JS94-25A	JS94-30C	JS94-30D
<i>Arnica mollis</i>			8	
<i>Caltha leptosepala</i>	43	10	6	
<i>Cardamine cordifolia</i>	20	16	18	82
<i>Carex cf. microptera</i>			15	
<i>Carex utriculata</i>		4		
<i>Epilobium hornemannii</i>		4		9
<i>Luzula parviflora</i>			6	
<i>Mimulus guttatus</i>				2
<i>Pedicularis groenlandica</i>		4		
<i>Saxifraga odontoloma</i>		13		
<i>Senecio triangularis</i>			8	2
<i>Swertia perennis</i>		5		
Unidentified moss	28			

Senecio triangularis alliance

Senecio triangularis (SETR) plant association

Arrowleaf groundsel p.a.

CNHP Rank: G2?SU

Stands: 25C

General Description and Comments: The *Senecio triangularis* plant association is a small association that occurs mainly along streams in the subalpine region. Many other forb species typically grow in a *Senecio triangularis* stand.

Geographic Extent: The *Senecio triangularis* plant association occurs throughout the subalpine of Colorado, around 2,900-3,550 m (9,500-11,650 ft.). This plant association has also been reported from Montana, where it is rare (Montana Natural Heritage Program Rank: S2) (Bourgeron and Engelking 1994).

Site Features: The *Senecio triangularis* plant association is found along creeks (some with a steep gradient) and in wet lowland meadows, mainly in the subalpine. Soils are Cryumbrepts (Komárková 1986).

Vegetation: *Senecio triangularis* is generally clearly dominant in this plant association, with up to 95% cover, although it may be more balanced with other mesic forbs. Komárková (1986) reports that in the West Elk Mountains of central Colorado, *Trisetum wolfii*, *Deschampsia cespitosa*, *Castilleja rhexifolia*, and *Phleum commutatum* [= *P. alpinum*] all have significant cover.

Succession/Management: This plant association appears to be a stable forb plant association.

Co-occurring Wetland Plant Associations: The *Senecio triangularis* plant association may occur in association with almost any other wetland type in its range, since it often occurs near inlets to larger wetland systems. It may also stand by itself in openings along streams in a forest.

Related Plant Associations from Other Studies: Komárková (1986) reported a *Senecio triangularis*–*Trisetum wolfii* plant association from the Gunnison National Forest, Colorado that appear synonymous with the *Senecio triangularis* plant association. Cooper (1993) reported an *Oxypolis fendleri*–*Senecio triangularis* plant association from the Crested Butte region that may be synonymous with this plant association.

Representative Stands:

Table 27. <i>Senecio triangularis</i> p.a. Percent Cover of Important Taxa				
Species	JS94-25C	VK86-36	DC93-111	DC93-67
<i>Aconitum columbianum</i>				15
<i>Arnica longifolia</i>		3		
<i>Caltha leptosepala</i>	3			
<i>Cardamine cordifolia</i>	8		15	40
<i>Deschampsia cespitosa</i>		3		
<i>Drepanocladus aduncus</i> (moss)			30	
<i>Epilobium anagallidifolium</i>	4			
<i>Epilobium lactiflorum</i>			5	
<i>Heracleum maximum</i>				10
<i>Juncus mertensianus</i>			15	
<i>Mertensia ciliata</i>	20		10	30
<i>Oxypolis fendleri</i>	+		20	
<i>Parnassia fimbriata</i>			5	
<i>Poa leptocoma</i>	+			5
<i>Saxifraga odontoloma</i>	15			
<i>Senecio serra</i>				5
<i>Senecio triangularis</i>	28	95	5	70
<i>Stellaria umbellata</i>		3		
<i>Trisetum wolffi</i>		5		

Unclassified *Senecio dimorphophyllus* stand

Stand: 29A

Comments: This very homogeneous stand was sampled on the shore of a lake just below treeline. The vegetation was sparse (as can be seen in the table below) and the substrate was coarse gravel with interstices filled with silt. High water marks were clear on the lower edge of this stand, but at the time of sampling the water had dropped an entire meter. This stand was not classified because it was seen only once during the field season and nothing resembling it was found in the literature.

Table 28. Unclassified <i>Senecio dimorphophyllus</i> stand Percent Cover of Important Taxa	
Species	JS94-29A
<i>Carex saxatilis</i>	3
<i>Deschampsia cespitosa</i>	3
<i>Senecio dimorphophyllus</i>	10

Unclassified wet meadow stands

Stand: 33A, 42B

Comments: Both of these wet meadow stands were sampled near beaver ponds on moist, seepy slopes in the upper montane. They both occurred upslope from well developed *Carex utriculata* stands. Adjacent ponds were filled with a *Potamogeton* stands. Site 33 was the only location during this study where the state-rare *Carex diandra* was seen.

Table 29. Unclassified wet meadow stand Percent Cover of Important Taxa		
Species	JS94-33A	JS94-42B
<i>Achillea millefolium</i> var. <i>occidentalis</i>		3
<i>Aconitum columbianum</i>		2
<i>Aster foliaceus</i>		7
<i>Calamagrostis canadensis</i>		3
<i>Carex microptera</i>		8
<i>Carex utriculata</i>	2	1
<i>Conioselinum scopulorum</i>	1	5
<i>Epilobium halleanum</i>	3	
<i>Epilobium saximontanum</i>		3
<i>Equisetum arvense</i>	3	+
<i>Fragaria virginiana</i>	3	
<i>Galium trifidum</i>	4	+
<i>Geranium richardsonii</i>	2	5
<i>Geum macrophyllum</i>	16	4
<i>Juncus longistylis</i>	2	
<i>Poa pratensis</i>	11	
<i>Poa leptocoma</i>		2
<i>Saxifraga odontoloma</i>	3	
<i>Taraxacum officinale</i>	3	+
<i>Veronica wormskjoldii</i>		2

VIII.E.1.c. SEASONALLY/SEMIPERMANENTLY FLOODED PERENNIAL LOW FORB VEGETATION

Bidens cernua alliance

Bidens cernua (BICE) plant association

Nodding beggartick
induced)

CNHP Rank: None (human

Stands: 13A, 21A

General Description and Comments: The *Bidens cernua* plant association is an adventitious plant association that occurs on highly disturbed edges of ponds, lakes, and backreaches of rivers. It can be recognized by the dominance of *Bidens cernua* with its yellow flowers and annoying, clasping seeds. On wet soil other adventitious, disturbed-site species may also be present, while in standing water a variety of native aquatic species may co-occur with *Bidens*.

Geographic Extent: In many parts of North America, the *Bidens cernua* plant association occurs commonly. It has been reported rarely in Colorado, probably because this species arrived relatively recently to the West Slope of Colorado (it is not even included in Weber (1987)). This type has been reported at low elevations on the East Slope (Cooper and Cottrell 1989). The two stands sampled around 2,290 m (7,500 ft.).

Site Features: The *Bidens cernua* plant association occurs on the edges of shallow ponds in clayey or sandy wet loams, sometimes in very shallow water. Cooper and Cottrell (1989) report a *Bidens* plant association on the edge of rivers (presumably in slow-moving or still water) in seasonally wet sites. *Bidens* species tend to occur in nitrogen rich sites (Cooper and Cottrell 1989).

Vegetation: *Bidens cernua* is the most common species in this plant association, but in the stands sampled it had less than 20% cover. At one site (stand 13A) many other early successional species were present (e.g., *Mentha arvensis*, *Epilobium ciliatum*, *Polygonum persicaria*); the other site held a variety of native aquatic plants such as *Sagittaria cuneata*, *Myriophyllum sibiricum*, and *Lemna* sp.

Succession/Management: The *Bidens cernua* plant association may indicate excessive trampling of the shoreline where it occurs. It may also indicate eutrophication of the pond, lake, or stream.

Co-occurring Wetland Plant Associations: Both stands sampled occurred near aquatic associations of *Potamogeton foliosus*–*Potamogeton pusillus* and *Myriophyllum sibiricum*.

Related Plant Associations from Other Studies: The *Bidens cernua*–*Bidens frondosa* plant association of Cooper and Cottrell (1989) appears to be synonymous with the *Bidens cernua* plant association.

Representative Stands:

Table 30. <i>Bidens cernua</i> p.a. Percent Cover of Important Taxa		
Species	JS94-13A	JS94-21A
<i>Agrostis gigantea</i>	4	
<i>Bidens cernua</i>	18	15
<i>Carduus acanthoides</i>	3	
<i>Chara sp.</i>		3
<i>Epilobium ciliatum</i>	3	
<i>Juncus ensifolius</i>	9	
<i>Lemna cf. turionifera</i>		4
<i>Mentha arvensis</i>	8	
<i>Myriophyllum sibiricum</i>		3
<i>Phleum pratense</i>	5	
<i>Potamogeton foliosus</i>		5
<i>Potamogeton natans</i>		8
<i>Rudbeckia laciniata</i>	3	
<i>Sagittaria cuneata</i>		3
<i>Spirodela polyrhiza</i>	5	

Menyanthes trifoliata alliance

***Menyanthes trifoliata* (METR3) plant association**

Common buckbean p.a.

CNHP Rank: GUSU

Stands: 06E, 36D

General Description and Comments: In the Colorado Rocky Mountains, the *Menyanthes trifoliata* plant association is a small, rare plant association occurring in shallow water of montane lakes and ponds. In Canada and Alaska, this plant association is more extensive and more common. The *Menyanthes trifoliata* plant association can be recognized by the dominance of the namesake plant.

Geographic Extent: The *Menyanthes trifoliata* plant association has not been widely reported in the literature from the Rocky Mountains, probably because of its typically small size. It can be expected to occur from Colorado, north into Canada, and from Alaska to Newfoundland. Cooper (1990a) reported this plant association at 2,950 m (9,600 ft.). In 1994 this type was sampled twice at slightly more than 3,050 m (10,000 ft.).

Site Features: *Menyanthes trifoliata* grows in loosely consolidated organic substrate on the edge of ponds. The sampled stands were found in shallow water on a layer of peat up to 2 m thick. Cooper (1990a) found this type growing on a Cryohemist soil.

This plant association typically occurs in water with a pH that is relatively low for the region (around 6.0-6.5) and with low conductivity (less than 50 μ s).

Vegetation: *Menyanthes trifoliata* dominates this type at low to moderately high cover, occasionally occurring as a monoculture. *Carex utriculata*, *Carex aquatilis*, and shallow water aquatics may be associates.

Succession/Management: Cooper (1990a) reports that *Menyanthes trifoliata* seeds were found in a peat core that dated to 12,000 years BP, suggesting that this type is very stable. The *Menyanthes trifoliata* plant association may decrease in size as the edges of the pond fill in with peat and sediment.

Co-occurring Wetland Plant Associations: The *Menyanthes trifoliata* plant association typically occurs near *Carex* plant associations, especially *Carex utriculata*. *Nuphar lutea* spp. *polysepala* stands were found on more than one occasion in the deeper water near *Menyanthes trifoliata*.

Related Plant Associations from Other Studies: Cooper (1990a) reports a *Menyanthes trifoliata*–*Carex utriculata* plant association from Big Meadows (Rocky Mountain National Park), Colorado, that appears synonymous with the *Menyanthes trifoliata* plant association

Representative Stands:

Table 30. <i>Menyanthes trifoliata</i> p.a. Percent Cover of Important Taxa			
Species	JS94-06E	JS94-36D	DC90a
<i>Carex aquatilis</i>		1	
<i>Carex utriculata</i>			2
<i>Menyanthes trifoliata</i>	43	20	80
<i>Nuphar lutea</i> ssp. <i>polysepala</i>		8	

Ranunculus flammula alliance

Ranunculus flammula (RAFLF2) plant association

Spearwort p.a.

CNHP Rank: G?S?

Stands: 04D, 05F

General Description and Comments: The *Ranunculus flammula* plant association occurs as small stands on muddy shorelines and pond bottoms after the water has receded or disappeared. It is also occasionally found submersed in very shallow water.

This plant association occurs in habitats similar to those of the *Veronica americana*–*Alopecurus aequalis* plant association. *Alopecurus aequalis* commonly appears in both, along with some other species (e.g., *Rorippa* sp.). In fact Cooper (1986) named a community in a similar habitat *Alopecurus aequalis*–*Ranunculus flammula*. The similarity in disturbed, shoreline habitats among these plant associations indicates a need for further study to determine relationships within the group.

Geographic Extent: The *Ranunculus flammula* plant association appears to be widespread, occurring from the plains to the subalpine, but it has been poorly reported in the literature. The two stands sampled in 1994 were found between 2,990 m (9,800 ft.) and 3,170 m (10,400 ft.).

Site Features: The habitat of the *Ranunculus flammula* plant association is usually characterized by mud or dried (often cracked) mineral soil where water has receded or dried up. This situation is generally found in and along shallow ponds. This type may also occur in very shallow water.

Vegetation: *Ranunculus flammula* dominates this type with (15)30-40% cover. A variety of other mud flat and shallow water species may occur in this association. *Alopecurus aequalis* appears to be an especially common associate, occasionally with higher cover than *Ranunculus flammula*.

Succession/Management: *Ranunculus flammula* is an early successional type. If water levels stabilize, this type may be replaced by a sedge association such as *Carex aquatilis*–*Carex utriculata*. If fluctuating water levels persist, however, this association may persist.

Co-occurring Wetland Plant Associations: The *Ranunculus flammula* plant association typically occurs near emergent or submerged plant associations (e.g., *Sparganium angustifolium* or *Potamogeton* sp.). It was not found near well-developed *Carex utriculata* plant associations, as may be expected, probably because of excessively fluctuating water tables.

Related Plant Associations from Other Studies: Cooper (1986) reported an *Alopecurus aequalis*–*Ranunculus flammula* plant association from the Sawatch Range in Colorado which appears synonymous with this association. Johnson (1939) reported that in Little Columbine Lake in northern Colorado “In the muck around the shore and along the streams *Ranunculus flammula* and *Callitriche bifida*[?] grow in abundance.” He probably was observing this same plant association.

Representative Stands:

Table 32. <i>Ranunculus flammula</i> p.a. Percent Cover of Important Taxa			
Species	JS94-04D	JS94-05F	DC86-39
<i>Alopecurus aequalis</i>	4		40
<i>Calliergon stramineum</i> (a moss)			10
<i>Carex utriculata</i>		23	3
<i>Polygonum amphibium</i>		8	
<i>Potamogeton epihydrus</i>		3	
<i>Ranunculus flammula</i>	31	36	15
<i>Sparganium angustifolium</i>	4		

Sparganium angustifolium alliance

Sparganium angustifolium (SPAN2) plant association

Narrowleaf burreed p.a.

CNHP Rank: GUSU

Stands: 17D, 38C, 39C

General Description: The *Sparganium angustifolium* plant association occurs in shallow, still water on the edges of lakes and ponds. The narrow, floating leaves of the dominant plant (*Sparganium angustifolium*) distinguish this plant association.

In the subalpine, *Sparganium nutans* may replace *Sparganium angustifolium* because of overlapping habitat requirements. Without fruits it is difficult to distinguish between the two species.

Geographic Extent: This plant association was found in the study area from 2,830 to 3,360 m (9,280 to 11,000 ft.). It has been reported from the upper montane and subalpine across central and northern Colorado. According to Bourgeron and Engelking (1994), no report of this plant association has appeared in the literature from outside Colorado, but it almost certainly does occur beyond this state's borders.

Site Features: The *Sparganium angustifolium* plant association occurs in 0.5 to 1.0 of water (or slightly more or less) on the edges of ponds and small lakes. Soils are generally a loosely consolidated mucky peat. Komárková (1986) classified the soil of the stand sampled as a Cryosaprist.

Vegetation: *Sparganium angustifolium* dominates this plant association, often forming a near or complete monoculture. Other submerged aquatic plants may also be present, including *Ranunculus trichophyllus* (see Cooper 1986) and *Potamogeton* spp.

Succession/Management: Robbins (1918) says this type dominates the second stage of glacial lake succession. It likely persists for a long time once established. *Sparganium angustifolium* provides important food for waterfowl (Cooper 1986).

Co-occurring Wetland Plant Associations: Stands of *Sparganium angustifolium* frequently occur near stands of *Carex* communities, especially *Carex utriculata*. It may also occur near other aquatic plant associations.

Related Plant Associations from Other Studies: Cooper (1986) cites a *Sparganium angustifolium*–*Ranunculus trichophyllus* plant association that occurs in shallow ponds. The stand sampled in his study does not, however, contain *Ranunculus trichophyllus*, so it could be placed in this plant association. Robbins (1918) found similar communities in Boulder Park, Colorado.

Representative stands:

Table 33. <i>Sparganium angustifolium</i> p.a. Percent Cover of Important Species					
Species	JS94-17D	JS94-38C	JS94-39C	DC86-47	VK86-127
<i>Sparganium nutans</i>			45		
<i>Potamogeton foliosus</i>		28			
<i>Sparganium angustifolium</i>	95	33		40	55

Veronica americana alliance

***Veronica americana*–*Alopecurus aequalis* (VEAM2–ALAE) plant association**

American speedwell–Shortawn foxtail p.a.

CNHP Rank: G?S?

Stands: 26A

General Description and Comments: This small community occurs on exposed, wet mineral soil along the edges of beaver ponds and on the bottoms of shallow, seasonally wet depressions. This habitat contains widely varying amounts of the major species (*Veronica americana*, *Alopecurus aequalis*, *Rorippa* sp., etc.). The *Veronica americana*–*Alopecurus aequalis* plant association and the related plant associations mentioned below deserve further study to clarify relationships within this group.

Geographic Extent: The *Veronica americana*–*Alopecurus aequalis* plant association has been described only from the mid-montane to lower-subalpine of central Colorado. It was seen at several sites in the study area, but sampled only once, at 2,740 m (8,990 ft.). This plant association probably occurs outside Colorado also, but it has not been reported.

Site Features: *Veronica americana*–*Alopecurus aequalis* occurs in muddy sites with exposed mineral soil. These sites are seasonally inundated, but may be dry for some or most of the growing season. Disturbance, either by heavy trampling or fluctuating water levels is

characteristic of this type (moist sites in drained beaver ponds provide typical habitat). Bare soil and standing water both may be present. Komárková (1986) reports that the stand sampled was associated with a *Cryaquept*.

Vegetation: Sprawling weedy forbs dominate this type, especially *Veronica americana*, *Rorippa* spp., and often aquatic *Ranunculus* species which have been stranded. Graminoids generally do not comprise a large component of this type, but *Alopecurus aequalis* does typify this plant association and may have high cover. Komárková (1986) reports *Ranunculus hyperboreus* from this type and the one stand sampled in 1994 contained *Ranunculus trichophyllus*; both species indicate that once high water levels has receded.

Succession/Management: The *Veronica americana*–*Alopecurus aequalis* type is an early successional plant association, colonizing disturbed sites with exposed mineral soil. It’s location in a natural environment (generally near beaver ponds) suggests it may in time yield to a *Carex* dominated plant association unless frequent disturbance continues.

Related Plant Associations from Other Studies: Komárková (1986) reports this plant association from the Gunnison National Forest, Colorado. Cooper (1993) describes an *Alopecurus aequalis* plant association from near Crested Butte, Colorado that occurs in the same habitat, but generally without *Veronica americana*.

Cooper (1986) describes an *Alopecurus aequalis*–*Ranunculus reptans* plant association in a filled in beaver pond and point bar deposit just above the water table. This type is certainly related to the *Veronica americana*–*Alopecurus aequalis*, but in this report it has been classified under *Ranunculus reptans* plant association because of the complete absence of *Veronica americana*. These communities may ultimately be classified together due the similarities of their habitats; differences in species composition may be due to stochastic variation in disturbance and seed dispersal.

Representative Stands:

Table 34. <i>Veronica americana</i> – <i>Alopecurus aequalis</i> p.a. Percent Cover of Important Taxa			
Species	JS94-26A	DC93-101	VK86-124
<i>Alopecurus aequalis</i>	6	40	3
<i>Callitriche hermaphroditica</i>		30	1
<i>Carex aquatilis</i>			2
<i>Carex utriculata</i>	3		
<i>Catabrosa aquatica</i>	3		
<i>Epilobium ciliatum</i>	8		
<i>Limosella aquatica</i>	4		
<i>Mimulus guttatus</i>	2		
<i>Ranunculus hyperboreus</i>			25
<i>Ranunculus trichophyllus</i>	11		
<i>Rorippa palustris</i> ssp. <i>hispida</i>	2	2	4
<i>Rorippa teres</i>	13		
<i>Veronica americana</i>	18		25

Unclassified *Viola–Juncus–Carex* stand

Stand: 22C

Comments: This stand was small, but contributed much to the overall diversity of the wetland. Given the dominance of *Viola macloskeyi*, *Juncus tracyi*, and *Carex lenticularis*, it does not fit easily into any existing plant association. Also, no similar stand was found elsewhere, nor was there an obvious set of environmental factors present to suggest strongly that this deserves tentative status as a plant association. It was found along the shore of a beaver pond on saturated soils high in organic matter.

Table 35. Unclassified <i>Viola–Juncus–Carex</i> stand Percent Cover of Important Taxa	
Species	JS94-22C
<i>Carex lenticularis</i>	7
<i>Carex utriculata</i>	6
<i>Epilobium ciliatum</i>	2
<i>Equisetum arvense</i>	4
<i>Galium trifidum</i> ssp. <i>subbiflorum</i>	2
<i>Geum macrophyllum</i>	5
<i>Glyceria elata</i>	2
<i>Juncus ensifolius</i>	2
<i>Juncus tracyi</i>	8
<i>Salix drummondiana</i>	8
<i>Viola macloskeyi</i>	13

Unclassified shoreline stands

Stand: 14A, 16C

Comments: These stands were sampled on the edges of beaver ponds with steep banks and mineral soils. Both occurred as a very distinct band of vegetation at the water/land interface. It is a minor type on the landscape, but included here because it is such an evident unit of vegetation.

These stands probably experience high-water disturbance in spring as well as grazing disturbance. They may represent a *Mimulus guttatus* plant association that occurs in humid spots on mesic, mineral soils adjacent to ponds and springs where it is subject to disturbance (thus exposing mineral soil). No *Mimulus guttatus* plant association descriptions were found in the literature. It may also be related to the *Veronica americana*–*Alopecurus aequalis* early-seral plant association.

Table 36. Unclassified shoreline stands Percent Cover of Important Taxa		
Species	JS94-14A	JS94-16C
<i>Achillea millefolium</i> var. <i>occidentalis</i>	3	5
<i>Agrostis exarata</i>	5	
<i>Calamagrostis canadensis</i>		13
<i>Carex aquatilis</i>	1	
<i>Carex microptera</i>	12	4
<i>Dugaldia hoopesii</i>	3	+
<i>Eleocharis palustris</i>		4
<i>Epilobium ciliatum</i>		8
<i>Epilobium saximontanum</i>	7	
<i>Equisetum arvense</i>		5
<i>Erigeron speciosus</i>	3	
<i>Fragaria virginiana</i>	10	
<i>Galium trifidum</i> ssp. <i>subbiflorum</i>		7
<i>Juncus tracyi</i>	4	18
<i>Mimulus guttatus</i>	18	7
<i>Oxypolis fendleri</i>	4	
<i>Plantago major</i>		6
<i>Poa pratensis</i>	2	5
<i>Sidalcea candida</i>		7
<i>Taraxacum officinale</i>	3	2
<i>Veronica americana</i>		10
<i>Veronica wormskjoldii</i>	2	

VIII.F.2. TEMPERATE FRESHWATER VEGETATION, ROOTED IN SOIL BUT SUPPORTED BY WATER

Callitriche spp. alliance

Callitriche palustris (CAPA52) plant association

Water starwort p.a.

CNHP Rank: GUSU

Stands: 41C

General Description and Comments: This small, apparently widespread plant association occurs in shallow water and on muddy shores. The eye-catching rosettes of *Callitriche palustris* distinguish this plant association. It is often left stranded on muddy shorelines when water levels recede.

Callitriche palustris and *Callitriche hermaphroditica* often closely resemble each other and occur in similar habitats. It is likely that *Callitriche hermaphroditica* can and does replace *Callitriche palustris* in this association based on their phenological and apparently ecological similarity. Further study may indicate that the name of this plant association should be *Callitriche palustris*–*Callitriche hermaphroditica*.

Geographic Extent: An accurate statement of the geographic extent of this plant association is difficult to make, because this generally small plant association has rarely been reported. The existing literature and the author's personal experience suggest the *Callitriche palustris* plant association is widespread throughout the study area and elsewhere in the region. In this study it was found at 3,460 m (11,340 ft.).

Site Features: The *Callitriche palustris* plant association may occur in water 50 cm deep or slightly deeper along the edges of ponds (especially beaver ponds), lakes, and reservoirs. It is frequently left stranded on muddy banks when water levels recede. The one stand of this plant association sampled during this study occurred across the bottom of a very small glacier-formed pond.

Vegetation: Sparse to moderate cover of *Callitriche palustris* typifies this plant association. Other aquatic species may be present, but generally at low cover. The uncommon fern relative *Isoetes bolanderi* occurred at 6% cover in the one stand sampled in 1994.

Succession/Management: The *Callitriche palustris* plant association appears to be an early successional plant association that occurs either where a pond has recently formed or where regular disturbance (e.g., fluctuating water levels) inhibits other aquatic plant establishment. If stable conditions persist, this plant association may be replaced by other aquatic species.

Co-occurring Wetland Plant Associations: The single stand sampled occurred near a large complex of *Salix planifolia*, *Caltha leptosepala*, and *Carex* spp. plant associations, but it was

separated from these by a very low, narrow ridge. Other reports of this type in the literature suggest it will be found with a wide variety of emergent and submerged communities.

Related Plant Associations from Other Studies: Cooper and Cottrell (1989) reported a *Callitriche cf. palustris* plant association from the Cherry Creek Basin, south of Denver.

Representative Stands:

Table 37. <i>Callitriche palustris</i> p.a. Percent Cover of Important Taxa	
Species	JS94-41C
<i>Callitriche palustris</i>	45
<i>Isoetes bolanderi</i>	6
<i>Sparganium nutans</i>	1

Myriophyllum sibiricum alliance

***Myriophyllum sibiricum* (MYSI) plant association**

Shortspike watermilfoil p.a.

CNHP Rank: GUSU

Stands: 12A, 13C

General Description and Comments: The *Myriophyllum sibiricum* plant association occurs in shallow ponds and along the shores of shallow lakes, generally in eutrophic conditions. This type is frequently highly productive and may contain several other aquatic macrophytes.

Geographic Extent: The *Myriophyllum sibiricum* plant association was found in the literature reported only from Colorado at mid-elevations. The lack of reporting in the literature probably results from inadequate study of aquatic communities; this type should be expected to have a wider distribution.

Site Features: The *Myriophyllum sibiricum* plant association generally occurs in still, shallow (up to 1.5 meter or slightly more) water. Nutrient rich water (which may result from an influx of sewage, livestock waste, etc.) characterizes its environment.

Vegetation: *Myriophyllum sibiricum* [= *M. exalbescens*] dominates this plant association with cover ranging from 10 to over 70%. Other aquatic macrophytes (e.g., *Ranunculus trichophyllus*, *Potamogeton* spp.) may co-dominate.

Succession/Management: The *Myriophyllum sibiricum* plant association provides important waterfowl food/habitat (see Cooper 1993). The dense aquatic stands it often forms also provide habitat for copious aquatic macroinvertebrates. This plant association may indicate excessive input of nutrients from human activities.

Co-occurring Wetland Plant Associations: The *Myriophyllum sibiricum* plant association commonly occurs adjacent to other stands of aquatic associations such as *Potamogeton* sp. The shoreline of ponds and lakes where this occurs may consist of undisturbed stands of *Carex utriculata* or highly disturbed stands of *Eleocharis palustris* or even anthropogenic plant associations such as *Bidens cernua*.

Related Plant Associations from Other Studies: Cooper (1993) describes a *Myriophyllum sibiricum* plant association from the Crested Butte area in Colorado. Johnson (1941) reported a pond in northern Colorado that was filled with *Myriophyllum sibiricum*.

Representative Stands:

Table 38. <i>Myriophyllum spicatum</i> p.a. Percent Cover of Important Taxa			
Species	JS94-12A	JS94-13C	DC93-45
<i>Myriophyllum sibiricum</i>	14	60	70
<i>Potamogeton foliosus</i>	1	2	
<i>Potamogeton gramineus</i>	7		
<i>Potamogeton pectinatus</i>		30	
<i>Potamogeton praelongus</i>			25
<i>Potamogeton pusillus</i>	2	1	20
<i>Ranunculus trichophyllus</i>		60	
<i>Spirodela polyrhiza</i>		20	

Nuphar lutea alliance

***Nuphar lutea* ssp. *polysepala* (NULUP) plant association**

Rocky Mountain pondlily p.a.

CNHP Rank: G4SU

Stands: 04C, 06F, 10A, 36B

General description and comments: The presence of *Nuphar lutea* ssp. *polysepala*, often in abundance, makes this type a conspicuous plant association. In the study area, it is found in relatively shallow water of lakes and ponds (often of glacial origin) in the subalpine. The prominent yellow flowers, broad floating leaves, and general lack of associated species make this plant association unmistakable.

Geographic extent: This type has been reported from Colorado, Wyoming, and Idaho (Bourgeron and Engelking 1994). It can be expected to have a much wider distribution. This plant association may occur at low elevations, but in the study area it was found always between 3,060 and 3,170 m (10,040 and 10,400 ft.). Cooper (1990a) reported this type from 2,870 m (9,400 ft.).

Site features: The *Nuphar lutea* ssp. *polysepala* plant association occurs in standing water that ranges from less than 0.1 m to greater than 1 m (Cooper 1990a) in ponds and lakes with long-term stability (i.e., rarely in more ephemeral water bodies such as beaver ponds). The substrate in which the plants are anchored is usually loosely consolidated organics, from mucks to mucky-peat. In montane areas of Colorado, this type tends to occur in nutrient poor water. The water where these stands occur usually has a pH less than 7.0 (more commonly around 6.0) and very low conductivity, often around 20-30 μ s.

Vegetation: *Nuphar lutea* ssp. *polysepala* generally dominates this type with a wide range of cover, ranging from 10% to 100%, even at one site. The average cover for any one stand appears to be around 40-50%. Often, *Nuphar lutea* ssp. *polysepala* occurs in a monoculture, but it may also occur with other aquatic plants. This study found *Potamogeton gramineus* once as an associate in this type, as did Cooper (1990a).

Succession/Management: Cooper (1990a) reports that in the Green Mountain Trail Pond in Rocky Mountain National Park, peat accumulation and sedimentation along the shores of the pond have reduced the extent of this plant association. At this site, basal peat cores indicated that *Nuphar lutea* ssp. *polysepala* has been present in this pond for almost 12,000 years.

Some waterfowl eat the seeds of the closely related *Nuphar variegatum*, and the plant may at times be eaten by mammals, especially beaver (Redington 1994).

Co-occurring Wetland Plant Associations: The *Nuphar lutea* ssp. *polysepala* plant association is commonly found adjacent to *Carex* spp. plant associations, especially *Carex utriculata*. It also may co-occur with *Menyanthes trifoliata* and *Carex aquatilis*–*Carex utriculata* stands, as well as with *Salix planifolia* plant associations where they form an outer ring near a lake or pond. Stand 10A occurred in a lake with a thick bed of peat along the shoreline; this stand occurred near a large occurrence of the *Eleocharis quinqueflora* plant association.

Related Plant Associations from Other Studies: Cooper (1990a) reports a *Nuphar lutea* ssp. *polysepala*–*Potamogeton gramineus* plant association that appears synonymous with this one. Ramaley and Robbins (1909) mention stands that appear to be this plant association.

Representative Stands:

Table 39. <i>Nuphar lutea</i> ssp. <i>polysepala</i> p.a. Percent Cover of Important Taxa				
Species	JS94-04C	JS94-06F	JS94-10A	JS94-36B
<i>Nuphar lutea</i> ssp. <i>polysepala</i>	53	53	40	40
<i>Potamogeton gramineus</i>		1		

Potamogeton filiformis alliance

Potamogeton filiformis (POFI2) plant association

Fineleaf pondweed p.a.

CNHP Rank: GUSU

Stands: 33B

General Description and Comments: *Potamogeton filiformis* is a submerged, narrowleaf pondweed that dominates lakes and ponds with still water that may be either shallow or deep. The *Potamogeton filiformis* plant association appears relatively common in long-established beaver ponds (cf. Cooper 1993), but may also occur in larger lakes (Johnson 1941). Weber (1987) notes that *Potamogeton filiformis* is common in larger lakes in the mountains. This type was sampled only once in 1994, but it has been mentioned in literature elsewhere.

The narrow-leaf *Potamogeton* species are not well-collected in Colorado (Weber 1987) and *Potamogeton* spp. plant associations have been poorly studied. Further study will reveal better information on which species commonly co-occur, the distribution of the communities, and the environmental conditions under which they occur. With this in mind, the narrow-leaf *Potamogeton* spp. plant associations as currently presented can be considered tentative.

Geographic Extent: According to Bourgeron and Engelking (1994), the *Potamogeton filiformis* plant association has been reported only from Colorado. In Colorado it appears to be widespread, but uncommon. Given the wide range of *Potamogeton filiformis* (Newfoundland to Alaska, south to Colorado, and elsewhere (see Harrington 1954)), this plant association may be much more widespread than it currently appears. In Colorado, the *Potamogeton filiformis* plant association has been reported from 2,050-2,900 m (6,750-9,600 ft.)

Site Features: Stand 38B was sampled in a small pond formed in glacial till. The depth of the pond has been augmented by beaver activity at the outlet. This appears to be a typical setting for this plant association. The *Potamogeton filiformis* plant association occurred in water from 50 cm to greater than 100 cm in depth.

Vegetation: *Potamogeton filiformis* dominates this plant association, but other *Potamogeton* species may be present as associates or co-dominants. Other submerged aquatic species (e.g., *Ranunculus* sp.) may also be present in varying amounts.

Succession/Management: *Potamogeton filiformis* appears to be a late-successional plant association, though its establishment and eventual dominance may in part be dictated by stochastic events. In larger ponds and lakes, this plant association provides valuable waterfowl habitat.

Co-occurring Wetland Plant Associations: The *Potamogeton filiformis* plant association is found offshore from *Carex* stands, especially *Carex utriculata*.

Related Plant Associations from Other Studies: Johnson (1941) does not give percent cover for the lakes studied, but he does report that in Lake Aldrich in northwestern Colorado, “submersed plants occupy a large area of the lake. *Potamogeton filiformis* is commonest.” He also reports that in Lake John in North Park, Colorado, “*Potamogeton filiformis* is the most frequent of the submersed plants . . . where it forms masses along the shores and among bulrushes.”

Representative Stands:

Table 40. <i>Potamogeton filiformis</i> p.a. Percent Cover of Important Taxa	
Species	JS94-33B
<i>Potamogeton filiformis</i>	31
<i>Potamogeton pusillus</i>	4
<i>Ranunculus longirostris</i>	2

Potamogeton pectinatus alliance

***Potamogeton pectinatus* (POPE6) plant association**

Sago pondweed p.a.

CNHP Rank: GUSU

Stands: 27D

General Description and Comments: The *Potamogeton pectinatus* plant association is a common narrow-leaf pondweed plant association occurring from the plains to the montane zone in ponds and lakes as well as ditches and perennial streams. It frequently is found in nutrient-rich and alkaline water.

The narrow-leaf *Potamogeton* species are not well-collected in Colorado (Weber 1987) and *Potamogeton* spp. plant associations have been poorly studied. Further study will reveal better information on which species commonly co-occur, the distribution of the communities, and the environmental conditions under which they occur. With this in mind, the narrow-leaf *Potamogeton* spp. plant associations as currently presented can be considered tentative.

Geographic Extent: *Potamogeton pectinatus* plant association and closely related communities have been reported from across much of Colorado (Cooper 1993, Cooper 1988, Cooper and Cottrell 1989, Cooper 1990b, Cooper and Severn 1992) from 1,525 m (5,000 ft.) to around 2,950 m (9,600 ft.). The *Potamogeton pectinatus* plant association has also been seen in small oxbow ponds along the Yampa River in northwestern Colorado (personal observation). Related plant associations have also been reported by the Montana Natural Heritage Program (No Date). The Montana report suggests that this type probably has a much broader range than currently reported; the gap in known distribution probably results from a general lack of study of aquatic communities.

Site Features: The *Potamogeton pectinatus* plant association is found in shallow ponds and slow-moving streams. It frequently occurs in water that is moderately to strongly alkaline.

Vegetation: *Potamogeton pectinatus* generally dominates this type with high cover (up to 100% in some patches). Other *Potamogeton* species, such as *Potamogeton pusillus*, may also be present. Frequently several other species of aquatic plants are associated with this association, including *Myriophyllum sibiricum*, *Ceratophyllum demersum*, and others.

Succession/Management: Although *Potamogeton pectinatus* colonizes lakes, ponds, and streams quickly, its apparent persistence at a location suggests it can be considered a climax plant association. In many areas, the *Potamogeton pectinatus* plant association provides important wildlife habitat.

Co-occurring Wetland Plant Associations: Ponds and lakes that contain this plant association can be expected to be lined with *Carex utriculata*, *Carex aquatilis*–*Carex utriculata*, and/or *Eleocharis palustris* plant associations.

Related Plant Associations from Other Studies: Cooper (1988) reported a plant association called *Potamogeton pectinatus*–*Potamogeton foliosus*–*Elodea canadensis* from Boulder, Colorado, which he says may contain only one of the listed species, but may contain all of them. Cooper and Cottrell (1989) reported a *Ceratophyllum demersum*–*Potamogeton pectinatus*–*Elodea canadensis* community that is closely related to the one described here. Cooper (1990b) reported a *Potamogeton pectinatus* plant association from slow-moving, shallow streams in High Creek Fen and other wetlands of South Park, Colorado. Cooper and Severn (1992) reported a *Potamogeton pusillus*–*Zannichellia palustris* plant association in Colorado’s San Luis Valley under the *Potamogeton pectinatus*–*Zannichellia palustris* alliance; this community is closely related to the *Potamogeton pectinatus* plant association. Cooper (1993) reported a *Potamogeton pectinatus*–*Potamogeton pusillus* plant association from the Crested Butte region.

Three communities dominated by *Potamogeton pectinatus* (*Potamogeton pectinatus*–*Myriophyllum sibiricum*, *Potamogeton pectinatus*–*Zannichellia palustris*, and *Potamogeton pectinatus*–*Ruppia maritima*) have been reported in Montana (Montana Natural Heritage Program No Date, in Bourgeron and Engelking 1994). Further work on *Potamogeton pectinatus* communities is necessary to determine if these truly are distinct communities, or simply phases of one *Potamogeton pectinatus* plant association.

Representative Stands:

Table 41. <i>Potamogeton pectinatus</i> p.a. Percent Cover of Important Taxa		
Species	JS94-27D	DC93-104
<i>Chara</i> sp.		5
<i>Potamogeton pectinatus</i>	13	60
<i>Potamogeton pusillus</i>		5
<i>Ranunculus trichophyllus</i>	2	
<i>Sparganium angustifolium</i>		15

Potamogeton richardsonii alliance

Potamogeton richardsonii (PORI2) plant association

Richardson's pondweed p.a.

CNHP Rank: GUSU

Stands: 31B, 42F

General Description and Comments: The uncommon *Potamogeton richardsonii* plant association is a submerged type found in mostly still, shallow to moderately deep water of ponds and lakes. *Potamogeton richardsonii* is a broadleaf pondweed, so this type looks quite different from the other pondweed plant associations in this report. It may have important ecological differences as well.

One of the stands sampled in 1994 contained 72% *Lemna trisulca*, a much higher cover value than *Potamogeton richardsonii* (47%). It's not clear yet to this author if this and other *Lemna* occurrences represent stochastic occurrences within other communities, or if there is enough consistency among *Lemna* occurrences (both associated species and environmental conditions) to classify them in a separate association. More work is needed in this area.

Geographic Extent: This type was found only twice in the literature, from Colorado (Cooper 1993) and Montana (Montana Natural Heritage Program (No Date) in Bourgeron and Engelking 1994), so its range cannot be confidently specified. The few Colorado reports of this type, including those from this study, were found at 2,800-2,950 m (9,250-9,750 ft.) in central and northcentral Colorado. It can be expected at lower and higher elevations.

Site Features: The *Potamogeton richardsonii* plant association occurs in 20 cm to 1 m or more of water in ponds and lakes. It has been found in beaver ponds as well as large and more permanent ponds and lakes. The water is generally still, though it may be moving very slowly through beaver ponds. The water where this plant association occurs is typically nutrient rich. Cooper (1993) writes that on the Slate River floodplain the water inhabited by this type "is clear but subject to erosive forces in spring flooding."

Vegetation: *Potamogeton richardsonii* is the most prominent and conspicuous plant in this plant association, in part due to its broad leaves. Most of the other submerged aquatics that may be associated with this association (other *Potamogeton* spp., *Myriophyllum sibiricum*, and others) have fine leaves. As in most aquatic communities, the abundance of both the dominant species and associated species can vary greatly across the area of the type, one patch often differing significantly from other patches nearby.

Succession/Management: This aquatic type may provide food and habitat for waterfowl and aquatic macroinvertebrates.

Co-occurring Wetland Plant Associations: Stands of *Potamogeton richardsonii* are found adjacent to *Carex utriculata* communities and possibly other aquatic communities.

Related Plant Associations from Other Studies: The Montana Natural Heritage Program has on record a *Potamogeton richardsonii*–*Myriophyllum sibiricum* plant association (No Date, in Bourgeron and Engelking 1994). Both stands in 1994 did contain *Myriophyllum sibiricum* at very low cover, but the only other report of a *Potamogeton richardsonii* plant association in Colorado (Cooper 1993) did not contain this species. This report retains Cooper’s name because the *Potamogeton richardsonii* plant association in Colorado can be expected to occur with or without *Myriophyllum sibiricum*, in addition to several other aquatic macrophytes.

Representative Stands:

Table 42. <i>Potamogeton richardsonii</i> p.a. Percent Cover of Important Taxa			
Species	JS94-31B	JS94-42F	DC93-22
<i>Lemna trisulca</i>		72	
<i>Myriophyllum sibiricum</i>	2	2	
<i>Potamogeton foliosus</i>			10
<i>Potamogeton richardsonii</i>	18	47	50
<i>Sparganium angustifolium</i>		1	

Potamogeton spp. alliance

Tentative *Potamogeton foliosus*–*Potamogeton pusillus* (POFO3–POPU) plant association

Tentative Leafy pondweed–Small pondweed p.a.

CNHP Rank: GUQSU

Stands: 11B, 13B, 21B, 23B, 23D, 38D

General Description and Comments: The *Potamogeton foliosus*–*Potamogeton pusillus* plant association consists of submerged narrow-leaf pondweeds that may grow in dense masses. One or the other species may dominate, while often one is not present. It is possible that these stands represent two distinct communities, but this was impossible to ascertain from the literature and the data gathered in this study. Since environmental conditions and community structure were so similar for all of the sampled stands, they were grouped into this one tentative plant association.

Stand 13B contained 42% *Spirodela polyrhiza*, a floating member of the duckweed family (Lemnaceae). This species is not indigenous to Colorado (Weber and Wittmann 1992). No plant association dominated by this adventive species was found in the Rocky Mountain wetland literature, and communities dominated by duckweeds have been in general poorly reported. Further research may indicate that plant associations dominated by duckweeds deserve distinct status.

In general, the narrow-leaf *Potamogeton* species are not well-collected in Colorado (Weber 1987) and *Potamogeton* spp. plant associations have been poorly studied. Further study will reveal better information on which species commonly co-occur, the distribution of the communities, and the environmental conditions under which they occur. With this in mind, the narrow-leaf *Potamogeton* spp. plant associations as currently presented can be considered tentative.

Geographic Extent: These stands are found in small ponds throughout the montane region of Colorado. This plant association has been reported from 2,250-2,950 m (7,450-9,600 ft.).

Site Features: All stands sampled occurred in still or nearly still water less than 1 meter deep. They may occur in much deeper water. *Potamogeton richardsonii* and *Potamogeton pusillus* stands appear to occur in nutrient rich water. The water where this type occurs almost always has a pH above neutral, sometimes as high as 8.9. Conductivity ranges between 110 and 220 μ s.

Vegetation: *Potamogeton foliosus* and/or *Potamogeton pusillus* dominate these stands with up to 90% cover. One or the other species is frequently absent. *Potamogeton pectinatus* is commonly an associate, occasionally as a co-dominant. Other submerged aquatics (e.g., *Myriophyllum sibiricum*) may also be present. *Sparganium angustifolium* also frequently occurs with low cover in this type. Stand 11B represents this plant association at its extreme of sparseness. At this site it was, however, very evenly distributed across a large area of the pond bottom.

Succession/Management: The *Potamogeton richardsonii* and *Potamogeton pusillus* stands may be an early successional since they are usually found in disturbed or temporary ponds. Heavy livestock use of the area around these ponds may benefit this type through increased nutrient input. *Potamogeton* spp. are important waterfowl food (Weber 1976).

Co-occurring Wetland Plant Associations: Shoreline communities found in association with these stands include *Bidens cernua* and *Eleocharis palustris* plant associations. The aquatic *Myriophyllum sibiricum* plant association is commonly near or intermixed with the *Potamogeton richardsonii*–*Potamogeton pusillus* plant association. It may also be found adjacent to and mixed with *Sparganium angustifolium* stands.

Related Plant Associations from Other Studies: Cooper (1993) reports a *Potamogeton pectinatus*–*Potamogeton pusillus* plant association in which he includes a stand dominated by *Potamogeton pusillus* without *Potamogeton pectinatus* present. This community is closely related to the one described in this report.

Representative Stands:

Table 43. Tentative <i>Potamogeton foliosus</i> – <i>Potamogeton pusillus</i> p.a. Percent Cover of Important Taxa							
Species	JS94-11B	JS94-13B	JS94-21B	JS94-23B	JS94-23D	JS94-38D	DC93-168
<i>Chara</i> sp.			9			3	
<i>Eleocharis palustris</i>				11			
<i>Elodea canadensis</i>							5
<i>Glyceria borealis</i>				4			
<i>Lemna</i> cf. <i>minor</i>			+				
<i>Myriophyllum sibiricum</i>		1	1				
<i>Potamogeton foliosus</i>	3	27	88				
<i>Potamogeton natans</i>			5				
<i>Potamogeton pectinatus</i>		11					
<i>Potamogeton pusillus</i>		26		15	87	42	40
<i>Ranunculus trichophyllus</i>		8					
<i>Sparganium angustifolium</i>	1	3		14		2	
<i>Spirodela polyrhiza</i>		42		+	+		

Unclassified *Potamogeton* stands

Stands: 05C, 05D

General Description and Comments: These stands, dominated by *Potamogeton epihydrus* (Ribbonleaf pondweed), were found in shallow (20-100 cm), still water of small kettlehole ponds that are ringed by *Carex utriculata* stands. The plants were rooted in 1 m of peat on top of mineral soil. These stands were sampled a few miles east of Taylor Park Reservoir in central Colorado at 3,000 m (9,800 ft.).

No description of a *Potamogeton epihydrus* plant association was found in the literature. Johnson (1939) studied a lake filled with stands dominated by *Potamogeton illinoensis* and *Potamogeton alpinus* that appear similar to these stands. Since *Potamogeton epihydrus* is found across the eastern and northeastern United States (Harrington 1954), the *Potamogeton epihydrus* plant association may actually be widespread although locally uncommon across northern North America.

Only two stands were sampled at one site; future work will allow us to observe how stands such as these repeat across the landscape. Stochastic events may be the best way to explain why this species dominates some kettlehole ponds, while different aquatic plants dominate other ponds in the same area. These stands were not classified as a plant association due to lack of data from this study or from the literature.

Species	JS94-05C	JS94-05D
<i>Potamogeton epihydrus</i>	83	83
<i>Hippuris vulgaris</i>		2
<i>Sparganium angustifolium</i>		10

Ranunculus trichophyllus alliance

Ranunculus trichophyllus (RATRT) plant association

Hairleaf water crowfoot p.a.

CNHP Rank: G?S?

Stands: 11A, 26B

General Description and Comments: This true aquatic type draws attention in mid-summer with its dense vegetation and distinctive white flowers. The *Ranunculus trichophyllus* plant association is an early successional type found in recently formed water bodies such as beaver ponds as well as in ditches, canals, and reservoirs.

Geographic Extent: The *Ranunculus trichophyllus* plant association has been reported rarely in the literature. It has been found in central Colorado between 2,590 and 2,900 m (8,500 and 9,500 ft.).

Site Features: This plant association is found in shallow (50 to 150 cm), still to slow flowing water. It may occur in ephemeral kettle ponds and beaver ponds, as well as in slow moving but moderately deep streams and ditches. The *Ranunculus trichophyllus* plant association generally covers a small surface area.

Vegetation: *Ranunculus trichophyllus* frequently occurs in very dense proportions in this type, often forming a monoculture. Other aquatic species may be present, especially species of *Callitriche*.

Succession/Management: This type may decrease in size as small ponds dry up and the component vegetation is left stranded on muddy banks.

Co-occurring Wetland Plant Associations: The *Ranunculus trichophyllus* plant association commonly occurs near other submerged or emergent wetland plant associations, including *Sparganium angustifolium* and *Eleocharis palustris* plant associations.

Related Plant Associations from Other Studies: This association has been reported elsewhere with one of two species of *Callitriche*. Cooper (1986) reported an association of *Ranunculus trichophyllus*/*Callitriche* cf. *hermaphroditica* (see stand table below) from the Sawatch Range in Colorado. Robbins (1918) and Fuller (1930) reported a stand of *Ranunculus trichophyllus* and *Callitriche palustris* dominating ponds in Boulder Park, Colorado.

Representative Stands:

Table 45. <i>Ranunculus trichophyllus</i> p.a. Percent Cover of Important Taxa			
Species	JS94-11A	JS94-26B	DC86-46
<i>Callitriche</i> cf. <i>hermaphroditica</i>			10
<i>Ranunculus trichophyllus</i> Chaix	30	63	25

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Appendix 1: Wetland Vascular Plants of the Study Area

Accepted vascular plant names from Kartesz (1994) and Weber and Wittman (1992) are listed below. When the authors accept the same name, an asterisk follows the Kartesz name and the Weber and Wittman column is blank. Common names in general follow those listed in the USDA Natural Resource Conservation Service PLANTS database.

Kartesz 1994	Weber & Wittman 1992	Common name
<i>Abies lasiocarpa</i> (Hook.) Nutt.*		subalpine fir
<i>Achillea millefolium</i> L. var. <i>occidentalis</i> DC.	<i>Achillea lanulosa</i> Nuttall	western yarrow
<i>Aconitum columbianum</i> Nutt.*		Columbian monkshood
<i>Actaea rubra</i> (Ait.) Willd. ssp. <i>arguta</i> (Nutt.) Hultén*		red baneberry
<i>Agrostis exarata</i> Trin.*		spike bentgrass
<i>Agrostis gigantea</i> Roth*		redtop
<i>Agrostis idahoensis</i> Nash*		Idaho bentgrass
<i>Agrostis scabra</i> Willd.*		rough bentgrass
<i>Agrostis stolonifera</i> L.*		creeping bentgrass
<i>Agrostis thurberiana</i> A.S. Hitchc.*		Thurber's bentgrass
<i>Allium brevistylum</i> S. Wats.*		shortstyle onion
<i>Alnus incana</i> ssp. <i>tenuifolia</i> (Nutt.) Breitung*		thinleaf alder
<i>Alopecurus aequalis</i> Sobol.*		shortawn foxtail
<i>Alopecurus pratensis</i> L.*		meadow foxtail
<i>Anaphalis margaritacea</i> (L.) Benth. & Hook. f.*		western pearlyeverlasting
<i>Angelica ampla</i> A. Nels.*		giant angelica
<i>Angelica grayi</i> (Coulter & Rose) Coulter & Rose*		Gray's angelica
<i>Angelica pinnata</i> S. Wats.*		smallleaf angelica
<i>Antennaria corymbosa</i> E. Nels.*		flattop pussytoes
<i>Arabis drummondii</i> Gray	<i>Boechea drummondii</i> (A. Gray) Löve & Löve	Drummond's rockcress
<i>Arctostaphylos uva-ursi</i> (L.) Spreng.	<i>Arctostaphylos adenotricha</i> (Fernald & Macbride) Löve et al.	kinnikkinnik
<i>Arnica mollis</i> Hook.*		hairy arnica
<i>Aster foliaceus</i> Lindl. ex DC.*		leafybract aster
<i>Betula glandulosa</i> Michx.*		bog birch
<i>Bidens cernua</i> L.*		nodding beggartick
<i>Bromus canadensis</i> Michx.	<i>Bromopsis canadensis</i> (Michaux) Holub. ssp. <i>richardsonii</i> (Link) Tsvelev.	Canadian brome
<i>Bromus inermis</i> Leyss.	<i>Bromopsis inermis</i> (Leysser) Holub	smooth brome
<i>Bromus lanatipes</i> (Shear) Rydb.	<i>Bromopsis lanatipes</i> (Shear) Holub	woolly brome
<i>Calamagrostis canadensis</i> (Michx.) Beauv.*		bluejoint
<i>Callitriche hermaphroditica</i> L.*		northern waterstarwort
<i>Callitriche palustris</i> L.	<i>Callitriche verna</i> L. emend Lönnroth	marsh waterstarwort
<i>Caltha leptosepala</i> DC.	<i>Psychrophila leptosepala</i> (DeCandolle) W.A. Weber	white marshmarigold
<i>Campanula parryi</i> Gray*		Parry's harebell
<i>Cardamine cordifolia</i> Gray*		heartleaf bittercress
<i>Carduus acanthoides</i> L.*		spiny plumeless thistle
<i>Carex aquatilis</i> Wahlenb.*		water sedge
<i>Carex athrostachya</i> Olney*		slenderbeak sedge
<i>Carex aurea</i> Nutt.*		golden sedge
<i>Carex bebbii</i> Olney ex Fern.*		Bebb's sedge
<i>Carex bipartita</i> All.	<i>Carex lachenalii</i> Schkuhr	bisected sedge
<i>Carex brunnescens</i> (Pers.) Poir.*		little brown sedge
<i>Carex buxbaumii</i> Wahlenb.*		Buxbaum's sedge
<i>Carex canescens</i> L.*		silvery sedge
<i>Carex capillaris</i> L.*		capillary sedge
<i>Carex diandra</i> Schrank*		lesser paniced sedge
<i>Carex disperma</i> Dewey*		softleaf sedge
<i>Carex ebenea</i> Rydb.*		ebony sedge
<i>Carex foenea</i> Willd.*		dryspike sedge
<i>Carex gynocrates</i> Wormsk. ex Drej.	<i>Carex dioica</i> L. ssp. <i>gynocrates</i> (Wormsk) Hulten	northern bog sedge

<i>Carex illota</i> Bailey*		sheep sedge
<i>Carex jonesii</i> Bailey*		Jones's sedge
<i>Carex lanuginosa</i> Michx.*		woolly sedge
<i>Carex lenticularis</i> Michx. var. <i>lipocarpa</i> (Holm) L.A. Standley*		biconvex sedge
<i>Carex macloviana</i> d'Urv.*		thickhead sedge
<i>Carex magellanica</i> Lam. ssp. <i>irrigua</i> (Smith) Hult.*		boreal bog sedge
<i>Carex microglochin</i> Wahlenb.*		fewseeded bog sedge
<i>Carex microptera</i> MacKenzie*		smallwing sedge
<i>Carex nebrascensis</i> Dewey*		Nebraska sedge
<i>Carex nigricans</i> C.A. Mey.*		black alpine sedge
<i>Carex norvegica</i> ssp. <i>norvegica</i> Retz.*		Norway sedge
<i>Carex nova</i> Bailey*		black sedge
<i>Carex pachystachya</i> Cham. ex Steud.*		chamisso sedge
<i>Carex phaeocephala</i> Piper*		dunhead sedge
<i>Carex praeceptorum</i> Mackenzie*		early sedge
<i>Carex sartwellii</i> Dewey*		Sartwell's sedge
<i>Carex saxatilis</i> L. var. <i>saxatilis</i>	<i>Carex saxatilis</i> L. ssp. <i>laxa</i> (Traut.) Kalela	russet sedge
<i>Carex scopulorum</i> Holm*		sedge of the Rockies
<i>Carex simulata</i> MacKenzie*		analogue sedge
<i>Carex utriculata</i> Boott*		beaked sedge
<i>Carex vesicaria</i> L.*		blister sedge
<i>Castilleja rhexifolia</i> Rydb.*		rexia-leaf
<i>Castilleja sulphurea</i> Rydb.*		yellow paintbrush
<i>Catabrosa aquatica</i> (L.) Beauv.*		brookgrass
<i>Ceratophyllum demersum</i> L.*		common hornwort
<i>Cirsium arvense</i> (L.) Scop.*		Canadian thistle
<i>Cirsium tioganum</i> var. <i>coloradense</i> (Rydb.) Dorn	<i>Cirsium coloradense</i> (Rydb.) Cockerell	Colorado thistle
<i>Conioselinum scopulorum</i> (Gray) Coult. & Rose*		Rocky Mountain hemlockparsley
<i>Corydalis caseana</i> ssp. <i>Gray brandegei</i> (S. Wats.) G.B. Ownbey*		Sierra corydalis
<i>Danthonia intermedia</i> Vasey*		timber oatgrass
<i>Delphinium barbeyi</i> (Huth) Huth*		tall larkspur
<i>Deschampsia cespitosa</i> (L.) Beauv.*		tufted hairgrass
<i>Dugaldia hoopesii</i> (Gray) Rydb.*		owlsclaws
<i>Eleocharis acicularis</i> (L.) Roemer & J.A. Schultes*		needle spikerush
<i>Eleocharis palustris</i> (L.) Roemer & J.A. Schultes*		common spikerush
<i>Eleocharis parvula</i> (Roemer & J.A. Schultes) Link ex Bluff, Nees & Schauer	<i>Eleocharis parvula</i> (Roemer & Schultes) Link var. <i>anachaeta</i> (Torrey) Svenson	dwarf spikerush
<i>Eleocharis quinqueflora</i> (F.X. Hartman) Schwarz*		fewflower spikerush
<i>Elymus trachycaulus</i> (Link) Gould ex Shinners*		slender wheatgrass
<i>Epilobium anagallidifolium</i> Lam.*		alpine willowherb
<i>Epilobium angustifolium</i> (L.) Scopoli ssp. <i>circumvagum</i> Mosquin	<i>Chamerion danielsii</i> D. Löve	fireweed
<i>Epilobium ciliatum</i> Rafinesque *		glandular willowweed
<i>Epilobium halleanum</i> Hausskn.*		glandular willowherb
<i>Epilobium hornemannii</i> Reichenb.*		Hornemann's willowherb
<i>Epilobium lactiflorum</i> Hausskn.*		milkflower willowweed
<i>Epilobium saximontanum</i> Hausskn.*		Rocky Mountain willowherb
<i>Equisetum arvense</i> L.*		field horsetail
<i>Equisetum variegatum</i> Schleich. ex F. Weber & D.M.H. Mohr	<i>Hippochaete variegata</i> (Schleicher) Bruhin	
<i>Erigeron coulteri</i> Porter*		large mountain fleabane
<i>Erigeron eximius</i> Greene*		extraordinary fleabane
<i>Erigeron peregrinus</i> (Banks ex Pursh) Greene ssp. <i>callianthemus</i> (Greene) Cronq.*		subalpine fleabane
<i>Erigeron speciosus</i> (Lindl.) D.C.		aspen fleabane
<i>Eriophorum angustifolium</i> Honckeny*		tall cottongrass
<i>Fragaria virginiana</i> Duchesne ssp. <i>glauca</i> (S. Wats.) Staudt	<i>Fragaria virginiana</i> P. Miller ssp. <i>glauca</i> (S. Watson) Staudt	common strawberry
<i>Galium boreale</i> L.	<i>Galium septentrionale</i> Roemer & Schultes	northern bedstraw

Galium trifidum ssp. subbiflorum (Wieg.) Piper*		threepetal bedstraw
Galium triflorum Michx.*		fragrant bedstraw
Gentiana affinis Griseb.	Pneumonanthe affinis (Griseb.) W.A. Weber	pleated gentian
Gentianopsis thermalis (Kuntze) Iltis*		Rocky Mountain fringed gentian
Geranium richardsonii Fisch. & Trautv.*		Richardson's geranium
Geum macrophyllum Willd. var. perincisum (Rydb.) Raup*		largeleaf avens
Geum triflorum var. triflorum Pursh	Erythrocoma triflora (Pursh) Greene	three-flowered avens
Glyceria borealis (Nash) Batchelder		northern mannagrass
Glyceria elata (Nash ex Rydb.) M.E. Jones*		tall mannagrass
Glyceria striata (Lam.) A.S. Hitchc. var. stricta (Scribn.) Fern.*		fowl mannagrass
Heracleum maximum Bartr.	Heracleum sphondylium L. ssp. montanum (Schleicher ex Gaudin) Briquet	Hercules' healer
Hierochloë hirta (Schrank) Borbas ssp. arctica (J. Presl) G. Weim.*		northern sweetgrass
Hippuris vulgaris L.*		common maretail
Hordeum brachyantherum Nevski	Critesion brachyantherum (Nevski) Barkworth & Dewey	meadow barley
Hordeum jubatum L. ssp. jubatum	Critesion jubatum (L.) Nevski	foxtail barley
Hypericum scouleri Hook. ssp. nortoniae (M.E. Jones) J. Gillett	Hypericum formosum Humboldt, Bonpland, & Kunth	Scouler's St. Johnswort
Isoëtes bolanderi Engelm.*		Bolander's quillwort
Juncus balticus Willd. var. montanus Engelm.	Juncus ater Rydberg	mountain rush
Juncus confusus Coville*		Colorado rush
Juncus drummondii E. Mey*		Drummond's rush
Juncus ensifolius Wikstr.*		swordleaf rush
Juncus longistylis Torr.*		longstyle rush
Juncus mertensianus Bong.*		Merten's rush
Juncus saximontanus A. Nels.*		Rocky Mountain rush
Juncus tracyi Rydb.*		Tracy's rush
Juncus tweedyi Rydb.*		Tweedy's rush
Juncus vaseyi Engelm.*		Vasey's rush
Lemna sp.		duckweed
Lemna trisulca L.*		star duckweed
Ligusticum tenuifolium S. Wats.	Ligusticum filicinum S. Wats. var. tenuifolium (S. Wats.) Mathias & Constance	thinleaved licoriceroot
Limosella aquatica L.*		water mudwort
Lonicera involucrata Banks ex Sprengel	Distegia involucrata (Banks ex Sprengel) Cockerell	twinberry honeysuckle
Luzula congesta (Thuill.) Lej.	Luzula comosa E. Mey.	heath woodrush
Luzula parviflora (Ehrh.) Desv.*		smallflowered woodrush
Maianthemum stellatum (L.) Link*		starry false Solomon's seal
Mentha arvensis L.*		wild mint
Menyanthes trifoliata L.*		common buckbean
Mertensia ciliata (James ex Torr.) G. Don*		mountain bluebells
Mimulus guttatus DC.*		seep monkeyflower
Mitella pentandra Hook.*		five-stamen miterwort
Myriophyllum sibiricum Komarov*		shortspike watermilfoil
Myriophyllum verticillatum L.*		whorlleaf watermilfoil
Nuphar lutea Sibthorp & Smith ssp. polysepala (Engelm.) E.O. Beal*		Rocky Mountain pondlily
Oxypolis fendleri (Gray) Heller*		Fendler's cowbane
Parnassia fimbriata Koenig*		Rocky Mountain parnassia
Pedicularis bracteosa Benth in Hooker ssp. paysoniana (Pennell) Cronq.*		Payson's lousewort
Pedicularis groenlandica Retz.*		elephanthead lousewort
Pentaphylloides floribunda (Pursh) A. Love*		shrubby cinquefoil
Petasites sagittatus (Banks ex Pursh) A. Gray*		arrowleaf coltsfoot
Phleum alpinum L.	Phleum commutatum Gaudin	alpine timothy
Phleum pratense L.*		timothy
Picea engelmannii Parry ex Engelm.*		Engelmann spruce

<i>Pinus contorta</i> Dougl. ex Loud*		
<i>Plantago major</i> L.*		common plantain
<i>Plantago tweedyi</i> Gray*		Tweedy's plantain
<i>Platanthera dilatata</i> (Pursh) Lindl. ex Beck var. <i>albiflora</i> (Cham.) Ledeb.	<i>Limnorchis dilatata</i> (Pursh) Hook. ssp. <i>albiflora</i> (Cham.) A. Löve & Simon	scentbottle
<i>Platanthera hyperborea</i> var. <i>hyperborea</i> (L.) Lindl.	<i>Limnorchis hyperborea</i> (L.) Rydb.	northern green orchid
<i>Poa alpina</i> L.*		alpine bluegrass
<i>Poa leptocoma</i> Trin.*		bog bluegrass
<i>Poa palustris</i> L.*		fowl bluegrass
<i>Poa pratensis</i> L.*		Kentucky bluegrass
<i>Poa reflexa</i> Vasey & Scribn.*		nodding bluegrass
<i>Podistera eastwoodiae</i> (Coul. & Rose) Mathias & Constance*		Eastwood's podistera
<i>Polemonium occidentale</i> ssp. <i>occidentale</i> Greene	<i>Polemonium caeruleum</i> L. ssp. <i>amygdalinum</i> (Wherry) Munz	western Jacob's-ladder
<i>Polygonum amphibium</i> L. var. <i>emersum</i> Michx.	<i>Persicaria amphibia</i> (L.) S. Gray	longroot smartweed
<i>Polygonum bistortoides</i> Pursh	<i>Bistorta bistortoides</i> (Pursh) Small	American bistort
<i>Polygonum persicaria</i> L.	<i>Persicaria maculata</i> (L.) S. Gray	spotted ladysthumb
<i>Polygonum viviparum</i> L.	<i>Bistorta vivipara</i> (L.) S. Gray	alpine bistort
<i>Populus tremuloides</i> Michx.*		quaking aspen
<i>Potamogeton epihydrus</i> Raf.	<i>Potamogeton epihydrus</i> Rafinesque var. <i>nuttallii</i> (Chamisso & Schlechtendal) Fernald	ribbonleaf pondweed
<i>Potamogeton filiformis</i> Pers.*		fineleaf pondweed
<i>Potamogeton foliosus</i> Rafinesque*		leafy pondweed
<i>Potamogeton gramineus</i> L.*		variableleaf pondweed
<i>Potamogeton natans</i> L.*		floating pondweed
<i>Potamogeton pectinatus</i> L.*		sago pondweed
<i>Potamogeton praelongus</i> Wulfen*		whitestem pondweed
<i>Potamogeton pusillus</i> L. var. <i>pusillus</i> *		small pondweed
<i>Potamogeton richardsonii</i> (Benn.) Rydb.	<i>Potamogeton perfoliatus</i> L. ssp. <i>richardsonii</i> (Bennett) Hulten.	Richardson's pondweed
<i>Potamogeton vaginatus</i> Turcz.*		sheathed pondweed
<i>Potentilla gracilis</i> Dougl. ex Hook.*		northwest cinquefoil
<i>Prunella vulgaris</i> L.*		common selfheal
<i>Pseudocymopterus montanus</i> (Gray) Coul. & Rose*		alpine false springparsley
<i>Pyrola chlorantha</i> Sw.*		greenflowered wintergreen
<i>Ranunculus alismifolius</i> var. <i>montanus</i> S. Wats.*		waterplantain buttercup
<i>Ranunculus flammula</i> L.	<i>Ranunculus reptans</i> L. var. <i>ovalis</i> Torrey & Gray	lesser spearwort
<i>Ranunculus gmelinii</i> var. <i>purshii</i> (Richards.) Hara	<i>Ranunculus gmelinii</i> DC. var. <i>hookeri</i> (D. Don) L. Benson	Pursh's buttercup
<i>Ranunculus hyperboreus</i> Rottb.	<i>R. hyperboreus</i> Rottb. ssp. <i>intertextus</i> (Greene.) Kapoor & Löve	
<i>Ranunculus longirostris</i> Godr.	<i>Batrachium longirostre</i> (Godron) F. Schultz	longbeak buttercup
<i>Ranunculus trichophyllus</i> Chaix	<i>Batrachium trichophyllum</i> (Chaix) F.W. Schultz	hairleaf water buttercup
<i>Ribes lacustre</i> (Pers.) Poir.*		prickly currant
<i>Rorippa alpina</i> (S. Wats.) Rydb.	<i>Rorippa curvipes</i> Greene var. <i>alpina</i> (S. Watson) Stuckey	alpine yellowcress
<i>Rorippa curvipes</i> Greene var. <i>curvipes</i> Greene*		bluntleaf yellowcress
<i>Rorippa palustris</i> (L.) Bess. spp. <i>hispida</i> (Desv.) Jonsell*		hispid yellowcress
<i>Rorippa teres</i> (Michx.) R. Stuckey*		southern marsh yellowcress
<i>Rosa woodsii</i> Lindl.*		Woods's rose
<i>Rubus idaeus</i> L. ssp. <i>strigosus</i> (Michx.) Focke	<i>Rubus idaeus</i> ssp. <i>melanolasius</i> (Dieck) Focke	grayleaf red raspberry
<i>Rudbeckia laciniata</i> var. <i>ampla</i> (A. Nels.) Cronq.	<i>Rudbeckia ampla</i> A. Nelson	cutleaf coneflower
<i>Rumex aquaticus</i> L. var. <i>fenestratus</i> (Greene) Dorn	<i>Rumex aquaticus</i> L. ssp. <i>occidentalis</i> (S. Wats.) Hultén	western dock
<i>Rumex densiflorus</i> Osterhout*		denseflowered dock
<i>Rumex salicifolius</i> Weinm. var. <i>mexicanus</i> (Meisn.) C.L. Hitchc.	<i>Rumex triangulivalvis</i> (Danser) Rechinger	Mexican dock
<i>Sagittaria cuneata</i> Sheldon*		arumleaf arrowhead
<i>Salix boothii</i> Dorn*		Booth's willow

<i>Salix brachycarpa</i> Nutt.*		shortfruit willow
<i>Salix drummondiana</i> Barratt ex Hook*		Drummond's willow
<i>Salix geyeriana</i> Anderss.*		Geyer's willow
<i>Salix monticola</i> Bebb*		park willow
<i>Salix planifolia</i> Pursh*		planeleaf willow
<i>Salix wolfii</i> Bebb*		Wolf's willow
<i>Saxifraga odontoloma</i> Piper	<i>Micranthes odontoloma</i> (Piper) Heller	brook saxifrage
<i>Saxifraga oregana</i> J.T. Howell	<i>Micranthes oregana</i> (T.J. Howell) Small	Oregon saxifrage
<i>Scirpus tabernaemontani</i> K.C. Gmel.	<i>Schoenoplectus lacustris</i> L. ssp. <i>creber</i> (Fernald) Löve & Löve	softstem bulrush
<i>Scutellaria galericulata</i> L.	<i>Scutellaria galericulata</i> L. var. <i>epilobiifolia</i> (Hamilton) Jordal	marsh skullcap
<i>Sedum integrifolium</i> (Raf.) A. Nels.	<i>Rhodiola integrifolia</i> Rafinesque	king's crown
<i>Sedum rhodanthum</i> Gray	<i>Clementsia rhodantha</i> (A. Gray) Rose	rose crown
<i>Senecio bigelovii</i> var. <i>hallii</i> Gray	<i>Ligularia bigelovii</i> (A. Gray) W.A. Weber var. <i>hallii</i> (A. Gray) W.A. Weber	Hall's ragwort
<i>Senecio dimorphophyllus</i> var. <i>dimorphophyllus</i> Greene	<i>Packera dimorphophylla</i> (Greene) Weber & Löve ssp. <i>dimorphophylla</i>	splitleaf groundsel
<i>Senecio serra</i> var. <i>serra</i> Hook.*		tall ragwort
<i>Senecio triangularis</i> Hook.*		arrowleaf groundsel
<i>Sibbaldia procumbens</i> L.*		creeping sibbaldia
<i>Sidalcea candida</i> Gray*		white checkermallow
<i>Sium suave</i> Walt.*		hemlock waterparsnip
<i>Solidago canadensis</i> L.*		Canada goldenrod
<i>Solidago multiradiata</i> var. <i>scopulorum</i> Gray*		manyray goldenrod
<i>Sparganium angustifolium</i> Michx.*		narrowleaf burreed
<i>Sparganium nutans</i> L.	<i>Sparganium minimum</i> Wallroth	arctic burreed
<i>Spirodela polyrhiza</i> (L.) Schleiden*		giant duckweed
<i>Stellaria calycantha</i> (Ledeb.) Bong.*		northern starwort
<i>Stellaria longipes</i> Goldie*		longstalk starwort
<i>Stellaria umbellata</i> Turcz. ex Kar. & Klr.*		umbellate starwort
<i>Swertia perennis</i> L.*		star gentian
<i>Symphoricarpos rotundifolius</i> Gray*		roundleaf snowberry
<i>Taraxacum officinale</i> G.H. Weber ex Wiggers*		common dandelion
<i>Thalictrum alpinum</i> L.*		alpine meadowrue
<i>Thalictrum fendleri</i> Engelm. ex Gray*		Fendler's meadowrue
<i>Trifolium parryi</i> Gray*		Parry's clover
<i>Trifolium pratense</i> L.*		red clover
<i>Trifolium repens</i> L.*		white clover
<i>Trisetum spicatum</i> (L.) Richter	<i>Trisetum spicatum</i> (L.) Richter ssp. <i>congdonii</i> (Scribner & Merrill) Hultén	spike trisetum
<i>Trisetum wolfii</i> Vasey*		Wolf's trisetum
<i>Trollius laxus</i> Salisbury ssp. <i>albiflorus</i> (Gray) A.D. Löve & Kapoor	<i>Trollius albiflorus</i> (A. Gray) Rydberg	American globeflower
<i>Typha latifolia</i> L.	<i>Typha latifolia</i> L.	broadleaf cattail
<i>Urtica dioica</i> ssp. <i>holosericea</i> (Nutt.) Thorne	<i>Urtica gracilis</i> Aiton ssp. <i>holosericea</i> (Nuttall) W.A. Weber	stinging nettle
<i>Vaccinium cespitosum</i> Michx.*		dwarf blueberry
<i>Valeriana edulis</i> Nutt. ex Torr. & Gray*		edible valerian
<i>Veratrum tenuipetalum</i> Heller*		cornhusk lily
<i>Veronica americana</i> Schwein. ex Benth.*		American speedwell
<i>Veronica anagallis-aquatica</i> L.*		water speedwell
<i>Veronica peregrina</i> ssp. <i>xalapensis</i> (Kunth) Pennell*		
<i>Veronica serpyllifolia</i> L. ssp. <i>humifusa</i> (Dickson) W.A. Weber*		
<i>Veronica wormskjoldii</i> Roemer & J.A. Schultes	<i>Veronica nutans</i> Bong.	alpine speedwell
<i>Viola adunca</i> Sm.*		mountain blue violet
<i>Viola macloskeyi</i> Lloyd ssp. <i>pallens</i> (Banks ex DC.) M.S. Baker*		smooth white violet
<i>Zigadenus elegans</i> ssp. <i>elegans</i> Pursh	<i>Anticlea elegans</i> (Pursh) Rydberg	mountain deathcamas

Appendix 2: Site Locations

Site Code	County	Latitude	Longitude	Elev. (ft.)	Elev. (m)	USGS 7.5' Topographic Quad Name	Topographic Quad Code
94JS01	GUNNISON	38° 37' 20" N	106° 43' 40" W	9,520 ft.	2,910 m	W9,520	Crystal
Creek	3810666						
94JS02	GUNNISON	38° 52' 20" N	106° 42' 55" W	9,970 ft.	3,040 m	W9,970	Matchless
Mbuntain	3810676						
94JS03	GUNNISON	38° 51' 43" N	106° 39' 48" W	10,520 ft.	3,210 m	W10,520	Matchless
Mbuntain	3810676						
94JS04	GUNNISON	38° 52' 58" N	106° 38' 37" W	10,400 ft.	3,170 m	W10,400	Italian
Creek	3810686						
94JS05	GUNNISON	38° 52' 13" N	106° 32' 20" W	9,800 ft.	2,990 m	W9,800	Taylor Park
Reservoir	3810675						
94JS06	WNFIELD	38° 52' 32" N	106° 28' 45" W	10,280 ft.	3,140 m	W10,280	Wnfield
94JS07	GUNNISON	38° 52' 35" N	106° 27' 55" W	10,478 ft.	3,200 m	W10,478	Wnfield
94JS08	GUNNISON	38° 50' 32" N	106° 25' 31" W	11,200 ft.	3,420 m	W11,200	Tincup
94JS09	GUNNISON	38° 46' 12" N	107° 09' 36" W	9,820 ft.	3,000 m	W9,820	Anthracite
Range	3810772						
94JS10	GUNNISON	38° 49' 59" N	107° 04' 35" W	10,381 ft.	3,170 m	W10,381	M. Axtell
94JS11	GUNNISON	38° 53' 50" N	107° 10' 06" W	8,850 ft.	2,700 m	W8,850	Marcellina
Mtn.	3810782						
94JS12	GUNNISON	38° 55' 09" N	107° 13' 40" W	8,820 ft.	2,690 m	W8,820	Marcellina
Mtn.	3810782						
94JS13	GUNNISON	38° 56' 45" N	107° 16' 20" W	7,450 ft.	2,270 m	W7,450	Paonia
Reservoir	3810783						
94JS14	GUNNISON	38° 43' 38" N	107° 24' 25" W	9,840 ft.	3,000 m	W9,840	Mbunt Guero 38
94JS15	GUNNISON	38° 44' 20" N	107° 26' 35" W	8,300 ft.	2,530 m	W8,300	Mbunt Guero 38
94JS16	GUNNISON	38° 41' 25" N	107° 25' 38" W	9,020 ft.	2,750 m	W9,020	Mbunt Guero 38
94JS17	GUNNISON	38° 38' 02" N	107° 23' 50" W	11,000 ft.	3,360 m	W11,000	Mbunt Guero 38
94JS18	PIKIN	39° 06' 55" N	106° 43' 15" W	9,560 ft.	2,920 m	W9,560	New York
Peak	3910616						
94JS19	PIKIN	39° 03' 11" N	106° 44' 52" W	11,800 ft.	3,600 m	W11,800	New York
Peak	3910616						
94JS20	GUNNISON	39° 00' 55" N	106° 45' 17" W	11,544 ft.	3,520 m	W11,544	Hayden Peak 39
94JS21	GUNNISON	39° 06' 23" N	107° 20' 15" W	7,640 ft.	2,330 m	W7,640	Chair
Mbuntain	3910713						
94JS22	GUNNISON	39° 01' 05" N	107° 11' 40" W	9,000 ft.	2,750 m	W9,000	Marble
94JS23	GUNNISON	39° 01' 03" N	107° 27' 20" W	8,880 ft.	2,710 m	W8,880	Bull
Mbuntain	3910714						
94JS24	PIKIN	39° 15' 23" N	107° 20' 30" W	9,600 ft.	2,930 m	W9,600	Stony Ridge 39
94JS25	EAGLE	39° 27' 14" N	106° 54' 01" W	10,710 ft.	3,270 m	W10,710	Toner
Reservoir	3910648						
94JS26	GARFIELD	38° 50' 40" N	107° 14' 27" W	8,990 ft.	2,740 m	W8,990	Sweetwater
Lake	3910772						
94JS27	GARFIELD	39° 46' 12" N	107° 22' 48" W	10,760 ft.	3,280 m	W10,760	Blair Mtn.
94JS28	GARFIELD	39° 40' 58" N	107° 18' 45" W	10,600 ft.	3,233 m	W10,600	Carbonate
94JS29	GARFIELD	39° 55' 00" N	107° 08' 58" W	11,040 ft.	3,370 m	W11,040	Trappers
Lake	3910782						
94JS30	GARFIELD	39° 54' 47" N	107° 09' 08" W	10,900 ft.	3,320 m	W10,900	Trappers
Lake	3910782						
94JS31	GARFIELD	39° 56' 00" N	107° 04' 42" W	9,238 ft.	2,820 m	W9,238	Dome Peak
94JS32	GARFIELD	39° 50' 55" N	107° 10' 34" W	9,600 ft.	2,930 m	W9,600	Sweetwater
Lake	3910772						
94JS33	GARFIELD	39° 50' 41" N	107° 11' 01" W	9,600 ft.	2,930 m	W9,600	Sweetwater
Lake	3910772						
94JS34	GARFIELD	39° 42' 10" N	107° 19' 58" W	10,720 ft.	3,270 m	W10,720	Carbonate
94JS35	GARFIELD	39° 43' 29" N	107° 12' 47" W	9,630 ft.	2,940 m	W9,630	Broken Rib
Creek	3910762						

94JS36	SUMM T	39° 42' 02' ' N	106° 09' 35' ' W	10,040 ft. 3,060 m	Willow
Lakes	3910662				
94JS37	SUMM T	39° 41' 58' ' N	106° 10' 23' ' W	9,600 ft. 2,930 m	Willow
Lakes	3910662				
94JS38	SUMM T	39° 45' 11' ' N	106° 11' 35' ' W	9,280 ft. 2,830 m	Squaw Creek 39
94JS39	SUMM T	39° 40' 09' ' N	106° 10' 14' ' W	10,990 ft. 3,350 m	Willow
Lakes	3910662				
94JS40	SUMM T	39° 49' 05' ' N	106° 22' 30' ' W	10,600 ft. 3,230 m	Pi ney Peak
94JS41	SUMM T	39° 48' 44' ' N	106° 23' 45' ' W	11,340 ft. 3,460 m	Pi ney Peak
94JS42	EAGLE	39° 50' 44' ' N		10,760 ft.	2,980 m
	Pi ney Peak	3910674			